LUND UNIVERSITY
School of Economics and Management

BUSN 89: Degree Project in Corporate and Financial Management - Master Level

Department of Business Administration

Lund University

Spring 2012

Emergence of a second Dot-Com boom?

An assessment of indications for overvalued Internet firms and the risk of another Dot-Com bubble

Advisor:

Maria Gårdängen

Authors:

Florian Falch

Madis Pappa

ACKNOWLEDGEMENTS

The authors would like to thank their supervisor Maria Gårdängen for the professional support and helpful comments throughout the process of writing this thesis.

The authors would also like to thank everybody else who supported the creation of this project and enabled to increase the quality of it.

ABSTRACT

Title: Emergence of a second Dot-Com boom? – An assessment of indications for overvalued Internet firms and the risk of another Dot-Com bubble

Seminar Date: 2012-06-01

Course: BUSN 89: Degree Project in Corporate and Financial Management - Master Level, 15 University Credit Points (15 ECTS)

Authors: Florian Falch and Madis Pappa

Advisor: Maria Gårdängen

Key words: Dot-Com bubble, overvaluation, Internet firms, short sale constraints, divergence in investors' opinion, lock-up period, cumulative abnormal returns, M&A intensity

Purpose: The main goal of this thesis is to determine to what degree can there be observed indications for an overvaluation of Internet companies, which in turn may lead to the next asset price bubble in the Internet industry. By conducting an ex-ante analysis, the current study sets out to add additional knowledge in regards to whether and how well the emergence of a bubble can be determined in advance.

Theoretical perspective: This study is based on prior research that uses market data on short sale constraints and divergence in investors' opinion to explore overvaluation. Furthermore, regulatory impacts on overvaluation, *i.e.* the lock-up period expiration, are analysed and insights on M&A data are provided.

Methodology: A quantitative analysis is conducted for the difference between Internet and non-Internet companies' short sale constraints, divergence in investors' opinion and abnormal returns around the expiration of the lock-up period (and the announcement about Facebook's IPO - as an alternative event). Statistical tests as well as an event study are implemented and the results are complemented with an M&A intensity analysis.

Empirical foundation: The analysis includes companies listed on the U.S. stock exchanges (NASDAQ, NYSE) with lock-up periods expiring between January 2010 and February 2012.

Conclusion: The findings of this study show no statistically significant short sale constraints, no divergence in investors' opinion and no negative abnormal returns upon the lock-up expirations for Internet firms, which would otherwise indicate them being overvalued. However, considering the announcement about Facebook's IPO as an alternative event, the results suggest that there can be seen signs of overvaluation of Internet firms, indicating the possible entrance into a next bubble (*i.e.* early stage of a bubble).

LIST OF ABBREVIATIONS

CAR – cumulative abnormal return

CLV – Customer Lifetime Value

DCF – Discounted Cash Flow

EBITA – earnings before interest, taxes and amortization

EBITDA – earnings before interest, taxes, depreciation and amortization

EMH – Efficient Market Hypothesis

EP – Economic Profit

EVA – Economic Value Added

GDP – Gross Domestic Product

IPO – initial public offering

IT – Information Technology

M&A – mergers and acquisitions

NOPLAT – net operating profit less adjusted taxes

NPD – new product development

OLS – ordinary least-squares regression

P/E – price-to-earnings

RO – Real Options

SEC – the Securities and Exchange Commission

SIC code – the Standard Industrial Classification code

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 Background

Facebook's announcement for its initial public offering (IPO) at the beginning of February 2012 was reasoned by its founder Mark Zuckerberg as a fulfilment of the commitment of making Facebook shares liquid and in turn the investment worth to their shareholders and employees (Gapper, 2012). John Gapper (2012) from Financial Times has claimed, however, that the sub-goal for the IPO is to rather encourage other similar firms in Silicon Valley to follow the footsteps of the social networking leader[1]. Recalling the previous Dot-Com bubble[2] in the late 1990s, Wharton marketing professor Peter Fader has argued: "We all look back and laugh and say we will not go through that exercise again, but this could easily be a case of history repeating itself" (Knowledge@Wharton, 2006). Makan and Demos (2012) from the Financial Times have further referred to the recent increase in short selling of social networking companies like LinkedIn and Renren, reflecting traders betting against social media firms. They also point out the fact that, although a small proportion of total shares, the stocks utilized for shorting amount for a significant part of the shares available for the public, in some cases even more than 90% (Makan & Demos, 2012). To add more to this, the NASDAQ Composite index is showing eleven-year period's highest levels (Makan & Demos, 2012). Therefore, an IPO wave of social media companies gives rise to the question whether the last Dot-Com bubble's scenario is being unfolded again or the high valuations for those firms are lying on a solid ground.

Previous discussion is an example of exuberant talks in the media about the potential emergence of another Dot-Com bubble, due to high valuations of young Internet companies, some of which may not even be profitable yet (see *e.g.* The Economist (2010), Broughton (2011), The Economist (2011), Rushe (2011)). Already in 2007, Hirschorn (2007) referred to the similarity of increase in emerging miscellaneous web sites as was the case around a decade ago. Moreover, Corr's (2007) analysis shows, based on significant increases in search engine firms' share prices during 2004, that Google's IPO ignited a search engine bubble back then, which fortunately was short-lived and did not expand to a larger part of Internet firms. Broughton (2011) additionally adds that nowadays it is relatively easier to seek and get funding for an idea concerning online business than it was during the end of the 1990s. He further links this fact to a plausible threat of approaching another Dot-Com bubble (Broughton, 2011). Concurrent to recent IPOs of Internet

[1] In the current thesis the terms "social networking firm", "social media firm" and "Internet firm" are used as synonyms. Since there is no common understanding of what constitutes an Internet firm, the term is mainly tied to the Standard Industrial Classification (SIC) code 737 in this study. This approach is also used by other authors, such as Griffin *et al.* (2011). However, it is a rather rough classification and tends to miss some companies (*e.g.* eBay with SIC code 738 would be excluded). The definition is for this reason extended to Tim O'Reilly's (2005) description of Web 2.0 companies available at: oreilly.com/web2/archive/what-is-web-20.html.

[2] Dot-Com bubble refers to the Internet stock price bubble in the late 1990s. Bubble is defined as a period of: "Temporarily high prices, driven by enthusiasm and an overestimation of the true value of an asset" (Norman & Thiagarajan, 2009, p. 7). In the current thesis "asset price bubble", "stock price bubble" and "bubble" are used as synonyms.

companies, the mergers and acquisitions (M&A) intensity in conjunction with prices paid regards to these firms seem to be higher than during the last Dot-Com bubble in the end of 1990s. This can be illustrated by Google's acquisition of YouTube in 2006 for $1.65bn or the recent $1bn purchase announcement of Instagram by Facebook (Waters & Nuttall, 2012).

These factors in conjunction with Corr's (2007) finding further support the necessity of analysing current IPOs of social media firms coupled with the increased intensity of M&A. The reason behind this being another plausible ignition for a bubble, which could potentially encompass more (Internet) firms than the temporary search engine bubble – caused by Google's IPO – did in 2004.

1.2 Problem discussion

As mentioned above, the importance of overvaluation lies in its potential to spur an asset price bubble. Avoiding a bubble is crucial due to the negative consequences it encompasses. Norman and Thiagarajan (2009) bring out deviation in asset prices, excessive investments, implementation of unsustainable policies and output loss (measured in Gross Domestic Product – GDP), concurrent with an economic downturn or crisis as examples of bubble's negative results. Thus, in addition to investors bearing losses, more importantly, the whole economy and society suffers in case a bubble bursts. Therefore, in order to see whether the market value corresponds or deviates from the intrinsic one, different valuation methods are being used in practice (*e.g.* Discounted Cash Flow (DCF) and multiples) (Koller*, et al.*, 2010). In the light of the last Dot-Com bubble and claims about the inapplicability of traditional techniques for technology and Internet companies (*e.g.* Bontis & Mill (2004) amongst others), some alternative approaches have been proposed (*e.g.* Customer Lifetime Value (CLV) as suggested by Gupta *et al.* (2004)). Additionally, a market-based approach by utilizing short interest[3] data, which might give the best reflection, has been suggested (*e.g.* Ofek & Richardson (2003)). Short interest data has been incorporated in several studies to analyse firms' overvaluation and causes for a bubble (*e.g.* Ofek & Richardson (2003), Battalio & Schultz (2006), Boehme *et al.* (2006)), but using this method no real attempts have been made to determine a bubble ex-ante.

As was touched upon above, some valuation methods are argued to be unsuitable for Internet firms. The inappropriateness or inaccuracy of the methods might lead to a deviation from intrinsic values and contribute to the formation of bubbles. Although commonly used and claimed to have a strong advantage of being based on explicit assumptions (*e.g.* Koller *et al.* (2010), French & Gabrielli (2005)), counterarguments draw the attention to the DCF model's drawbacks and inapplicability to high growth firms (*e.g.* Gupta *et al.* (2004), Bontis & Mill (2004), Kossecki (2009)). On the other hand, some authors have argued the opposite, claiming that traditional

[3] The total number of shares in the security that are reflected on the books and records of the reporting firm(s) as short, but uncovered or not closed out yet (NASDAQ, 2012).

methods are valid even for companies surrounded with uncertainty, which also applies for Internet firms (*e.g.* Gavious & Schwartz (2011)). In addition to the DCF model a multiples approach is being used in practice and similarly has been subject to critique (*e.g.* Gupta & Chevalier (2002)) as well as support (*e.g.* PricewaterhouseCoopers (2011), Gavious & Schwartz (2011)). Additionally, other valuation techniques that have been proposed to capture the value of firms with high growth and uncertainty comprise the Real Options (RO) method (*e.g.* Jägle (1999)) and the "new" approaches, which emerged during the last Dot-Com bubble (*e.g.* Gupta (2009), Kossecki (2009)). However, the views differ in the preferences of valuation methods resulting in no consensus of whether any of those is paramount and has significant advantages over the others (the pros and cons of the methods are discussed in more detail in chapter 2). In turn, the method itself might not be the root cause of a potential misevaluation. When the investor or its expectations are biased then regardless of goodness and accuracy of the model, the end results will still contain errors as can be inferred from Gupta and Chevalier (2002). Thus, the solution may be looking at the market instead.

A market-based approach that uses short sale constraints and divergence in investors' opinion as the causes for overvaluation was first introduced by Miller (1977). Figlewski (1981) further corroborated Miller's (1977) results showing how short sale restrictions create asymmetry that enables more optimistic views on stocks to rule over negative beliefs. Ofek's and Richardson's (2003) study set out to apply Miller's and Figlewski's argumentation to the last Dot-Com bubble by incorporating lock-up periods[4], representing short sale restrictions, and investor heterogeneity. They conclude that short sale constraints are relieved when lock-up periods expire and allow insiders to short sell (Ofek & Richardson, 2003). Boehme *et al.* (2006) further add that it takes both, dispersion of investors' opinion and short sale constraints, to result in overvaluation, referring to insufficiency of one's presence alone.

As mentioned, regulatory aspects like lock-up periods may cause constraints that contribute to overvaluation and the creation of a bubble. They restrict insiders who typically have better information about the firm and may want to incorporate their views into share prices by (short) selling them (Ofek & Richardson, 2000). Contrary to the U.K. and Continental Europe, lock-up periods in the U.S. are not mandatory nor regulated (Espenlaub*, et al.*, 2001; Goergen*, et al.*, 2006). However, they are commonly used as underwriters' standard arrangement (especially with IPOs) (Klungerbo*, et al.*, 2012; Ofek & Richardson, 2000). Field and Hanka (2001) and Klungerbo *et al.* (2012) show that expirations of IPO lock-up periods are characterized by negative abnormal returns. Those studies do not bind their findings explicitly with the fact that insiders are selling due to negative beliefs, but still leave this as an option, partly supporting Ofek

[4] Period (after the IPO) during which insiders (*e.g.* managers, employees, venture capitalist) are banned from selling their shares (U.S. Securities and Exchange Commission, 2012).

and Richardson (2003). Hong *et al.* (2006), however, reason this decline as rational insiders having less optimistic beliefs than some overconfident outside investors, referring to heterogeneous beliefs, which support Ofek and Richardson (2003). Moreover, besides the insider selling factor, the effect of the lock-up periods is also in line with Miller's (1977) model, based on the downward sloping demand curve, where an increased supply of shares leads to a decreasing stock price.

Based on Ofek's and Richardson's (2003) findings that short interest in conjunction with lock-up periods' expirations can cause a bubble, especially if they expire close to the same time, together with Boehme *et al.* (2006) adding that divergence in investors' opinion needs to be present simultaneously with short sale constraints, the current study focuses on the time around the expiration of lock-ups (and additionally, the announcement about Facebook's IPO s is considered as an alternative event[5]). Since in previous studies, the short sale model's results have not been controlled with another approach, the authors of the current thesis look at M&A intensity in the Internet industry as a control method for capturing overvaluation in addition to exploring short sale restrictions, lock-up expirations and divergence in investors' belief. It has been shown that more M&A happen during periods that are characterized by overvalued firms (*e.g.* Gaughan (2011), Rhodes-Kropf *et al.* (2005)). Thus, an increase in the number of M&A amongst Internet companies would point towards overvaluation. This control method adds strength to the results and credibility for the conclusions. All in all, the results offered by this thesis give suggestions to the underwriters as to whether it is necessary to alter the policies regarding lock-up periods and it may also enable investors to adjust their portfolios.

There are pro (*e.g.* Ofek & Richardson (2003), Boehme *et al.* (2006), Hong *et al.* (2006)) and contra (*e.g.* Battalio & Schultz (2006)) arguments for the validity of the market-based approach that relies on short interest, lock-up periods and divergence in investors' opinion. The authors of the current thesis support this approach mainly due to its avoidance of the shortcomings of other valuation techniques coupled with the fact that it is one of the rare indicators that can be applied ex-ante. Since according to the authors' recognition, there have been no well-known attempts to determine a bubble ex-ante based on the market-based approach, this study intends to make enhanced effort and add knowledge in that respect.

1.3 Purpose and research questions of the thesis

The purpose of this thesis is to add further knowledge in regards to whether indications for a bubble can be determined ex-ante by exploring short sale constraints together with divergence in investors' opinion. To control and complement those parameters the intensity of M&A activity is

[5] Due to discussions in the media about the justification of this IPO and its possible effect on other Internet companies pursuing IPOs (Gapper, 2012).

additionally examined. The research is implemented by creating two data samples, one encompassing Internet firms and the other comprising non-Internet companies.

The main objective of the current thesis is to give answers to the following questions:

- To what degree can there be observed indications for an overvaluation of Internet companies that may lead to an asset price bubble in the Internet industry?
    - What influence do lock-up periods have on an overvaluation that could contribute to the formation of a potential asset price bubble?

To achieve the goal of this thesis the authors go through the following steps:

- Discuss possible applicable valuation methods (together with their advantages and disadvantages) for Internet firms.
- Discuss how M&A's intensity can be an indicator for overvaluation.
- Analyse regulations' role, in the form of lock-up periods, in the creation of an asset price bubble.
- Analyse short sale constraints and divergence in investors' opinion around the lock-up expirations (and the announcement about Facebook's IPO as an alternative event).

The findings of this study contribute to the ability of determining the emergence of an asset price bubbles ex-ante in conjunction with offering suggestions for underwriters regarding the future revision of lock-up period policies during IPOs[6].

1.4 Delimitation of the study

With regards to this thesis delimitation is set by the authors in order to avoid biases in the data and in the results. A more detailed discussion of those reasons is presented in subchapter 3.2.

- The companies that have been focused upon include those whose lock-up periods expired between January 2010 and February 2012. The time frame is chosen to avoid bias in the data based on the assumption of a more stable economic situation and normalized level of investment patterns.
    - Observing this period is the most relevant for analysing if currently any signs for a bubble exist. Including more historical data would be irrelevant and bias the results.
    - Companies that had their lock-up periods expiring within the mentioned time frame, but were delisted are excluded from the analysis.
- Since the short interest data utilized in this thesis covers end-month data that in addition to mid-month data became available only in August 2007, the time frame is further limited by this date.
- Academic literature and relevant news, such as the ones about Facebook's IPO, are taken into account up to April 30th 2012.

[6] Due to the fact that in the U.S. underwriters implement lock-up periods as a standard arrangement although they are not obligatory nor regulated.

1.5 Target group

The target group of this thesis comprises mainly business people (investors and underwriters) and an academic audience. Investors could prepare themselves based on, and even take advantage of, the information about whether there is another stock price bubble emerging. Underwriters might benefit from incorporating the findings about regulatory aspects in working out future policies. This thesis is also of interest to other finance academics who may improve this study and extend upon it by further exploring the possibility of determining stock price bubbles ex-ante.

1.6 Thesis outline

This thesis proceeds as follows: chapter 2 presents a literature review, focusing on the basics of asset price bubbles, different valuation methods and their applicability for Internet firms, the importance of lock-up periods as well as the connection between overvaluation and M&A activity. Chapter 3 further develops the theoretical part into a research approach. Details about the data set, the variables and hypotheses as well as the statistical methods used are also presented there. Chapter 4 includes the empirical findings of the study as well as a discussion in the context of existing theoretical and empirical literature. Finally, chapter 5 summarizes the findings and presents some general conclusions and recommendations. Suggestions for further research are also included in that chapter.

2 LITERATURE REVIEW

The following chapter gives a definition for the term "asset price bubble" and discusses different valuation methods' applicability for determining overvaluation. Moreover, the attention is drawn to alternative approaches and to the pros and cons of the selected techniques when applied to Internet firms. Finally, the impact of regulatory aspects, more specifically lock-up periods, on the creation of overvaluation and a potential bubble is being discussed.

2.1 Asset price bubble

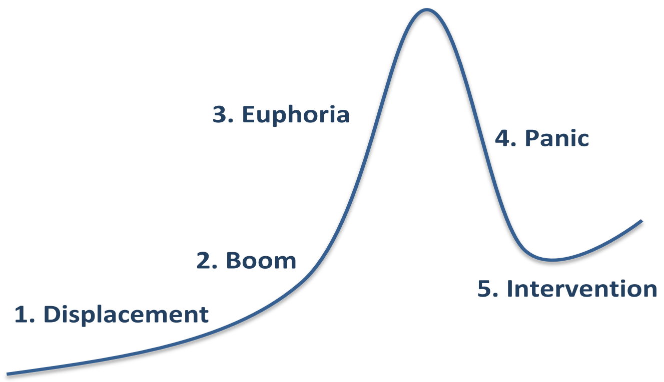
Kindleberger *et al.* (2011, p. 14) define "bubble" as follows: "A generic term for the increases in asset prices in the mania phase of the cycle that cannot be explained by the changes in the economic fundamentals."

John Barley Rosser's (2000, p. 107) definition for a "bubble": "A speculative bubble exists when the price of something does not equal its market fundamentals for some period of time for reasons other than random shocks. Fundamental argued to be a long-run equilibrium consistent with a general equilibrium."

Siegel (2003), being of another opinion about determining a bubble based on immediate price action, focuses on subsequent 30 years of returns and compares them with the historical mean return. He (Siegel, 2003, p. 14) then proposes the following operational definition for a "bubble": "One must wait a sufficient period of time to see how the future plays out before anyone can identify a bubble. If, after this time period has been reached, the realised asset return is more than two standard deviations from the expected return, then one can call the asset price movement a bubble."

Figure 2.1 below gives a graphic overview of the creation and evolvement of a bubble. A bubble typically starts with a displacement phase and intervention is needed to stop it.

Figure 2.1 *Life cycle and development of a bubble*



Source: Norman & Thiagarajan (2009, p. 9)

The respective phases of a bubble's life cycle are described in Table 2.1 below. Displacement as the first phase of a bubble is caused by a change, which makes investors overly optimistic, ensued by overlooking the aspect of possible declining returns (*e.g.* excessive reliance on initial asset price increases due to new technology). The mentioned phase is the ignition to the subsequent events that, if left to unfold, may in the end result in an economic downturn or even a crisis.

Table 2.1 *Phases of a bubble*

Phase	Description
Displacement	Displacement causes a change in people's thinking, *i.e.* that the world has altered. Typical sources for emergence of displacement are: • Technological innovation, • Mania for commodity due to supply/demand dynamics, • Increase in popularity of an asset that leads to herd mentality, • Capital or regulatory favours provided by the government.
Boom	The source of displacement (*e.g.* new technology) leads to increased investments to the sector of this "source". Job creation, economic prosperity and enhanced consumption ensue.
Euphoria	When returns/profits are driven up by the boom, a situation is created in which normal growth patterns are left aside, assuming continuous fast growth. The result is overinvestment and speculations that are often accompanied by cheap credit.
Panic	This phase emerges when excessively leveraged investment fails. Lost confidence causes downside in investments and asset prices that in turn lead to an economic downturn and in worst case to crisis.
Intervention	If crisis becomes severe, central bank, external governments, World Bank or International Monetary Fund may have to step in to avoid the economic collapse. The intervention) is typically expensive (especially an external one.

Source: Norman & Thiagarajan (2009)

Understanding a bubble and its impacts is crucial, since typically negative consequences like dislocation of asset values emerge with it, as shown in Table 2.1 above (Norman & Thiagarajan, 2009). In addition, Norman and Thiagarajan (2009, pp. 7-8) have argued that bubbles entail the following negative aspects:

- ***Excessive investment*** – investors become myopic and biased during overall euphoria and are of the opinion that the increase in prices will last in the long-term. When asset values decrease, those excessive investments need to be unwound. Consequently, investment flow becomes volatile, which is detrimental to the key drivers of economic productivity (*e.g.* infrastructure, education).
- ***Policy mistakes*** – during boom times firms and governments are eager to engage in benefit increases, which in the long-term are unsustainable (*e.g.* increase in pensions, health care). Thus, the short-term increment may come at the expense of the long-term stability in benefits.
- ***Output loss*** – it has been shown that prior bubbles' bursts have resulted in output loss measured in GDP (actual GDP trend compared to extrapolated pre-burst GDP). It infers that the whole economy is influenced (including job creation/retention).

An asset price bubble entails negative consequences for the whole economy as discussed above (*e.g.* output loss). A bubble itself encompasses deviation of asset's intrinsic price (typically exceeding it), which may be caused by the cognitive biases of investors. Therefore, a proper valuation technique is crucial to minimize the plausible error made and to avoid the formation of a bubble in the first place. Such valuation methods are discussed next.

2.2 Traditional valuation methods

2.2.1 Discounted Cash Flow (DCF) model's applicability to Internet firms

The most commonly used valuation technique is the DCF model that considers discounted future cash flows, comprising operational cash flows together with investments under the most likely scenario, to retrieve an enterprise value (Gupta & Chevalier, 2002). According to Gupta and Chevalier (2002), one of the main advantages of the DCF model is taking the firm as one portfolio of several investments.

In the light of the last Dot-Com bubble it has been claimed that traditional valuation techniques (*e.g.* the DCF) might not be completely applicable to Internet companies (Bontis & Mill, 2004; Gupta, *et al.*, 2004; Gupta, 2009). The main argumentation includes limited history, difficulty to predict future cash flows, coupled with negative cash flows during the initial years (Gupta, 2009). Contrary to this view it has been shown that the DCF model and a multiples approach work equivalently well for high growth firms (including Internet companies) and should not be immediately excluded (Gavious & Schwartz, 2011). French and Gabrielli (2005) contribute to this, claiming that the DCF model enhances the clarity of the valuation on account of explicit assumptions made for it. Corr (2007) further adds to this that the DCF model comprises key parameters linked to shareholder value creation. Villiger and Bogdan (2005) also point out the simplicity of implementation together with reliance on few hypotheses.

However, since the assumptions depend on the valuer's views, they are also prone to subjectivity. Moreover, the DCF model presumes that the future is known for certainty in conjunction with being sensitive to the input used for the calculations (Gupta & Chevalier, 2002). Hence, as Internet companies' future cash flows are subject to uncertainty that is characterized by plausible rapid changes in the business environment, which are hard to predict, the DCF model might be difficult to apply (Gupta & Chevalier, 2002). Uncertainty, however, plays an essential role in valuing these types of companies, since it requires an approach of looking in the future rather than the past performance (Koller, *et al.*, 2010). On account of the possible lack of industry comparables, the end value may be subject to extreme variations, dependent on the valuer's incorporated assumptions (Corr, 2007). Moreover, Villiger and Bogdan (2005) claim that the DCF model considers no potential changes in the economic frame that in turn would cause alternations to the cash flows. In that sense the DCF model does not take into account plausible changes in the value drivers to which management can actually react (Villiger & Bogdan, 2005). Hence, it does not capture flexibility (Villiger & Bogdan, 2005; Gupta & Chevalier, 2002). French and Gabrielli

(2005), however, propose incorporating uncertainty by using simulations (*e.g. Monte Carlo*), *i.e.* different scenarios. Using the DCF model in conjunction with a *Monte Carlo* simulation could mitigate the imprecision of the outcome caused by uncertainty (French & Gabrielli, 2005). It is also recommended that by including uncertainty, the resulting value should be given in a range, not as a single figure (French & Gabrielli, 2005).

The DCF model, together with its pros and cons, was reviewed in this subchapter. This model's potential inapplicability for the valuation of Internet firms can be reasoned by pointing to difficulties of capturing uncertainty and relying on historical performance. The former aspect is a typical characteristic of these companies and the latter biases the end results due to the growth factor of Internet firms that is accompanied by rapid changes. Hence, other valuation methods come into focus. One of the close alternatives is the Economic Profit model discussed subsequently.

2.2.2 Economic Profit (EP) model's applicability to the Internet firms

The Economic Profit (EP) model (also known as Economic Value Added (EVA)[7] model) considers the value creation in a company over a period of time (Gupta & Chevalier, 2002). The EP is derived as the difference between net operating profit less adjusted taxes (NOPLAT) and the capital charge (capital invested multiplied by the cost of capital) (Gupta & Chevalier, 2002; Koller*, et al.*, 2010). Hence, unlike the DCF model, which includes only cash flows, the EP provides insights to a company's economic performance (Gupta & Chevalier, 2002; Koller*, et al.*, 2010). Although the method itself is very similar to the DCF model and the end result in terms of a company's value is identical to the one of the DCF, an advantage of the EP model is that it shows if and when the value creation takes place (Gupta & Chevalier, 2002; Koller*, et al.*, 2010). The concept of potential value creation that the EP model encompasses makes it better-suited for Internet firms than the DCF model, since these companies typically make heavy investments during the growth phase that on the one hand result in negative cash flows, but are necessary for future profitability and performance on the other hand (Gupta & Chevalier, 2002).

Despite being said to be more informative than the DCF model, the EP model still comprises several drawbacks similar to the former model discussed above (*e.g.* difficulties capturing uncertainty, since the forecasts and NOPLAT calculations are done the same way as in the DCF model). Major similar issues, when compared to the DCF model, are a reliance on the past performance and no consideration of flexibility (Gupta & Chevalier, 2002). Both of the aspects brought out are, however, crucial when the valuation of Internet firms is in focus. Consequently, these problems make the EP in the end also inapplicable to Internet firms (Gupta & Chevalier, 2002).

[7] Trademark patented by Stern Stewart & Co. (Gupta & Chevalier, 2002).

A short discussion of the EP model, the pros and cons of which in general are similar to the DCF, was covered in this subchapter. The major advantage of considering value creation, a necessary aspect for determining Internet firms' prices as well, makes it better fitted for those companies than the DCF model. However, the severe drawbacks of reliance on past performance and the exclusion of flexibility still do not solve the issues of valuing Internet firms. Therefore, another method should be considered. A multiples approach as an alternative, is discussed next.

2.2.3 Multiples approach's applicability to Internet firms

Complementary to the DCF and EP model, another commonly used approach encompasses multiples that enable a fast way of determining a firm's value. The multiples approach includes finding companies with similar characteristics and so deriving the value, whilst assuming that if firms are comparable and similar in size, they should also be valued the same (Gupta & Chevalier, 2002). Some of the commonly used multiples comprise EBITA (earnings before interest, taxes and amortization), EBITDA (earnings before interest, taxes, depreciation and amortization), revenue and P/E (price-to-earnings) ratios to mention some of them (Koller*, et al.*, 2010). Koller *et al.* (2010) propose that the most suitable of the before mentioned is the EBITA multiple, mainly due to the fact that it contains operating items. It seems from the first glimpse that multiples fit best for companies with a certain future in mature industries, since the forward-looking multiple represents a steady period. In that sense multiples' suitability may be questioned for high-technology companies. On the other hand, a PricewaterhouseCoopers (PwC) (2011) report shows that using the P/E ratio for valuation might not necessarily be completely misleading. They compare historical "NASDAQ 100" and "FTSE Techmark FOCUS" P/E ratios together with "FTSE All Share" P/E ratio, inferring that technology P/E ratios have always been higher than the rest of the market (PricewaterhouseCoopers, 2011). Therefore, they claim that technology firms' current high P/E ratios themselves should not create concerns about the next bubble (PricewaterhouseCoopers, 2011). They further point to the decreased "value gap" between the listed technology firms and the overall market in comparison with the previous Dot-Com bubble (PricewaterhouseCoopers, 2011). Gavious and Schwartz (2011) study findings support the favourable view of multiples approach by indicating how this method was relevant before, during and after the previous Dot-Com bubble.

However, multiples, though convenient and a fast way of determining a value, have drawbacks. Gupta and Chevalier (2002) claim that even if firms are comparable there are always factors that differ significantly, which in turn may cause the end result to deviate from the actual intrinsic value. Koller *et al.* (2010), amongst others, claim that multiples should contain forward-looking figures. This is somewhat complicated if Internet firms are in the valuation focus, due to the fast evolving essence of the Internet industry. Therefore, inclusion of uncertainty allows components of a multiple deviate significantly from each other in forecast years. Hence, the value of the firm can differ based on which year's multiples component is considered, giving an inconsistent view for the value. Further, the forecast itself is rather "art" and subjective, resulting in an end value that is dependent on the investor's expectations and can thus vary amongst valuers. Moreover, another issue with multiples comprises negative values (either negative numerator or denominator), which hinder using that approach. Also, similarly to the DCF model, a multiples approach may suffer from the lack of proper peer data in valuing some of the Internet companies, especially social media firms (Knowledge@Wharton, 2006).

On the other hand, as Gupta and Chevalier (2002) note, traditional methods (*e.g.* the DCF model, EP model and multiples) are not obsolete, because financial analysts still rely on them. They further point out that market values are based on expectations that in turn are affected by investors' views, indicating that the methods themselves are not problematic, but rather the assumptions made or expectations relied on (Gupta & Chevalier, 2002).

Considering the challenges, such as the potential biases in analysts' forecasts, in applying traditional methods, alternative approaches for valuing Internet firms have been proposed. Real Options is one of those and is discussed next.

2.3 Real Options technique's applicability to Internet firms

Since the value of the company depends on different projects' outcome, as claimed by Gupta and Chevalier (2002), which then create the overall growth for the firm, a Real Options (RO) approach can be used to determine the enterprise value. The logic lies on the ground that projects can be implemented, cancelled or put on hold, *i.e.* flexibility is incorporated to the valuation process. Villiger and Bogdan (2005) and Gupta and Chevalier (2002) indicate that RO valuation is analogous and an extension to financial call options as well as a decision tree approach. The basic idea behind the decision tree approach is taking into account all plausible choices that can be implemented and then constructing a tree (Gupta & Chevalier, 2002). Subsequently, the present value of the investment is derived by utilizing a discount rate (Gupta & Chevalier, 2002). Villiger and Bogdan (2005) also refer to how a decision tree analysis, captures the flexibility on the one hand, but since the attributed probabilities are subjective estimations, it may distort the final value (like the subjective assumptions' impact in the DCF model). In addition to the decision tree analysis, financial models, such as the binomial and Black-Scholes model are being utilized (Gupta & Chevalier, 2002). These models rely on the presumption that by using asset and options, one can compile a portfolio that is riskless (Gupta & Chevalier, 2002).

In a study from late 1990s, Jägle (1999) suggests alternatively using a RO valuation technique that is less dependent on projected cash flows, which are hard to forecast for high growth companies. Villiger and Bogdan (2005) add that RO are less prone to subjectivity, because of relying on sound theory of probabilities, *i.e.* a binomial tree, and further enable to incorporate more decisions in the valuation. Concurrently, Gupta and Chevalier (2002) draw the attention to the aspect that the RO method does not penalize firms subject to uncertainty unlike the DCF does. Jägle (1999) further refers to the fact that the enterprise value of Information Technology (IT) firms comprises largely future growth opportunities, *i.e.* options that could be exercised. He binds it with new product development (NPD) and projects, which execution or continuation management needs to decide upon (Jägle, 1999). The outcomes of these choices are often the basis for the success of the overall company's growth. That in turn makes the RO method more appropriate for high growth firms in comparison with the DCF or multiples approach (Jägle, 1999).

However, the RO approach includes a difficulty in determining a proper discount rate, since it should incorporate the risk that in turn varies over time as claimed by Jägle (1999). Additionally, there is still a threat of overvaluing flexibility in RO, resulting in unreasonably high values (Villiger & Bogdan, 2005). Concurrently, Corr (2007) draws the attention to the problem that industry competition is not captured in the RO techniques (*e.g.* Black-Scholes). RO further presume having accurate information with regards to management and technological capabilities that is hard for outsiders to always obtain (Gupta & Chevalier, 2002). Additionally, the estimation of parameters, including cash flows generated if the option is exercised, volatility of the options, coupled with the time needed to make the step, is necessary (Gupta & Chevalier, 2002). Finally, in the RO approach, the underlying asset is an investment project, *i.e.* being not tradable unlike the option valuation models presume (Gupta & Chevalier, 2002). Consequently, Gupta and Chevalier (2002) argue that in this sense the RO (*e.g.* Black-Scholes formula) may not be applicable.

The discussion of the RO approach provided in this subchapter brought out advantages of this method that traditional techniques do not comprise (most importantly inclusion of flexibility into the analysis). Regardless of the benefits, however, the drawbacks of the RO technique indicate all in all that this method does not eliminate the issues of valuing Internet firms. Therefore, it may be necessary to use completely new methods, which are focused on next.

2.4 "New" methods and approaches for valuing Internet firms

The need for new methods for capturing high growth Internet companies' values arose during the end of 1990s due to the apparent inapplicability and limitations of traditional valuation techniques to cope with the sensitivity to negative earnings and uncertainty (Bontis & Mill, 2004; Kossecki, 2009; Gupta*, et al.*, 2004; Gavious & Schwartz, 2011; Corr, 2007). The traditional methods have been questioned by Kossecki (2009) who, similarly to Koller *et al.* (2010), Gavious and Scwartz (2011) and Corr (2007), claims that due to the limited history to extrapolate future projections from, coupled with heavy investing activity in early periods resulting in negative cash flows, traditional methods' ability to properly value high growth companies is hindered. Hence, those aspects and a necessity for a new technique gave rise to alternative methods to evaluate Internet firms during the last Dot-Com bubble (Bontis & Mill, 2004).

Although prone to some limitations, a study of 15 Internet firms considering the end of 1999 by Bontis and Mill (2004) shows how implementing web metric measures (*e.g.* unique visitors) for valuing Internet firms do as equally well as traditional techniques. Alternatively, Kossecki (2009) recommends separating customers into categories of "one-deal" and "relation oriented" and in turn calculating a customer lifetime value (CLV) by retrieving the present value of forecasts per individual income stream over the respective customer lifetime (Kossecki, 2009). CLV includes shortcomings, like the need for an appropriate discount factor, the need to know the cost of acquiring and serving each customer, the ignorance of investors' expectations as well as the assumption of a customer's value being independent of other customers (Gupta*, et al.*, 2004). Despite these drawbacks it is still supported and proven to work for Internet as well as, up to some degree, for non-Internet firms (Gupta*, et al.*, 2004; Gupta, 2009). Concomitantly, both, Kossecki (2009) and Bontis and Mill (2004), point to the user/visitor base coupled with the customer's loyalty as the most valuable and crucial assets of Internet companies. The before-mentioned aspects impact the size of the advertising revenue, the main income for the majority of those types of companies. Thus, considering the importance of user base and traditional valuation approaches' drawbacks/inapplicability (*e.g.* creating errors / biased results in case of negative or very low earnings), a PwC report (2011) suggests an alternative metric, *i.e.* "value per user". Koller *et al.* (2010), similarly to PwC, propose a "per user" multiple, amongst the other nonfinancial data based multiples, if the utilization of financial data is complicated. However, they also draw the attention to the aspect that nonfinancial multiples should be used only in case their explanatory power exceeds the one of financial multiples (Koller*, et al.*, 2010).

On the other hand, Gupta *et al.* (2004) refer to the criticism that questionable marketing metrics (*e.g.* click-throughs, unique customers) were addressed during the last Dot-Com bubble. Furthermore, Corr (2007) points out that the "new" multiples had a weak connection to the future cash flows, concurrently the enterprise value, regardless of creating a comparison basis for Internet firms. In addition, the enabled comparison did not enhance the justification of the values themselves (Corr, 2007). Moreover, though providing support for using web metrics for valuation, the samples of Gupta *et al.* (2004) and Bontis and Mill (2004) studies are rather small and coupled with the limitation of these methods of being valid at a certain point in time (*i.e.* at the end of 1990s). Therefore, value per user type approaches themselves may not solve the issues, because of the disadvantages they are subject to. According to Wharton accounting professor Robert W. Holthausen it is still difficult to value advertisement-reliant websites, since similar figures (*e.g.* the number of users or visitors' views) may contain different information depending on the chosen approach for invoicing the advertisement-buyers (*e.g.* how the sale is being recognized, when being paid for advertising) (Knowledge@Wharton, 2006). Furthermore, Kossecki (2009) and Holthausen (Knowledge@Wharton, 2006) claim that the value of each user varies depending on their spending profile and so does in turn the profit generation potential.

Another problem concerning the reliance on the user base includes the exposure to alternations. Internet firms, especially social media platforms, are vulnerable to changes, mainly due to the fact that the industry itself is evolving in a faster manner in comparison with some mature industries (*e.g.* food). Hence, these companies face higher business risk if a substitute arises (*e.g.* a new environment that could replace Facebook, affecting users to abandon the page and follow the new trend) or if "idol users" (*e.g.* well-known sportsmen or pop stars) leave the sites (Hirschorn, 2007). It is, thus, questionable how easy it is for these companies to adhere to their users and in turn secure future revenues (particularly problematic in case of non-contractual agreements that typically apply to these firms). On the other hand, as Holthausen points out, the effort put into establishing a setup to share information with friends creates some stickiness and, thus, may hinder users to abandon the websites (Knowledge@Wharton, 2006). However, he further refers to lacking proper peer data that could be used to compare different social media platforms (Knowledge@Wharton, 2006).

The current subchapter included a discussion of new methods for valuing Internet firms (*e.g.* web metrics and value per users) that were developed during the last Dot-Com bubble, relying on the claim of being more suitable than other models. However, it has been shown that these methods have drawbacks that do not make them supreme over the traditional techniques. Hence, since even new techniques are problematic when it comes to determining true values for Internet companies, the best way might be turning to the market. Such a market-based approach is covered in the following subchapter.

2.5 An alternative way of analysing potential overvaluation of Internet firms – a market-based approach

The aforementioned problems with traditional valuation methods shed light on the question of whether applying them to Internet firms, gives accurate results. Additionally, traditional techniques may suffer from subjectivity and cognitive biases of the investors and as alternative ways of evaluating Internet firms have not proven to outperform models such as the DCF model either, the question of how to plausibly determine an overvaluation remains. However, as Gupta and Chevalier (2002) have referred, the problem may not lie in the traditional methods *per se*, but in investors' expectations and assumptions. Hence, to mitigate this issue, a solution might be to turn to the market, which has been claimed to always know the best or as Gupta and Chevalier (2002, p. 198) phrase it: "… the consensus in the market … determines the equilibrium between the supply and demand."

Several studies (Miller, 1977; Figlewski, 1981; Ofek & Richardson, 2003) have been focusing on short selling and its predictability of a potential overvaluation. The earliest attempts include the studies by Miller (1977) and Figlewski (1981). Miller (1977) was the first one to argue how overvalued stock prices may be caused by short sale constraints and divergence in investors' opinion. According to Miller's (1977) model overpricing occurs, when pessimistic investors are disabled from shorting stocks and incorporating their negative views in the market, leaving the stock price exposed to be affected by excessively optimistic investors (Miller, 1977). Figlewski (1981) corroborates the fact that asymmetry, created by short sale restrictions, gives rise to the emergence of more optimistic views on stocks, whereas excluding putting weight on more negative beliefs. He uses relative short interest[8] as a proxy for short sale constraints, resulting in findings of less shorted companies outperforming more shorted ones (Figlewski, 1981). This result underpins the fact that allowing short selling may help more rational investors adjust the stock prices to remain at their true intrinsic values.

Later studies have followed Miller and Figlewski, trying to apply their argumentations/models to the last Dot-Com bubble. There are three main views on explaining the creation of the last Dot-Com bubble. The first one lies on the basis that short sale constraints ban rational investors from participating on the market. One of these comprises the study by Ofek and Richardson (2003), which concludes that short sale constraints were one of the factors hindering arbitrage and pessimistic investors from "adjusting" the overvalued stock prices, hence contributing to the creation of the bubble. They incorporate lock-up periods and investor heterogeneity as proxies for those restrictions (Ofek & Richardson, 2003). More specifically, Ofek and Richardson (2003) show that the expiration of lock-up periods relieves short sale constraints, *i.e.* it allows insiders to sell their shares, which increases the overall supply and the availability of shares to short on the market. Boehme *et al.* (2006) inquire the study by Miller (1977), but corroborate the results, showing that dispersion of investors' opinion and short sale constraints only simultaneously create overvaluation and one alone is insufficient for it. They use rebate rates[9], relative short interest and options as short sale constraints' proxies, as well as analysts' forecasts, idiosyncratic firm volatility and relative trading volume[10] as proxies of divergence in investors' opinion (Boehme*, et al.*, 2006). Consequently, as their findings support Miller (1977), they also support the results of Ofek and Richardson (2003). Hong *et al.* (2006) also confirm Ofek and Richardson (2003) in the sense that they draw the attention to divergence in investors' belief and lock-up periods, which

[8] Computed as short interest divided by shares outstanding.
[9] Under U.S. law investors who borrow stocks to sell them short have to place the proceeds as a deposit with the lender of the stock. The lender receives interest on this collateral of which a pre-negotiated part is rebated to the borrower, the so-called "rebate rate" (Ofek & Richardson, 2003).
[10] Computed as trading volume divided by shares outstanding.

might cause a bubble. They look at the ratio of float to risk-bearing capacity[11] and infer that the larger the ratio, the smaller a bubble will probably be (Hong*, et al.*, 2006).

The second view on explanation for the last Dot-Com bubble relies on the reluctance of rational traders to attack mispricing. Contrary to Ofek and Richardson (2003) and Boehme *et al.* (2006), Battalio and Schultz (2006) claim that short sale constraints were not solely liable for excessively high stock prices and rational investors had ways to arbitrage against those stocks. Concomitantly, they show that during the last Dot-Com bubble, investors could have used options as an alternative way of engaging in short selling (*i.e.* synthetic short selling) and by referring that synthetic short selling is cheaper in case of artificially inflated prices, investors could have earned equivalent amounts in comparison to if they had committed to direct short selling (Battalio & Schultz, 2006). Lamont and Stein (2004) support this fact and also show that investors engaged in too little short selling in rising markets, which in turn created problems. Moreover, Battalio and Schultz (2006) find no evidence of irrationality of excessively optimistic investors that might have caused the increase in stock prices. Although some shares were harder to short than others (*e.g.* it is easier to short bigger firms' stocks), as suggested by D'Avolio (2002), thus creating difficulties with committing to short selling, Battalio and Schultz (2006) provide evidence of how investors could have synthetically shorted even those stocks that were difficult to borrow during the last Dot-Com bubble. Furthermore, Lamont and Stein (2004), relying on their study results, argue that short selling does not even contribute to stabilizing an overpriced market.

Similarly to Battalio and Schultz (2006), Schultz (2008) study further opposes Ofek's and Richardson's (2003) findings by showing that the expirations of lock-up periods had little effect on the collapse of the last Dot-Com bubble and that it was rather caused by a market-wide decrease in stock prices. According to his results there was no statistically significant amount by which the performance of the stocks with lock-ups exceeded the stocks with expiring lock-ups (Schultz, 2008). Schultz (2008) also points out that in addition to Internet companies' stocks, shares of other growth companies that were not even related to Internet firms faced a poor performance too. The results of Battalio and Schultz (2006) and Schultz (2008) are in line with a previous study of Geczy *et al.* (2002), who find that non-short sale constrained shares in addition to short sale constrained stocks had also negative excess returns upon the lock-up expiration. They further provide some insights on the short sale constraints of Internet firms. Despite using the same proxy (*i.e.* rebate rates) for short sale constraints as Ofek and Richardson (2003), they show that Internet firms' stocks were actually available for shorting during the time period from October 1998 to October 1999 (Geczy*, et al.*, 2002).

[11] Hong *et al.* (2006) do not specify the essence of the risk-bearing capacity proxy, but refer that a limited risk-bearing capacity represents a close to horizontal downward-sloping demand curve, *i.e.* little potential for the stock to be overvalued.

The aforementioned findings may seem puzzling at first sight, when compared to the findings of Ofek and Richardson (2003) as well as Hong *et al.* (2006). However, Brunnermeier and Nagel (2004) and Griffin *et al.* (2011) provide additional explanatory evidence to them. Both studies are based on a set of theories suggesting that rational investors with pessimistic views are not counteracting the market due to a reluctance to arbitrage away mispricing (amongst others see De Long *et al.* (1990) as well as Abreu and Brunnermeier (2002)). An example of such a reluctance to attack mispricing is the synchronization risk among rational investors (Abreu & Brunnermeier, 2002). Since a single investor cannot remove mispricing, a coordinated effort of rational traders is necessary. Yet, no investor wants to take the first step, because of being unsure if the others will follow. Instead of trading against the irrational investors, the rational investors then decide to ride on a bubble for some time. While Brunnermeier and Nagel (2004) base their study solely on the observation of hedge-fund portfolios during the last Dot-Com bubble, Griffin *et al.* (2011) cover the trading patterns of all investor categories during the bubble through proprietary data obtained from NASDAQ stock exchange. Both studies provide evidence that institutional investors (*i.e.* rational traders) are able to change their evaluation of stock prices rapidly and sell-off their positions right at the peak of a bubble, while irrational investors (*e.g.* individual noise traders) still keep buying. Yet neither of these two studies is able to pinpoint the exact mechanism that leads to this sell-off. Nevertheless, Griffin *et al.* (2011) mention that news can explain institutional trading to a certain extent.

An alternative and third type of view that confronts the findings of Battalio and Schultz (2006) that rational investors could have used synthetic short selling, encompasses investors' irrationality. Hong *et al.* (2006) point to overconfident outsiders believing they are as "smart" as the insiders and that other investors have even higher beliefs about the firm. This refers to irrational investors, who contribute to the formation of a bubble. Moreover, Greenwood and Nagel (2009) analyse the last Dot-Com bubble and show how inexperienced younger fund managers were investing into technology firms with inflated prices, whereas their older colleagues took rather conservative positions. Hence, they infer that younger managers might have been more subject to biases and concomitantly helped the bubble to sustain (Greenwood & Nagel, 2009). Bailey *et al.* (2011), in addition, jointly examine several behavioural factors (disposition effect, narrow framing, local bias, lottery stocks preferences and inattention to news) in the context of mutual fund choices, concluding that these affect investors' decisions and being more biased makes one suffer from trend-chasing behaviour (which typically fits to less sophisticated investors). The biases resulting in trend-chasing decisions can in turn be linked back to the younger managers' behaviour in Greenwood's and Nagel's (2009) study, again indicating irrationality. Moreover, Corr (2007) suggests in the light of the last Dot-Com bubble that investors may have been prone to herd mentality coupled with the *Greater Fool Theory* (*i.e.* the possibility to make profits not by purchasing stocks according to the intrinsic value, but due to the presence of even more optimistic investors willing to buy stocks at a higher price) that enabled the bubble to be inflated as specified by Cassidy (2002). The results of those mentioned studies indicate that investors (even the ones supposed to be rational) may actually suffer from cognitive biases like discussed by Shefrin (2007).

Summarizing the aforementioned findings, there are three streams of evidence for the last Dot-Com bubble. The first one is based on a model whereby rational investors are excluded from the market due to short sale constraints (Miller, 1977). The second one is based on a model whereby rational investors are reluctant to attack mispricing (see *e.g.* Abreu & Brunnermeier (2002)). The third one relies on the fact that investors are in reality irrational. Table 2.2 below briefly summarizes the theoretical and empirical foundation for these literature strands.

Table 2.2 *Literature streams for the explanation of the last Dot-Com bubble*

Literature stream 1: Short sale constraints (and divergence in investors' opinion)	Literature stream 2: Reluctance of attacking mispricing	Literature stream 3: Biases and irrationality
Theoretical foundation:	*Theoretical foundation:*	*Theoretical foundation:*
Miller (1977) Chen *et al.* (2002) Hong & Stein (2003)	De Long *et al.* (1990) Abreu & Brunnermeier (2002) Abreu & Brunnermeier (2003)	Shefrin (2007) – *good source covering and compiling the main behavioural aspects in regards to corporate finance*
Empirical evidence:	*Empirical evidence:*	*Empirical evidence:*
Lamont & Thaler (2003) Ofek & Richardson (2003) Cochrane (2005) Hong *et al.* (2006) Xiong & Yu (2011) *… and partly supporting evidence from:* Field & Hanka (2001) Klungerbo *et al.* (2012)	Brunnermeier & Nagel (2004) Griffin *et al.* (2011) *… and supporting evidence from:* Geczy *et al.* (2002) Battalio & Schultz (2006) Schultz (2008)	Greenwood & Nagel (2009) Bailey *et al.* (2011) *… and supporting evidence from:* Cassidy (2002) Corr (2007)

Source: compiled by authors

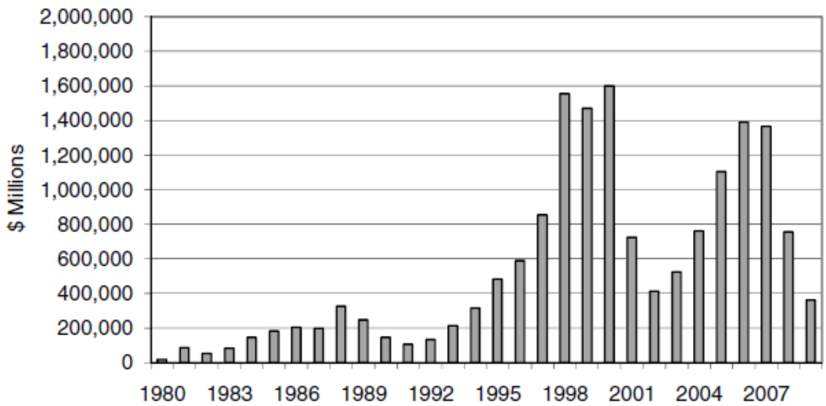
While all three streams rely on market data (though the third less than the prior two) to provide explanations for the last Dot-Com bubble, only the findings for the model of Miller (1977) allow for an ex-ante analysis. In fact, the second stream does not provide clear evidence on the underlying mechanisms of institutional investors exiting at the peak of a bubble, which limits research to ex-post assessments. Similarly, the assessment of irrationality is only plausible in an ex-post analysis. Finally, even authors as Geczy *et al.* (2002) and Brunnermeier and Nagel (2004) admit that short sale constraints, respectively lock-up expirations, may – to a certain extent – be part of the explanation for the last Dot-Com bubble. Since this thesis aims to determine the risk of another Dot-Com bubble ex-ante (not just look at it ex-post), it focuses mainly on the former strand of literature, but may consider aspects from other streams if found to be relevant.

This subchapter concentrated on a market-based approach for determining overvaluation and indications for a bubble. Short sale constraints, divergence in investors' opinion and the implications of lock-up periods used in this approach were touched upon, concurrent with some supporting and contradicting research results. Since the above-discussed market-based approach may not give unambiguous results, an additional control technique seems useful. One method that allows controlling for this is observing the M&A intensity as discussed below.

2.6 Intensity of M&A activity as an indicator for overvaluation

Gaughan (2011) claims that M&A come in waves and there have been six of those up until now. He further points to the fact that over time M&A have become more worldwide, which opens the field for foreign acquirers and targets and, hence, enlarges the total M&A market (Gaughan, 2011). Concurrently, as there are more participants on the market, the prices and in turn values may unjustifiably be driven up in a faster manner. To illustrate this, Figure 2.2 below depicts the value of M&A in the U.S. over 30-year time period.

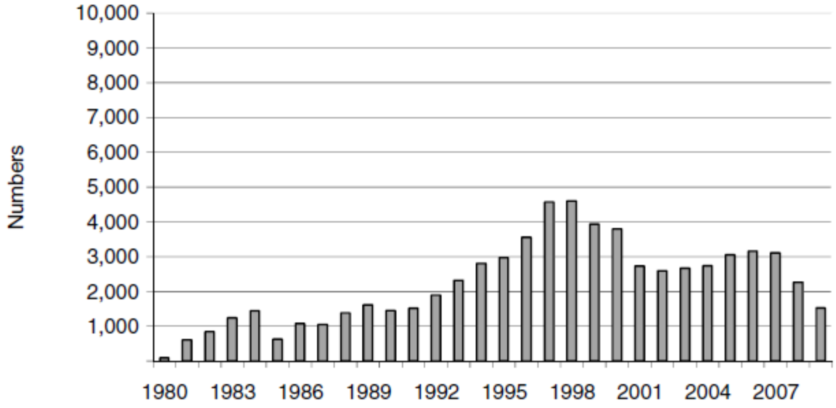
***Figure 2.2** M&A's value in the U.S. during 1980-2009*



Source: Gaughan (2011, p. 64)

Since the pattern for M&A's value itself may be informative only up to a limited degree, the number of M&A for the same time period is brought out as a complementary for this comparison. The trends in M&A intensity are shown in Figure 2.3 below.

Figure 2.3 *Number of M&A in the U.S. during 1980-2009*



Source: Gaughan (2011, p. 64)

As can be seen from Figure 2.2 and Figure 2.3, the pattern for M&A's value follows the pattern of number of M&A. That proves that the prices paid are higher during the time when more M&A happen and *vice versa*. In turn, both figures depict how the peaks in values as well as the number of M&A are in line with the economic peaks (*e.g.* 1999-2000 or 2006-2007) and troughs occur during the recession periods (*e.g.* 2001-2002 or 2008-2009). Thus, a high number of M&A coupled with the excessive prices paid during the economic booms are more likely the result of overvalued companies (both, targets and acquirers) based on the historical evidence as claimed by Gaughan (2011) and the results of empirical studies (see *e.g.* Rhodes-Kropf *et al.* (2005)). Rhodes-Kropf *et al.* (2005) also find that payment method is also an indication of misevaluation, referring to stock deals reflecting overvalued firms. Therefore, looking at the pattern of M&A activity can give indications of overvalued firms that in turn may lead to a possible bubble.

As was discussed in this subchapter, the intensity of M&A activity can be a control method for determining overvaluation, since it has been shown that the intensity peaks during times when companies are prone to excessive valuations. As pointed out in subchapter 2.5, regulatory aspects, especially lock-up periods, have been shown to impact overvaluation and the development of bubbles. Thus, the next subchapter incorporates and discusses these aspects.

2.7 The impact of regulatory aspects on bubbles – lock-up periods

The aforementioned accuracy of valuation methods and investors' expectations themselves are not the only attributes that may affect the establishment of an asset price bubble. Regulations, which may restrict certain participants from taking desired actions, are equivalently important when it comes to impacting the values of exchange-listed firms. One of the regulatory aspects prohibiting some investors' decision implementation comprises lock-up periods.

The Securities and Exchange Commission (SEC) defines the lock-up period as the period of time during which firm's insiders (*e.g.* management, employees) are prohibited from selling their shares (U.S. Securities and Exchange Commission, 2012).

The typical duration of a lock-up period lies between 90 and 180 days after the IPO date (first trading day) (Field & Hanka, 2001), but may also exceed 180 days in some less common cases. (*e.g.* it might exceed two years for hedge funds) (Ofek & Richardson, 2000). Although the insiders are restricted to sell shares during the lock-up period, underwriters might make special exceptions, which, however, are rather rare (Ofek & Richardson, 2000). In spite of lock-up periods being not regulated nor required by the SEC in the U.S., they are underwriters' standard arrangement, thus commonly used (especially with IPOs) (Ofek & Richardson, 2000; Klungerbo*, et al.*, 2012). Though standard but still voluntary in the U.S., in Continental Europe (*e.g.* in France, Germany) and in U.K., however, lock-up periods are often obligatory (Espenlaub*, et al.*, 2001; Goergen*, et al.*, 2006). The purpose of utilizing lock-up periods is justified as a mean of incentive alignment between present and new owners, protecting the latter from plausible insider selling resulting in a drop of the share price (Ofek & Richardson, 2000; Klungerbo*, et al.*, 2012). Additionally, it avoids the situation of excessive supply in shares during the initial period of trading (U.S. Securities and Exchange Commission, 2012). Furthermore, it is a signal of insiders not engaging in a cash-out attempt before bad news and reassurance of key employees adhering to the firm and putting in effort (Field & Hanka, 2001).

Replicating the study of Field and Hanka (2001) to test their results' validity, research by Klungerbo *et al.* (2012) confirms that IPO lock-up period's expiration is linked to negative abnormal returns, further supporting Ofek and Richardson (2000). The research specifies that negative abnormal returns occur more likely for companies with high betas and firms whose stocks experience negative returns during lock-up periods (Klungerbo*, et al.*, 2012). This finding supports the results of Field and Hanka (2001) that indicate more negative abnormal returns for high-tech companies (*i.e.* firms typically with high betas) and NASDAQ firms (which comprises many technology, including Internet, companies). However, Klungerbo *et al.* (2012) point out that negative abnormal returns are not the result of selling by rational investors, but rather insiders, since it is a possibility for the latter, after a long stay with the company, to profit. Field and Hanka (2001) also find that when insider sales are reported, the abnormal returns are more negative, being a reflection of the view that insiders lack confidence. However, as they find abnormal returns being negative even without this factor they infer reported insider sales as not the sole cause for negative excess returns (Field & Hanka, 2001). According to a study by Espenlaub *et al.* (2001) negative abnormal returns are not found for the U.K. market. Additionally, Goergen *et al.* (2006) confirm this finding for German and French IPO lock-up periods. Consequently, these results indicate that abnormal negative returns close to lock-up periods may be an anomaly particular for the U.S. Hence, the results of Klungerbo *et al.* (2012) do not necessarily indicate overvaluation, but rather accentuate the exiting opportunity for insiders (whose wealth has previously been tied up), contradicting in that sense *e.g.* Ofek and Richardson (2003). The before-mentioned reporting aspect by Field and Hanka (2001) on the other hand might be reasoned through insiders selling due to low confidence in the firm or potentially because of overvaluation that is also suggested by Ofek and Richardson (2003).

Further, a study by Hong *et al.* (2006) also underpins Ofek and Richardson (2003) by pointing to rational insiders who, whilst being less optimistic in terms of the beliefs than some overconfident outside investors, are selling more heavily after the lock-up expiration than anticipated by non-insiders. Thus, Hong *et al.* (2006) refer to heterogeneous opinions together with a "waking-up effect", in which the beliefs become aligned, that may cause a potential overvaluation and the burst of a bubble as similarly suggested by Ofek and Richardson (2003). In spite of different views, the effect of the lock-up period is still the same: it disables insiders from selling, regardless of whether the company actually is overvalued, and might potentially still contribute to the excess misevaluation of the firm, thus underpinning the creation of a bubble. Additionally, Ofek and Richardson (2000), Field and Hanka (2001) and Klungerbo *et al.* (2012) studies' results contradict the Efficient Market Hypothesis (EMH), inferring that the lock-up periods' expiration is not incorporated into the IPO stock price. However, they do support the downward sloping demand curve hypothesis (see *e.g.* Field & Hanka (2001)).

The current subchapter provided a discussion of lock-up periods' essence and impact on firms' stock prices. In general, there is evidence of negative excess returns around the lock-up period, which might also refer to overvaluation. In that sense lock-up periods may contribute to the formation of a bubble as some investors are prohibited from selling for a specified time. In order to explore an overvaluation and the potential occurrence of another Dot-Com bubble empirically, specific methods need to be applied. The following chapter gives a discussion about the methodology used in this thesis.

3 METHODOLOGY

Chapter 2 introduced the theoretical foundation for asset price bubbles, valuation techniques and their disadvantages when applied to Internet companies as well as the impact of lock-up periods on stock prices. This chapter ties the theoretical background together into a research method utilized to assess the risk of another stock price bubble in the Internet industry.

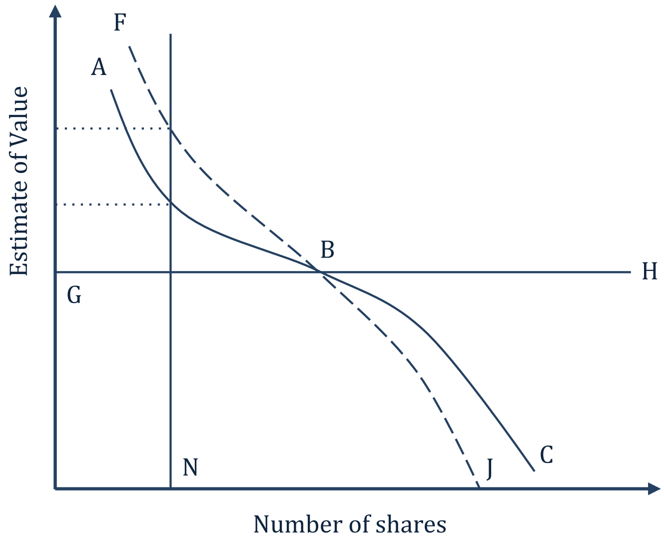
3.1 Research approach

As previously noted, traditional valuation methods are difficult to apply to Internet companies. Although several other approaches have been proposed, one can in retrospect conclude that they did not help much either to prevent the stock price bubble that emerged during 1995 and 2000. This raises the important question of whether an overvaluation of stocks in this specific industry can be observed at all.

Miller's (1977) model of overpricing under short sale constraints and divergence in investors' opinion represents an interesting alternative for this case. Ofek and Richardson (2003) use this model to assess the Dot-Com bubble and find that the combination of short sale restrictions together with the cumulative expiration of lock-up periods may be a viable explanation why Internet companies initially became overvalued and also why the bubble finally burst in March 2000. Most interestingly an analysis on short sale restrictions and divergence in investors' opinion is not limited to an ex-post assessment of stock price bubbles. When brought into conjunction with lock-up expiration patterns, market data on both dimensions can be used to evaluate the risk of a stock price bubble ex-ante, which is rather uncommon in business and economics where such events are typically explored ex-post.

Miller's (1977) model seems intuitively appealing. When pessimistic investors are excluded from the market, due to short sale constraints, optimistic investors will bid up the stock price. This reaction is based on a supply and demand model for stocks, where the supply is fixed and the demand curve is downward sloping as depicted in Figure 3.1 below.

Figure 3.1 *Supply and downward sloping demand curve for stocks*



Source: adapted by authors based on Miller (1977, p. 1152)

The downward slope of the demand curve (*ABC*), on the one hand, is caused by the divergence in investors' opinion about the fair value of the stock. The greater the divergence, the more steeply sloping the demand curve will be (depicted as shift to curve *FBJ*). However, if there is no disagreement among investors, the demand curve will be horizontal (depicted as curve *GBH*) and overpricing cannot appear. The fixed supply (curve *N*), on the other hand, is caused by short sale constraints. If short sales are not constraint, pessimistic investors will increase the supply of shares on the market (curve *N* will shift to the right), thereby counteracting the optimistic investors and bringing back the stock price to an equilibrium level. Obviously, without short sale constraints overpricing cannot appear.

The above-discussed model has three important implications for this study. Firstly, all stocks may be short sale constrained to a certain extent. Borrowing fees, low liquidity and the fact that the market for borrowing stocks is not a public one are the key factors influencing short sale constraints (Boehme*, et al.*, 2006). Hence, short sale constraints need to be assessed relatively among stocks and not on an absolute basis. Secondly, higher uncertainty leads to higher divergence in investors' opinion and a more steeply sloping demand curve (Miller, 1977). Thus, a higher uncertainty yields a higher overvaluation under short sale constraints. Thirdly, lock-up agreements do not only limit the amount of shares made available in an IPO; they do also limit the amount of shares available to short (Ofek & Richardson, 2003). Field and Hanka (2001) as well as Klungerbo *et al.* (2012) observe statistically significant abnormal returns upon the expiration of the lock-up period and attribute this effect to an unexpectedly high amount of insider sales as well as to a downward sloping demand curve. Therefore, when uncertainty is high and the demand curve is steeply sloped, the negative excess returns upon expiration of the lock-up period are high too. This effect is magnified by the amount of shares becoming available to borrow and take short positions.

Consistent with the aforementioned implications, Ofek and Richardson (2003) find that Internet stocks during the last Dot-Com bubble were more short sale constrained than non-Internet stocks. They also observe that a higher amount of retail investors, who are supposed to be more prone to cognitive biases, held long positions in Internet stocks as well as a statistically significant reduction in short sale constraints and negative abnormal returns in stock prices around the lock-up expiration. One might, hence, reasonably argue that if there is another stock price bubble emerging in the Internet industry, similar patterns could be observed.

However, as mentioned under subchapter 2.5 there are also other theoretical streams that may explain the creation of a stock price bubble without companies being short sale constrained and without considering lock-up periods (*e.g.* Abreu & Brunnermeier (2002)). Griffin *et al.* (2011) highlight the fact that rational investors may ride a bubble until a certain point when they drop their reluctance to attack the mispricing and eventually start (short) selling. To incorporate this alternative notion in the current study, the announcement about Facebook's IPO is chosen as an event around which trading patterns are observed. The announcement seems to be an appropriate event, since there has been broad media coverage and an extensive discussion about the fair price range of the IPO (Gapper, 2012). Hence, rational investors may use this as a warning signal and start arbitraging away misevaluation among Internet stocks.

Either way, the advantages of assessing overvaluation on a market-based approach compared to the other valuation methods discussed in chapter 2 are apparent. The analysis does not require the determination of a discount factor, as it is needed for RO, the DCF and CLV model. Neither is there a need to have comparables, as it is required for a multiples approach. Additionally, the study is not dependent on a firm's historical performance like the DCF and EP model and is more objective and less time consuming than valuing each company individually.

To control for the findings under the aforementioned research approach, M&A data can be utilized as suggested in subchapter 2.6. Since M&A intensity tends to increase during booming markets (Gaughan, 2011), one would expect to see a complementing higher intensity of M&A in the Internet industry when compared to other industries, if the firms are indeed overvalued.

In summary, the effect of a downward-sloping demand curve in context of the IPO lock-up expiration and the announcement about Facebook's IPO is used as a research approach to assess whether Internet companies are overvalued, possibly leading to another stock price bubble. The next subchapter gives insights to the data and its sources, utilized for this study.

3.2 Data collection

3.2.1 Data set

The complete data set comprises 235 Internet and non-Internet companies listed on the U.S. stock exchanges and with their lock-up periods expiring between January 2010 and end of February 2012. This time frame is chosen to allow for a tracking of market data under a normalized economic environment. More specifically the recent financial crisis led to a recession in 2008 and 2009 that did not only cause a drop in stock prices, but also influenced short selling patterns in an abnormal way (as can be seen from the temporary short sale ban on financial stocks in 2008 (U.S. Securities and Exchange Commission, 2008)) and, thus, would introduce a potential bias into the analysis. The restriction of the time horizon is insofar unproblematic as the number of IPOs follows the economic cycle. IPOs started to pick up again in the second half of 2009, with lock-up agreements expiring in 2010. Finally, prior to August 2007 short interest data was only reported on the 15th day of each month (or the previous business day), afterwards it also became available for end of the month dates. To track short selling patterns as close as possible it seems reasonable to make use of mid- and end-month data, which would not allow going past August 2007 in the analysis under any circumstance.

To allow for a relative assessment of short sale constraints and dispersion of investors' belief the selected firms are split into two portfolios: one consisting of Internet companies and a comparison portfolio comprising non-Internet firms. Since there is no common agreement of what defines an Internet company (see for example Cochrane (2005)), a two-step selection process is utilized. In the first step the companies are categorized according to their Standard Industrial Classification (SIC) code. This allows for a rough selection that for example rules out manufacturing companies. However, the SIC code does not capture all aspects of a company's business. Namely, one would expect to find Internet companies under the SIC code 737 "Computer Programming, Data Processing, And Other Computer Related Services". Yet, eBay for example is listed under SIC code 738 "Miscellaneous Business Services". For the second selection-step Tim O'Reilly's description of Web 2.0 companies is chosen as a point of reference, due to the fact that much of the talks on a second Dot-Com bubble revolve around companies like Facebook and LinkedIn, falling into the category of Web 2.0 firms. The most important features of such a company are (O'Reilly, 2005):

- It provides a platform that allows users to participate in the generation of content and interact with each other (*e.g.* YouTube or LinkedIn) as well as
- more technical aspects, such as a user-centric interface and interoperability of services (like the possibility to integrate Facebook's *like*-button on other websites).

If the aforementioned criteria are met, the firm is selected to the Internet portfolio. The results of the overall selection process lead to a portfolio of 46 Internet companies[12] and a comparison portfolio of 189 non-Internet firms (for the full list, see Appendix A). Companies that were delisted during the observation period are excluded from the selection. Observed irregularities, such as mismatches in dates or missing data, are corrected to the authors' best possibility through manual research.

Some previous studies on IPO's and lock-up periods (see for example Ibbotson *et al.* (1988) or Field & Hanka (2001)) further exclude non-domestic firms (*i.e.* companies that are listed on the U.S. stock markets but not headquartered in the U.S.), closed-end funds, REIT's and stocks with an offering price below a certain threshold ("penny stocks"), due to liquidity reasons. This approach is not applied in this study *per se*. However, to check for the robustness of the results a marker is included in the data set that separates "domestic" (U.S.) and "non-domestic" (non-U.S.) companies. A manual check of the data also reveals that it includes no closed-end funds and only one REIT, the effect of which is considered negligible.

Furthermore, a word of caution concerning the expiration of lock-up periods is necessary. Companies conducting an IPO may agree on multiple lock-up periods with their underwriters. While there is usually a main lock-up period, with a length of 90 to 180 days, that prevents the major portion of shares from being sold, smaller fractions of shares may be unlocked before or after that date (Field & Hanka, 2001). Yet, these agreements differ on a firm-to-firm basis and to allow for a meaningful analysis only the expiration-date of the main lock-up period is considered in this study.

Finally, for the control method, data on M&A intensity is being obtained for the years 2002 to 2012. A longer time horizon for the observation seems reasonable, because M&A occur in waves (see subchapter 2.6) and the long-term pattern needs to be observed. The data set is again split into two portfolios. However, due to the amount of data representing this time frame (61,044 M&A transactions worldwide) the separation criterion is chosen differently. The portfolios are split up based on the industry classification of the Reuters3000 XTRA M&A database. One portfolio consists of M&A in the Information Technology (Software and Services) industry (5,746 transactions) and the other portfolio of all remaining M&A (55,298 transactions).

The current subchapter provided an overview of the data set utilized in the current thesis. More specifically, criteria for selecting the companies to the sample and explanation of how data is used were carried out. Data, however, is gathered from different databases and, hence, the sources for it are outlined next.

[12] It is the most recent and the most comprehensive data available at the moment. Increasing the sample size would be possible by extending the time period further to the past, which, however, is irrelevant considering the purpose of this study (determining a bubble ex-ante, *i.e.* based on the most recent data).

3.2.2 Data sources

To implement the quantitative methods mentioned above, collecting relevant data is necessary. The respective data is retrieved from the following sources:

- Thomson Reuters – Datastream (including data types): *Short Interest (SID), Institutional Ownership (NOSHIC + NOSHPF), Trading Volume (VO), Number of Shares Outstanding (NOSH), Share Prices (P), Number of Analysts (EPS1NE), Dispersion of Analysts' forecast (EPS1CV) and EV/EBITDA multiple (DWEE)*,
- NASDAQtrader.com: *Short interest data,*
- Yahoo! Finance: *Companies' profiles (countries of origin)*,
- Thomson Reuters – Reuters 3000 XTRA: *International M&A transaction data (for 2002-2012 first quarter)*,
- The U.S. Securities and Exchange Commission's EDGAR system: *Lock-up periods' expirations*,
- 123jump.com – Global Financial Markets: *Dates for the IPOs and companies' industries*.

In terms of literature covered in the current thesis the Lund University Library database, Summon, is used as the main source for previous empirical studies, relevant journal articles and e-books. Regarding the Internet sources used in the current study, information is retrieved from reliable and trustworthy sources.

To draw conclusions from the data, descriptive and inferential statistics can be applied (Dodge, 2008). The following two subchapters lay the foundation for the empirical part of the study by introducing the utilized variables, hypotheses and statistical tests.

3.3 Statistical tests

3.3.1 Variables and hypotheses formulation

As outlined under the research approach (subchapter 3.1), short sale constraints and divergence in investors' opinion leads to overpricing of stocks. However, neither short sale constraints nor the disagreement on a securities fair value among investors are directly observable. To conduct an analysis on both dimensions proxies are needed. Along with a description of these variables the research hypotheses are developed. The alternative hypotheses H_1 represent the authors' anticipation that Internet firms differ on both dimensions from non-Internet firms. This claim has to be proven by evidence. Otherwise the null hypothesis H_0 (Internet and non-Internet firms are equal) is retained (Anderson*, et al.*, 2011).

a) Relative short interest

Relative short interest was proposed as a proxy for short sale constraints by Figlewski (1981), the first paper to empirically assess Miller's (1977) model. The proxy is calculated as:

$$Relative\ short\ interest\ (RSI) = \frac{Short\ interest}{Shares\ outstanding} \tag{1}$$

Short interest data is published by stock exchanges at the middle and end of the month and captures the number of shares held short in a stock at that point in time. Dividing it by shares outstanding one receives the percentage of a firm's shares that are held short, which is the most utilized proxy for short sale constraints in previous studies (Boehme*, et al.*, 2006). Following Figlewski's (1981) line of argumentation a high short interest not only reflects the current amount of shares held short, but also the amount of negative information that would be incorporated in the market if the stock was not short sale constraint. Hence, the higher the relative short interest, the higher the short sale constraint.

For this study, data on short interest and shares outstanding is being collected for four points in time – the closest publication date prior to the lock-up expiration as well as the three publication dates following the lock-up expiration. In line with Figlewski's (1981) study it can be expected that short sale constrained stocks show a higher relative short interest prior to the lock-up expiration, while this effect should disappear after the lock-up expiration when shares become available to short.

The reason for not only collecting the closest post lock-up short interest data is that according to Ofek and Richardson (2003), it takes some time until shares get redistributed from previously locked-up investors to short sellers. In their study they find that the number of shares sold peaks in the second month after the lock-up expiration. To capture this effect it seems sufficient to collect data on 3 post lock-up publication dates. Furthermore, when a lock-up period expires directly on the short interest publication date, it is still considered as pre lock-up, due to the aforementioned time lag in the redistribution of the shares.

The findings and anticipations mentioned above lead to the development of the following research hypotheses:

H_0: Internet companies *do not have* higher relative short interest than non-Internet companies prior to the lock-up expiration.

H_1: Internet companies *do have* higher relative short interest than non-Internet companies prior to the lock-up expiration.

… and …

H_0: Internet companies *do not have* higher relative short interest than non-Internet companies after the lock-up expiration.

H_1: Internet companies *do have* higher relative short interest than non-Internet companies after the lock-up expiration, but with a diminishing effect.

However, there are two main points that can be brought forward against relative short interest as a single proxy for short sale constraints. First, a high relative short interest may as well be a sign that there is no short sale constraint and dispersed investors' opinions do actually get incorporated in the market (Boehme*, et al.*, 2006). Second, differences in relative short interest may be attributable to breadth of ownership in the company. With regards to that, D'Avolio (2002) observes that institutional ownership explains about 55% of the variability in supply of shortable shares.

b) Ownership breadth

Based on the aforementioned arguments it becomes obvious to look at ownership patterns as another proxy for short sale constraints. Asquith *et al.* (2005) argue that short sale constraints are most severe when demand for shares to short is high (measured by relative short interest) and supply is limited (measured by institutional ownership). Their empirical findings support this notion and the utilization of ownership breadth in combination with relative short interest as a proxy for short sale constraints. Hence, it can be expected that short sale constrained stocks show low institutional ownership (in combination with high relative short interest) before the lock-up expiration, while this effect may disappear after the lock-up expiration.

The ownership data for this study is gathered for the same points in time as relative short interest, *i.e.* one pre lock-up date and three post lock-up dates, to have corresponding variables. Two important things need to be mentioned with regards to this data. First, the proxy is a combination of the Datastream data-types NOSHIC and NOSHPF, since pension funds are also considered as institutional owners for the purpose of this study. Second, Datastream only reports historical share holdings above the 5% level. This inherently leads to a weaker proxy, since all institutional holdings below 5% stay unconsidered. Nevertheless, it is expected to have stronger inferences from including this variable than only using relative short interest.

The following hypotheses are used to test for a difference in supply of shares as a second proxy for short sale constraints:

H_0: Internet companies *do not have* lower institutional ownership than non-Internet companies prior to the lock-up expiration.

H_1: Internet companies *do have* lower institutional ownership than non-Internet companies prior to the lock-up expiration.

… and …

> H_0: Internet companies *do not have* lower institutional ownership than non-Internet companies after the lock-up expiration.
>
> H_1: Internet companies *do have* lower institutional ownership than non-Internet companies after the lock-up expiration, but with a diminishing effect.

As already pointed out, short sale constraints are only one of two dimensions in Miller's (1977) model, the other one being a divergence in investors' opinion on the company's value. Two proxies for this divergence are utilized, the dispersion of analysts' forecast and the relative trading volume.

c) Dispersion of analysts' forecast

First considered as an indicator for difference in investors' beliefs by Ajinkya *et al.* (1991), Diether *et al.* (2002) apply the proxy in their empirical analysis on Miller's (1977) model. The authors analyse the earnings per share forecasts of firms followed by more than one analyst and find a statistically significant relation between the dispersion of analysts' forecast and subsequent stock returns, where:

$$Dispersion\ of\ analysts'\ forecasts = \frac{Std.dev.of\ EPS\ forecasts\ for\ current\ fiscal\ year}{Absolute\ mean\ of\ EPS\ forecasts} \qquad (2)$$

Although this proxy seems appealing at first sight, Diether *et al.* (2002) as well as Boehme *et al.* (2006) report that only relatively large companies are followed by more than two analysts. To control whether the proxy is applicable to this study the number of analysts following each company in the Internet and non-Internet portfolio is collected from the I/B/E/S database accessible through Datastream. The number of analysts does change over time, but when collected for the same points in time as used for short interest and institutional ownership, at least 43 companies of the Internet portfolio and 168 firms of the non-Internet portfolio are followed by more than 1 analyst. This exceeds the amount reported in previous studies and covers roughly 90% of the two portfolios. The proxy is, thus, considered as applicable.

Furthermore, Diether *et al.* (2002) report an inaccuracy in the I/B/E/S database due to the ex-post adjustment of analysts' forecasts for stock-splits, which falsifies the standard deviation measure. Since the authors of this thesis are not aware of any company in the data set where this would have been the case, this inaccuracy is deemed unproblematic for the current study.

Taking the dispersion of analysts' forecast as a proxy for the whole investor base, the following hypotheses can be developed:

H_0: Internet companies *do not have* more dispersed analysts' forecasts than non-Internet companies prior to the lock-up expiration.

H_1: Internet companies *do have* more dispersed analysts' forecasts than non-Internet companies prior to the lock-up expiration.

No second pair of hypotheses is necessary for this proxy, since the lock-up expiration is not an event revealing new information about the firm. Hence, uncertainty about the business will remain at the same level and so should the divergence in investors' opinion. However, to observe the development of the proxy after the expiration of the lock-up period, it is still incorporated in the analysis. In order to make the right inferences on the post lock-up dispersion of analysts' forecast, the number of analysts is used again, since a change in the dispersion could be attributable to either a change in analysts' opinion or a changed number of analysts following the firm.

d) Relative trading volume

Finally, literature proposes trading volume as a proxy for divergence in investors' opinion. There is broad consensus among academics that "... volume is related to volatility because it reflects the extent of disagreement about a security's value based on either differential information or differences in opinion" (Jones*, et al.*, 1994, p. 633). This means that a high trading volume indicates a high dispersion of investors' belief. The most common way of calculating this measure, utilized for example by Boehme *et al.* (2006), Danielsen and Sorescu, (2001) as well as Lee and Swaminathan, (2000), is the mean daily trading volume scaled by shares outstanding (over a certain time horizon prior to the date for which short interest data is reported):

$$Mean\ daily\ trading\ volume = \frac{\sum(number\ of\ shares\ traded\ each\ day)}{Number\ of\ days} \tag{3}$$

$$Relative\ trading\ volume = \frac{Mean\ daily\ trading\ volume}{Shares\ outstanding} \tag{4}$$

There is, however, no agreement among authors what time horizon to use. Boehme *et al.* (2006) for example use a time frame of 100 days including a lag of 15 days, whereas Diether *et al.* (2002) use 250 days including a lag of one month. For this study two time frames are used, one pre lock-up expiration [-44 … -6] and one post lock-up expiration [+6 … +44], representing a lag of 5 days (considered as one week in trading days).[13] Additionally, the trading volume of stocks listed on NASDAQ is divided by two to account for the higher trading volume on NASDAQ as a dealer market in comparison with NYSE as an auction market (Anderson & Dyl, 2007).

[13] The mentioned pre and post lock-up expiration periods are used as the maximum symmetric time frames that enable the inclusion of all selected companies into the analysis.

As with the dispersion of analysts' forecast only one pair of hypotheses is needed to reflect the anticipation that the divergence in investors' opinion is different prior to the lock-up expiration, while it may stay like that after the expiration date. These hypotheses are:

H_0: Internet companies *do not have* higher relative trading volume than non-Internet companies prior to the lock-up expiration.

H_1: Internet companies *do have* higher relative trading volume than non-Internet companies prior to the lock-up expiration.

Nevertheless, to observe the development of the proxy after the expiration of the lock-up period it is also incorporated in the analysis.

The four proxies for short sale constraints and divergence in investors' opinion mentioned above are also used for the analysis of the announcement about Facebook's IPO. There however are no hypotheses to be tested around this event, since it does not coincide with the characteristics of the lock-up expiration (*i.e.* an increased supply in shares).

Aside those four proxies there are additional ones that have been used in previous studies but are not being used in this thesis. Short descriptions of these, coupled with the reasons for not using them are outlined below:

- **Rebate rate:** Under U.S. law investors who borrow stocks to sell them short have to place the proceeds as a deposit with the lender of the stock. The lender receives interest on this collateral of which a pre-negotiated part is rebated to the borrower, the so-called "rebate rate". The proxy was originally introduced by Jones and Lamont (2002) and is supposed to be the closest observable measure for short sale constraints. However, it is proprietary data that is only accessible through broker dealers (Boehme*, et al.*, 2006).
- **Traded options:** Since options can be used to artificially take a short position in a stock, shares with traded options are supposed to be less short sale constrained (Boehme*, et al.*, 2006). Yet, it has become more common for stocks to have traded options and, thus, this proxy is not considered as meaningful to distinguish between short sale constraint and non-constraint stocks as in previous studies.
- **Violation of put-call parity:** An extended version of the previous proxy is proposed by Lamont and Thaler (2003), who find that short sale constraints are more binding in stocks where the put-call parity restriction for options is violated. However, the process of filtering the options is complicated, as Ofek *et al.* (2004) show in their paper. The use of this proxy is for this reason considered beyond the scope of this thesis.
- **Idiosyncratic firm volatility:** While the three proxies provided above are used to observe short sale constraints, the idiosyncratic firm volatility is a proxy for the dispersion of investors' belief (Boehme*, et al.*, 2006). It can be measured as the sum of the squared error terms from the regression of individual stock returns on the return of a value weighted portfolio of all stocks. (Campbell*, et al.*, 2001). However, there is no agreement among authors which model to use for the regression. Due to this lack of clarity the proxy is not used in this thesis.

To assess whether the four variables – relative short interest, ownership breadth, divergence in analysts' forecast and relative trading volume – indicate short sale constraints and a dispersion of investors' belief for Internet stocks, a statistical test is needed. The next subchapter summarizes the main characteristics of the applied statistical test as well as the used significance levels.

3.3.2 Choice of test and significance levels

There are two broad categories of statistical tests available for testing hypotheses: parametric tests and non-parametric tests. Parametric tests have stricter underlying assumptions than non-parametric tests, most importantly a normally distributed population. Typically parametric tests are more powerful in case the underlying assumptions are met. However, if the collected data is not normally distributed, non-parametric tests become the preferred choice (Conover, 1999).

A particularity of this thesis is that the collected data for Internet and non-Internet firms includes all stocks with lock-up expirations from January 2010 to February 2012, *i.e.* the entire populations (with the exception of analysts' forecasts, where about 10% of the data points are missing)[14]. Yet, this carries the advantage of not needing to make inferences from the sample distributions on the distribution of the populations, a common issue in statistics. The populations can rather be assessed directly on their distribution. To explore whether the data is normally distributed the two most common tests, Kolmogorov-Smirnov and Shapiro-Wilk (Conover, 1999; Dodge, 2008), are conducted. The latter one is used for inferences in the current thesis, since it allows flexibility in terms of sample sizes, *i.e.* it can specifically be used for small samples ($n \leq 50$), but also for larger ones ($n > 50$) (Conover, 1999). The tests are conducted in the statistical program SPSS 20. More specific information and calculation steps about normality tests can be read in Conover (1999).

Appendix C includes the results of the aforementioned tests for all proxies brought out in subchapter 3.3.1. These tests show that none of the variables has normally distributed data points. For this reason non-parametric statistics are applied to test the hypotheses developed in the previous subchapter.

Specifically, the Mann-Whitney U-test (sometimes also called Wilcoxon rank-sum test) is the most commonly used non-parametric test to assess whether two independent samples, *i.e.* the Internet and non-Internet portfolios, are from identical populations or not (Conover, 1999). The underlying assumptions for the test are as follows (Dodge, 2008):

- Both data samples are randomly picked from their respective populations.
- Aside being independent from each other, there is mutual independence between the two samples.
- The measurement scale is at least ordinal.

[14] For practicality and to avoid confusion when introducing the test statistic, the two populations are still referred to as "samples" or "data samples" here.

Since the data samples are equal to the populations in the case of this study, the assumption of randomly picked samples becomes irrelevant. Moreover, the two samples are independent from each other, meaning they are not related in any way, and the requirement of mutual independence is met, meaning that each data point in either sample corresponds to a different firm. Finally, all variables are measured on an interval scale and, thus, applicable for the test.

Conover (1999) further points out that the results of the Mann-Whitney U-test may be biased when looking at the expected values of two random variables. To avoid this he adds a fourth assumption requiring the distribution of the two populations to be similarly shaped. However, this is again unproblematic for this study, since the data sample is not randomly picked but rather represents the whole population.

The Mann-Whitney U-test is a rank based test that involves assigning each observation from the two populations (denoted $X_1, X_2 \ldots X_n$ and $Y_1, Y_2 \ldots Y_m$) a rank from 1 to N. Depending on the size of the two samples and whether they contain tied data points, *i.e.* observations that have the same values and ranks, a test statistic can be calculated. In case of this study the two samples exceed the critical size of 22 observations and both do have numerous ties. Hence, the test statistic is calculated as follows (Conover, 1999):

$$T = \sum_{i=1}^{n} R(X_i) \tag{5}$$

$$T_1 = \frac{T - n\frac{N+1}{2}}{\sqrt{\frac{nm}{n(N-1)}\sum_{i=1}^{N} R_i^2 - \frac{nm(N+1)^2}{4(N-1)}}} \tag{6}$$

where $R(X_i)$ is the rank assigned to the observations from population X (and only population X), n and m refer to the sample size drawn from population X and Y respectively, N equals $n + m$ and $\sum R_i^2$ represents the sum of the squares of all N of the ranks or average ranks actually used in both samples.

With a given z-value the normal distribution can then be used to derive the p-value (*i.e.* statistical significance) for comparison with the significance level α.

$$p\text{-}value = P(z \geq T_1) \text{ or } P(z \leq T_1) \tag{7}$$

Whether the upper-tailed version ($P(z \geq T_1)$) or the lower-tailed version ($P(z \leq T_1)$) of the test is conducted depends on the formulation of the alternative hypothesis. The significance level α is chosen as the commonly applied 5% (Dodge, 2008). While $\alpha < 5\%$ is the determining factor for retaining or rejecting the null hypothesis, the empirical part also includes remarks on the 1% and the 10% significance level for the reader's information. All statistical tests are carried out in SPSS 20.

Moreover, to strengthen the results of the aforementioned hypotheses test, an event study on the expiration of the lock-up periods as well as the announcement about Facebook's IPO is being carried out, which is outlined in the subchapter below.

3.4 Event study

3.4.1 Method

Analysing short sale restrictions and divergence in investors' opinion around the lock-up expiration is rather a comparative analysis, but scrutinizing abnormal returns around the same event (*i.e.* lock-up expiration) requires implementing an event study method. Even though in the current case the event is known beforehand, which is uncommon for a typical event study, the method is still applicable. The goal is to see if negative abnormal returns occur around the lock-up expiration day and how big is the difference in abnormal returns between Internet and non-Internet firms, which if the gap is further exacerbated after the expiry, would indicate aggressive (short) selling due to overpriced companies. Moreover, as referred to in subchapter 3.1, based on some theoretical streams, the creation of a bubble can occur without companies being short sale constrained, *i.e.* not considering specifically lock-up expirations. For that reason, the announcement about Facebook's IPO, which has caused myriad discussions in the media, is focused on as an additional event to the lock-up expirations to determine possible overvaluation.

An event study is used to examine the response by the stock market to an event to conclude its effect on the company's value (Werner, 2010). Werner (2010) points out that there are two purposes of an event study: test whether the Efficient Market Hypothesis (EMH) is valid and assess the size of an event's impact that is caused by changes in regulations, corporate actions or shocks in the economy. If the EMH holds, a stock reflects the event's economic importance and conflicts on the contrary if after the event abnormal returns remain (Werner, 2010).

According to MacKinlay (1997) the procedure of an event study encompasses seven steps. The following description of the procedure is rather informative and a more detailed discussion can be found in MacKinlay (1997). To conduct an event study Strong (1992), MacKinlay (1997) and Werner (2010) suggest the following steps:

1) ***Define the event and the time span*** – an initial step is to identify the event and the time span covering this event, *i.e.* the event window. The time series factors of an event study are depicted on the Figure 3.2. The current thesis focuses on the expiration of lock-up period and the announcement about Facebook's IPO as the events and considers the following event windows: *[-5 … -1, [-5 … +5], [-1 … +1], [0], [+1 … +10]* around the

event day.[15] Lengths of the event windows are chosen due to these period's common implementation in prior similar studies (*e.g.* Field & Hanka (2001), Ofek & Richardson (2003), Schultz (2008), Ahern (2009))

2) ***Set criteria for the sample firms*** – after the event and time period have been identified, criteria for selecting firms to the sample should be determined and used in the study. Since the main objective of the current thesis is to determine whether there are signs for another Dot-Com bubble, two portfolios are formed. Internet companies are selected to the first and non-Internet firms to the other portfolio (respective selection criteria for being included to either of the portfolios is provided in subchapter 3.2.1).

3) ***Measure abnormal returns*** – the abnormal return of a stock is the difference between the actual return and the normal return of a stock (expected return if the event had not occurred). There are several options for determining normal return – *e.g.* the *constant mean return model*, the *market adjusted return model*, the *market model* and the *Fama-French 3 factor model* (for details see also Ahern (2009)). The first assumes that the stock mean return is constant over time. The second model takes the market index return as a proxy for normal return. The third model uses a regression on a constant and market return to derive the actual return. In the fourth model normal returns are calculated using the Fama-French 3 factor model. In the current thesis the *market model* as the most common one is used for the analysis. It is shown not to underperform Fama-French 3 factor model in forecasting expected returns nor in the statistical significance tests if non-parametric tests are used (Ahern, 2009).

4) ***Determine estimation window*** – after choosing a model for normal performance determination, the period preceding the event window needs to be set.[16] In the current thesis *116 and 106 days prior to the event window* is used as the pre-event estimation windows for lock-up expiration and the announcement about Facebook's IPO, respectively. 116- and 106-day time spans are chosen to have the possible longest pre-event periods for all firms.[17]

5) ***Test the framework for abnormal returns*** – the subsequent step is to calculate abnormal returns and further test the significance of the results. In the current thesis a higher focus is put on non-parametric test (*Wilcoxon signed rank test*). Implementing a non-parametric test is preferred, since it is proven to outperform t-test statistic in terms of less misspecification in case the event study data is chosen based on predetermined characteristics (Corrado & Zivney, 1992; Ahern, 2009). However, for robustness check Student's t-test is also performed and taken into consideration of inferences in case the data is normally distributed.

6) ***Present the results*** – after doing the necessary calculations, the results should be presented. The results of the analysis of this thesis are presented in chapter 4.

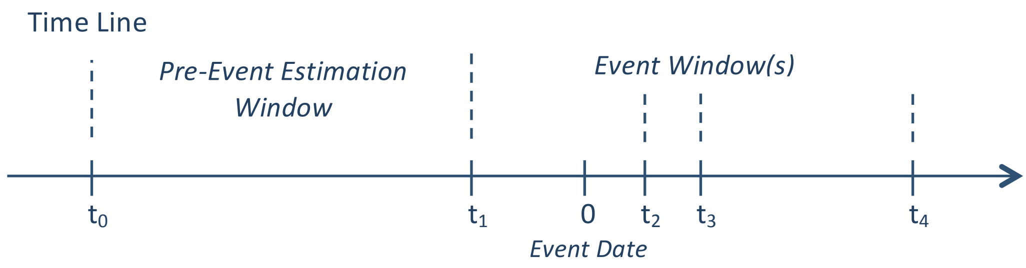
7) ***Conclude*** – the final step of an event study is to make conclusions based on interpretation of the outcome. To give an economic explanation for the results chapter 5 comprises concluding remarks and the authors' views coupled with suggestions.

[15] Additionally, separate days prior to the event are looked at to observe if any effects occur during these days. These days comprise [-5], [-4], [-3], [-2] and [-1].

[16] Typically a total of 250 days is chosen as estimation window as it corresponds to the total number of trading days in a calendar year (Corrado, 2011). This study, however, is limited to a maximum of 180 calendar days, which is the most common duration of lock-up periods, prior to which shares are not traded.

[17] 121 days (represents 116 day estimation window, considering event window starting of day -5) prior to the lock-up period expiration and 111 days (represents 106 day estimation window, considering event window starting of day -5) prior to the announcement about Facebook's IPO are chosen as the possible maximum periods to enable for including all firms. As mentioned before, in the current analysis the estimation window is limited to a maximum of 180 calendar days that respond on average close to 121 and 111 trading days (dependent on the event), prior which no stocks of the sample companies were traded.

***Figure 3.2** Time components of a typical event study*



Source: adapted by authors based on Werner (2010, p. 55)

In this subchapter the main steps for implementing an event study were brought forward. Putting the method into practice to gauge the event's effect on the stock prices requires calculating abnormal returns. The following subchapter concentrates on that.

3.4.2 Calculation of abnormal returns

As said above in the event study excess returns are observed. In the current thesis all the selected companies' stock price excess returns are calculated for five different event windows around the lock-up expiration day and the announcement about Facebook's IPO. The event windows are chosen based on time frames used in prior similar studies (*e.g.* Field & Hanka (2001), Ofek & Richardson (2003)) and comprise the following: [-5 … -1], [-5 … +5], [-1 … +1], [0], [+1 … +10]. The pre-event estimation window includes the period [-121 … -6] for lock-up expirations and [-111 … -6] for the announcement about Facebook's IPO. The market model is used to calculate the expected normal returns, which together with the actual returns are utilized to derive abnormal returns. For calculating normal returns, coefficients are estimated with an ordinary least-squares (OLS) regression of each company's stock returns on S&P 500 index returns[18]. To calculate abnormal returns, equations are used as shown below (Strong, 1992, p. 535; MacKinlay, 1997, pp. 15-18):

$$R_{i,t} = ln\left(\frac{share\ price\ at\ day\ t}{share\ price\ at\ day\ t-1}\right) \quad (8)$$

$$E\left(R_{i,t}\right) = \alpha_i + \beta_i R_{M,t} + \varepsilon_{i,t} \quad (9)$$

$$A_{i,t} = R_{i,t} - E\left(R_{i,t}\right) \quad (10)$$

where $R_{i,t}$ is the actual return of security *i* on the day *t* and $E(R_{i,t})$ is the expected return of security *i* on the day *t*. $R_{M,t}$ is the return on S&P500 index on day *t* (calculated similarly to security's daily

[18] The S&P 500 index is used as a representative for the market, since this is common practice and also implemented by MacKinlay (1997).

return), α and β are estimates for OLS coefficients from the pre-event estimation period, $\varepsilon_{i,t}$ is the zero mean disturbance term with $E(\varepsilon_{i,t} = 0)$ and $var\ (\varepsilon_{i,t}) = \sigma^2_{\varepsilon_i}$.

As MacKinlay (1997) suggests, cumulative abnormal returns (CARs) must be calculated to arrive to overall inferences for the event. The calculation steps for CAR are derived by using the equation below (MacKinlay, 1997, p. 21):

$$CAR_i(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_{i,\tau} \tag{11}$$

where τ_1 and τ_2 represent the beginning and the end of the period for which the CAR is calculated.

To perform the t-test, the variance of CAR needs to be calculated. Although in the current thesis the statistical program SPSS 20 is utilized for this matter, the commonly implemented equation according to MacKinlay (1997, p. 21) is as follows:

$$\sigma_i^2(\tau_1, \tau_2) = (\tau_1 - \ \tau_2 + 1)\sigma^2_{\varepsilon_i} \tag{12}$$

where σ_i^2 is the variance of CAR and $\sigma^2_{\varepsilon_i}$ is the standard error of regression.

The majority of the calculations of the input for the event study are done using Microsoft Excel and the following analysis is conducted using the statistical program SPSS 20.

This subchapter discussed abnormal returns and their calculation steps. Though, excess returns themselves might not be informative if the significance is rather low. Therefore, running statistical tests is required. This is in the focus of the next subchapter.

3.4.3 Choice of statistical significance tests

To gauge the results' statistical significance, specific tests need to be conducted. The implementation of a proper significance test – either parametric (Student's t-test) or non-parametric (*e.g.* rank or sign tests) – depends on the normality of the population's distribution. The most common way to decide upon a distribution's normality is to use the Shapiro-Wilk test (Gel*, et al.*, 2007), which will also be utilized for the event study due to the reasons mentioned in subchapter 3.3.2 (*e.g.* flexibility regards to sample sizes). Hence, if the assumption of normal distribution is fulfilled, inferences should be based on Student's t-test and on Wilcoxon signed rank test otherwise. However, as proven by Corrado and Zivney (1992) and Ahern (2009) non-parametric tests (*e.g.* rank and sign tests) tend to perform better than parametric tests (*e.g.* t-test), especially when the data for the event study is not randomly selected. Thus, more emphasis is put on non-parametric tests, but as said above, to check for robustness, Student's t-test results are also observed in case there is a normal distribution. This should add more credibility to the analysis. The chosen significance level α is 5%, as brought out in subchapter 3.3.2.

3.4.3.1 Wilcoxon signed rank test

In addition to outperforming parametric tests, another major advantage of the Wilcoxon signed rank test is not assuming the differences between observed pairs to be normally distributed (Conover, 1999; Ahern, 2009; Anderson*, et al.*, 2011), which is rather improbable if the data is not randomly selected, as is the case in the current thesis. The method first uses the calculation of differences between pairs of two observations and then omits all pairs that have a discrepancy of 0 (Conover, 1999; Anderson*, et al.*, 2011). Further, ranks in ascending order (lowest value ranked 1 and highest value ranked *N*) are assigned to the absolute values of those differences and eventually signs are given to these ranks (either positive or negative, dependent on the initial sign of the actual value of the respective difference) (Conover, 1999; Anderson*, et al.*, 2011). Finally, these ranks are used to calculate the test statistic from which the *p*-value is derived in order to conclude whether the dissimilarity between the medians of the two observations statistically significantly deviates from 0 (Conover, 1999; Anderson*, et al.*, 2011).

Additionally, the Wilcoxon signed rank test can also be used for a non-parametric test about hypothesised medians with the same steps as brought out above (Conover, 1999; Anderson*, et al.*, 2011). This is also utilized in the current thesis. In this study median CARs are compared to the set median value of 0. The Wilcoxon signed ranked test itself is conducted in SPSS 20 by comparing whether the difference between 0 and the respective median CAR is statistically different from 0.

In the context of the current thesis subsequently posed hypotheses for the Wilcoxon signed rank test are as follows:

H_0: Difference between median $CAR\ (\tau_1, \tau_2)$ and 0 *equals* 0.

H_1: Difference between median $CAR\ (\tau_1, \tau_2)$ and 0 *does not equal* 0.

To determine, whether the null hypothesis can be retained or must be rejected, a test statistic is calculated and the *p*-value derived in turn. Although, the calculations are done by SPSS 20, the common way for calculating Wilcoxon signed rank test statistic for samples larger than 50 is shown in the equation below (Conover, 1999, p. 353):

$$T = \frac{\sum_{i=1}^{n} r_i}{\sqrt{\sum_{i=1}^{n} r_i^2}} \tag{13}$$

where r_i is the respective signed rank assigned based on the difference between $CAR\ (\tau_1,\tau_2)$ and *0*.

To derive the two tailed *p-value*, it should be noted that it is twice the smaller than the one-tailed *p*-values, approximated from *e.g.* upper-tailed *p*-value as follows (Conover, 1999, p. 354):

$$P\left(z \geq \frac{\sum_{i=1}^{n} r_i - 1}{\sqrt{\sum_{i=1}^{n} r_i^2}}\right) \tag{14}$$

However, if the data is normally distributed, Student's t-test results are additionally taken into account whilst making inferences. The mentioned test is discussed below.

3.4.3.2 Student's t-test

In case the assumption of a normal distribution, which Student's t-test presumes (Gel*, et al.*, 2007), is violated, the conclusions should rather be drawn based on non-parametric test, like the Wilcoxon signed rank test discussed above. However, when the assumption holds, the t-test can be used in conjunction for making inferences. The way of calculating the t-statistic is shown below (MacKinlay, 1997, p. 24):

$$t = \frac{CAR_i(\tau_1, \tau_2)}{\sqrt{\sigma_i^2(\tau_1, \tau_2)}} \tag{15}$$

In the context of this thesis subsequently posed hypotheses for Student's t-test are:

H_0: Difference between mean *CAR* (τ_1, τ_2) and 0 *equals* 0.

H_1: Difference between mean *CAR* (τ_1, τ_2) and 0 *does not equal* 0.

After testing for distribution's normality and the significance of CARs for both portfolios, a subsequent comparison is carried out between Internet and non-Internet firms using the Mann-Whitney U-test, similarly to the market-based approach brought out in subchapter 3.3.2. It is done to see if and which CARs are statistically significantly different between Internet and non-Internet firms. In case there is overvaluation amongst Internet firms, it is expected to observe higher negative abnormal returns for Internet than for non-Internet companies around the lock-up period. In terms of the announcement about Facebook's IPO it is expected to similarly detect higher negative abnormal returns for Internet companies, reflecting a higher selling activity by rational investors.

The current subchapter discussed tests that need to be conducted in order to determine the excess returns' statistical significance. More specific discussion about the Wilcoxon signed rank test statistic was provided, since as a non-parametric test, it is proven to outperform parametric tests and is also utilized in the current thesis. Additionally, Student's t-test was briefly discussed.

However, the reliability and validity of the methods should also be considered. The following discussion touches upon those aspects.

3.5 Reliability and validity of the methodology

Reliability and validity of a research method refer to the consistency of the measures that are used as well as the question whether the variables really capture what they are expected to gauge (Bryman, 2008). For a measure to be reliable it has to be stable over time, internally reliable and have inter-observer consistency (Bryman, 2008).[19]

In context of this thesis a requirement for stability of the measures outlined in the previous subchapters, such as the proxy relative short interest, is considered to be fulfilled, since they have been used in several previous studies and have yielded supporting evidence for the research approach used in the thesis. Moreover, the matter of internal reliability is of little concern to this study, since there are no multiple-item measures (*e.g.* qualitative survey questions) (Bryman, 2008). Taking into account the chosen variables, inter-observer consistency is, again, not a severe concern in this thesis, because the data is collected from acknowledged databases (*e.g.* Datastream) and is processed using MS Excel and SPSS 20 (using formulas for computations and crosschecking manual entries). When it comes to the selection of the Internet and non-Internet portfolio, inter-observer consistency does certainly play a role. However, to achieve this reliability a clear selection process is used, as outlined in subchapter 3.2.1. Finally, the validity of the measures of this study fulfils the requirement of face validity[20] (Bryman, 2008). As highlighted in the previous two subchapters, several studies (with the same characteristics as this thesis) have already used the aforementioned variables to conduct research. Overall, the current thesis is, thus, considered to be reliable and valid.

[19] Stability over time refers to a measure gauging the same concept throughout time (Bryman, 2008). Internal reliability means that multi-item measures are coherent in capturing the same concept (Bryman, 2008). Inter-observer consistency refers to consistency in cases where subjective categorization or selection criteria are involved (Bryman, 2008).
[20] Face validity implies that experts in the respective field consider the measure to reflect the underlying concept (Bryman, 2008).

4 RESULTS AND ANALYSIS

This chapter comprises the data analysis' results of the current thesis. More specifically, the statistics are discussed first, followed by Internet and non-Internet portfolios' comparison results with regards to the pre and post lock-up periods' expiration ratios as well as ratios of pre and post announcement about Facebook's IPO. The risk of an accumulation of lock-up periods' expirations is observed and the subsequent event study results in terms of abnormal returns around the expiration of lock-up periods and the announcement about Facebook's IPO are reported. Finally, the analysis of M&A intensity patterns is provided as a control method.

4.1 Descriptive statistics

The abbreviations used in the statistical calculations are described in Appendix B. Descriptive statistics for the data used are shown in Table 4.1 below.

Looking at the EV/EBITDA multiple one can see that the mean and median for Internet firms are remarkably higher than for non-Internet firms. This may explain why the question of another Dot-Com bubble has recently been raised so often in the media (The Economist, 2010; The Economist, 2011). However, as pointed out in the literature review (see subchapter 2.2.3), multiples are only useful when compared to firms with similar characteristics. Since Internet companies differ on many aspects from non-Internet firms, most importantly the uncertainty, a higher multiple is not a sign for overvaluation *per se*. The valuations may actually be justified, given the firms' fundamentals. Furthermore, multiples suffer from a drawback of plausible inapplicability on Internet companies and on firms at an early stage. Specifically, for 61 companies in both portfolios no multiple is reported around the lock-up period. As a manual crosscheck reveals this is in many cases due to the fact that the firms still report a negative EBITDA at this early stage. The problem becomes even more severe when using P/E-multiples. Looking at the relative trading volume one can also see that it is higher for Internet firms than for non-Internet firms. This indicates a higher divergence in investors' opinion about Internet firms than non-Internet companies. Moreover, the average daily return figures surprisingly reveal that non-Internet firms have higher maximum negative return values than Internet firms. This effect may be caused by non-domestic firms and will be elaborated on in more detail in the upcoming two subchapters.

***Table 4.1** Descriptive statistics*

Panel A: Key factors of firms in the sample						
Characteristic	Internet / non-Internet	Mean	Median	Max	Min	STD
EV/EBITDA pre lock-up expiration	Internet	62.8	32.2	323.9	1.0	77.2
	non-Internet	38.8	12.6	1,545.6	0.3	176.6
EV/EBITDA post lock-up expiration	Internet	55.6	31.7	323.9	1.0	66.1
	non-Internet	36.3	13.8	1,545.6	0.3	158.8
Trading volume pre lock-up expiration (*in '000 shares*)	Internet	403.7	83.4	10,440.3	0.3	897.7
	non-Internet	351.2	76.0	29,894.8	0.0	1,459.3
Trading volume post lock-up expiration (*in '000 shares*)	Internet	633.9	137.5	22,009.4	0.5	1,405.4
	non-Internet	406.3	97.6	50,062.2	0.0	1,506.6
Average daily return pre lock-up expiration	Internet	-0.2%	-0.3%	35.8%	-24.9%	4.5%
	non-Internet	-0.1%	0.0%	51.8%	-226.2%	4.6%
Average daily return post lock-up expiration	Internet	-0.1%	-0.1%	94.2%	-32.3%	4.7%
	non-Internet	-0.1%	0.0%	30.6%	-105.7%	3.7%
Lock-up expiration	Internet	-	10.06.11	13.02.12	24.03.10	-
	non-Internet	-	17.05.11	7.02.12	31.03.10	-

Panel B:Origin of firms in the sample				
Characteristic		Internet / non-Internet	Absolute figure	% of total sample
Number of firms		Internet	46	19.6%
		non-Internet	189	80.4%
Countries of origin	*USA*	Internet	28	11.9%
		non-Internet	137	58.3%
	China	Internet	17	7.2%
		non-Internet	30	12.8%
	Netherlands	Internet	1	0.4%
		non-Internet	4	1.7%
	Other	Internet	0	0.0%
		non-Internet	18	7.7%

The companies for the study are selected according to their lock-up periods expiring during the time frame January 2010 until February 2012. Domestic firms are firms headquartered in the U.S. and listed in the U.S., whereas non-domestic firms have their headquarters outside the U.S., but are listed on U.S. stock markets. The EV/EBITDA multiple is a trailing multiple that is collected from Datastream. Since the multiple changes quarterly it is presented as the average over the time periods [-44 ... -6] and [+6 ... +44]. These time periods are chosen for consistency with the time periods for which the relative trading volume is measured later in this study. The same time frame is used for average trading volume (shown in absolute figures here), the average share price and the average daily return. To get an overview where the non-domestic companies are headquartered, the main countries of origin are presented (a more detailed overview can be found in Appendix A).

Source: created by authors

In order to make general inferences, the next two subchapters present the findings of the Mann-Whitney U-test, applying it to all proxies for short sale constraints and divergence in investors' opinion, as well as the event study outcomes. Additionally, the results are discussed in connection with existing literature.

4.2 Pre- and post-event comparison

4.2.1 Comparison of pre and post lock-up period expiration measures

Table 4.2 below shows the short sale constraint measures for Internet and non-Internet companies. It is apparent that the relative short interest for Internet firms is higher than for non-Internet firms. This holds throughout the observation period, which includes one reporting date before the expiration of the lock-period (RSI_PRE) and three reporting dates after the expiration

(RSI_POST). Looking at the first two reporting dates a pattern similar to Ofek and Richardson (2003) can be found. The relative short interest increases after the lock-up expiration, since the short sale constraints are relieved. This effect takes place for both portfolios but is stronger for the portfolio of Internet firms. Although Ofek and Richardson (2003) point out that it takes some time until previously locked-up shareholders liquidate their positions (with the number of shares sold peaking in the second month after the lock-up expiration), they do not look at this proxy for a longer time period. For this reason the other two relative short interest figures after the lock-up expiration cannot be compared to their study. However, as expected there is a diminishing effect. The difference between the two portfolios mean relative short interest gets smaller over time. Yet, the median for RSI_POST3 increases again, which indicates that outliers influence the mean value. Looking at the *p*-values of the statistical test the differences between both portfolios on the first three reporting dates are statistically significant at the 5% level. The difference on the fourth reporting date is only significant at the 10% level, which support the concept of a diminishing effect. These results lead to a rejection of both null hypotheses for the proxy relative short interest.[21]

Turning to the second proxy for short sale constraints, the ownership breadth, the findings of the first proxy are not confirmed. Indeed, the reported mean institutional ownership for Internet firms is higher than for non-Internet firms over the whole observation period. The picture becomes a bit clearer, though, when looking at the median values. There the institutional ownership for Internet firms is smaller than for non-Internet firms before the lock-up expiration and increases afterwards. This again indicates that outliers influence the mean value. However, the differences in the median values are very small and none of them are statistically significant, which leads to retaining both null hypotheses for this proxy. The findings are contrary to Ofek and Richardson (2003), who in the light of the last Dot-Com bubble report a significantly smaller institutional ownership for Internet firms than for non-Internet companies. An explanation for the observations in Table 4.2 is that the reported figures do actually not capture all institutional holdings below 5% (see subchapter 3.3.1). Yet, this does not mean that only a potentially higher institutional ownership in non-Internet firms cannot be observed. It may as well be the case that a high institutional ownership among Internet firms is not captured.[22]

Thus, the overall findings on short sale constraints are mixed. The proxy relative short interest points to a higher short sale constraint for Internet companies (similar to the findings of Ofek and Richardson (2003) as well as Hong *et al.* (2006)), while this finding is not supported by the proxy institutional ownership.

---

[21] For the null hypotheses for each proxy see subchapter 3.3.1. A rejection of the null hypothesis implies that the two portfolios of Internet and non-Internet firms are statistically significantly different from each other.

[22] The historical ownership data in Ofek and Richardson (2003) is collected from a different database (Morningstar) and does not exclude holdings below 5%. For that reason their findings are deemed to be more accurate.

***Table 4.2** Measures of short sale constraints of Internet and non-Internet firms*

Proxy	Non-Internet / Internet	Median	Mean	Z	Asymp. Sig. (2-tailed)
RSI_PRE	non-Internet	0.017	0.030		
	Internet	0.025	0.041		
	Difference	**-0.008**	**-0.011**	**-2.259**	**0.024**[b]
RSI_POST1	non-Internet	0.017	0.030		
	Internet	0.028	0.046		
	Difference	**-0.012**	**-0.015**	**-2.348**	**0.019**[b]
RSI_POST2	non-Internet	0.018	0.032		
	Internet	0.028	0.044		
	Difference	**-0.009**	**-0.013**	**-2.312**	**0.021**[b]
RSI_POST3	non-Internet	0.019	0.033		
	Internet	0.030	0.045		
	Difference	**-0.011**	**-0.012**	**-1.920**	**0.055**[c]
INST_OWNER_PRE	non-Internet	0.090	0.172		
	Internet	0.075	0.177		
	Difference	**0.015**	**-0.005**	**-0.110**	**0.912**
INST_OWNER_POST1	non-Internet	0.090	0.174		
	Internet	0.115	0.190		
	Difference	**-0.025**	**-0.016**	**-0.130**	**0.897**
INST_OWNER_POST2	non-Internet	0.090	0.174		
	Internet	0.100	0.186		
	Difference	**-0.010**	**-0.012**	**-0.181**	**0.856**
INST_OWNER_POST3	non-Internet	0.110	0.178		
	Internet	0.100	0.186		
	Difference	**0.010**	**-0.008**	**-0.046**	**0.963**

[b] *significant at 5% level*
[c] *significant at 10% level*

The table shows the proxies for short sale constraints, measured for domestic as well as non-domestic Internet and non-Internet companies, for one date prior to the lock-up expiration and 3 dates after the lock-up expiration. The observation dates coincide with the short interest reporting dates, i.e. the mid and the end of the respective months. For institutional ownership (INST_OWNER) 1.000 represents 100%.

The comparison of the two portfolios of Internet and non-Internet firms is conducted using SPSS 20 and the non-parametric Mann-Whitney U-test. A detailed list of abbreviations is available in Appendix B.

Source: created by authors using SPSS 20

Table 4.3 below comprises the investors' opinion's divergence measures. The first proxy to be considered for divergence in investors' opinion is the relative trading volume. Table 4.3 reports a higher relative trading volume for Internet companies than for non-Internet firms for the time frame [-44 … -6] prior to the lock-up expiration (VOL_PRE). This observation is made for the mean as well as for the median value and is in line with the expectations. Yet, the difference is not statistically significant, which means the null hypothesis for this proxy is retained, leading to the inference that there is no significantly higher divergence in investors' opinion about the stock price for Internet firms than for non-Internet firms.

For the post lock-up time period [+6 … +44] Internet firms again have a higher relative trading volume than non-internet firms. However, it is still not significantly different. Nevertheless, two interesting observations can be made. First, the relative trading volume for both portfolios increased compared to the observations prior to the lock-up expiration. This is in line with the findings of Field and Hanka (2001), who report a 40 % increase in trading volume after the lock-up period. Second, the differences in the mean and median values for VOL_POST1 again indicate that there are outliers influencing the measures.

Even more interesting are the results for the proxy dispersion of analysts' forecast. While the median values report a higher divergence for Internet than for non-Internet firms, the mean values show the exact opposite. In such a case it makes more sense to refer to the median values for the analysis, since outliers obviously impact the observations. The difference between the median values is, however, not statistically significant prior to the lock-up expiration and for this reason the null hypothesis is retained.

Yet, the difference becomes statistically significant at the 10% level for the observation ANAL_FC_POST1, which would infer that analysts have a more dispersed opinion on the fair value of Internet stocks after the lock-up expiration. To see whether this finding is attributable to the number of analysts following the companies in both portfolios, Table 4.3 also includes statistics on that matter. One could expect that the increase in divergence after the lock-up expiration may be caused by an increasing number of analysts following Internet firms. Looking at the mean and median values for the number of analysts following both portfolios prior and directly after the lock-up expiration, one can, however, not observe a remarkable change that would cause the increased dispersion of their forecasts. Neither does the number of analysts provide a plausible explanation why the mean values show the exact opposite of the median values for the divergence in analysts' forecast for all four points in time. As already mentioned it appears that it is once more outliers influencing the measures.

Considering the findings on all four proxies together, there is some support for higher short sale constraints among Internet firms compared to non-Internet firms, but no support for a higher divergence in investors' opinion about the fair value of the firms. However, as noted for each proxy, the findings seem to be influenced by outliers in the observations, which may be caused by the non-domestic firms included in both portfolios. As mentioned in subchapter 3.2.1 some previous studies (*e.g.* Geczy *et al.* (2002)) excluded non-domestic firms listed on the U.S. stock markets due to their illiquidity. The marker for non-domestic firms included in both portfolios for this study allows for a robustness check of the findings above.

***Table 4.3** Measures of divergence in investors' opinion for Internet and non-Internet firms*

Proxy	Non-Internet / Internet	Median	Mean	Z	Asymp. Sig. (2-tailed)
VOL_PRE	non-Internet	0.003	0.005		
	Internet	0.003	0.007		
	Difference	**0.000**	**-0.002**	**-0.222**	**0.824**
VOL_POST1	non-Internet	0.004	0.006		
	Internet	0.005	0.013		
	Difference	**-0.001**	**-0.006**	**-1.599**	**0.110**
ANAL_FC_PRE	non-Internet	7.634	29.212		
	Internet	9.091	25.433		
	Difference	**-1.457**	**3.780**	**-0.828**	**0.408**
ANAL_FC_POST1	non-Internet	7.081	28.518		
	Internet	10.526	22.011		
	Difference	**-3.446**	**6.507**	**-1.669**	**0.095**[c]
ANAL_FC_POST2	non-Internet	6.931	30.136		
	Internet	9.902	16.262		
	Difference	**-2.971**	**13.874**	**-1.125**	**0.261**
ANAL_FC_POST3	non-Internet	6.984	27.621		
	Internet	9.878	19.969		
	Difference	**-2.894**	**7.651**	**-1.402**	**0.161**
NR_ANAL_PRE	non-Internet	4.000	4.810		
	Internet	5.000	5.260		
	Difference	**-1.000**	**-0.450**	**-1.543**	**0.123**
NR_ANAL_POST1	non-Internet	4.000	4.800		
	Internet	5.000	5.280		
	Difference	**-1.000**	**-0.480**	**-1.396**	**0.163**
NR_ANAL_POST2	non-Internet	4.000	4.760		
	Internet	5.000	5.350		
	Difference	**-1.000**	**-0.590**	**-1.549**	**0.121**
NR_ANAL_POST3	non-Internet	4.000	4.890		
	Internet	5.000	5.590		
	Difference	**-1.000**	**-0.700**	**-1.786**	**0.074**[c]

[c] significant at 10% level

The table shows the proxies for the divergence in investors' opinion on the fair stock price, measured for domestic as well as non-domestic Internet and non-Internet companies. The relative trading volume (VOL) is calculated over the time periods [-44 … -6] and [+6 … +44], relative to the lock-up expiration date. The 11 days around the lock-up expiration are excluded to avoid biases by abnormal trading volumes that are reported in previous studies.

The dispersion of analysts' forecast (ANAL_FC) on the other hand is observed for the same dates as relative short interest and institutional ownership, i.e. one short interest reporting date before the lock-up expiration and three reporting dates after the expiration. Companies followed by only one or no analyst are excluded from the observations, which leads to a smaller number of observations for both portfolios, i.e. Internet and non-Internet firms. For a better understanding of changes in the dispersion of analysts' forecast the number of analysts (NR_ANAL) is also included in the table.

The comparison of the two portfolios is conducted using SPSS 20 and the non-parametric Mann-Whitney U-test. A full list of the used abbreviations is also available in Appendix B.

Source: created by authors using SPSS 20

Table 4.4 and Table 4.5 below summarize the findings for short sale constraints and divergence in investors' opinion around the lock-up period for domestic (U.S.) firms only. A test for the normal distribution of the two samples (see Appendix D) reveals that the data is still not normally distributed. The hypotheses remain the same as before.

Turning to the measures for short sale constraints in Table 4.4, one can see that the mean and median values of RSI_PRE are higher when compared to the figures including non-domestic firms in Table 4.2. Interestingly, the difference between Internet and non-Internet firms is not statistically significant anymore. After the lock-up expiration the relative short interest increases for Internet as well as for non-Internet firms, but relatively more for the former so that the difference becomes statistically significant. However, the difference is significant only at the 10%, whereas it is at the 5% level for RSI_POST1 and RSI_POST2 in Table 4.2. Overall the findings require both null-hypotheses for this proxy to be retained at the 5% significance level.

Clearly the exclusion of non-domestic firms changed the results, which are not in line with Ofek's and Richardson's (2003) findings for the last Dot-Com bubble anymore.[23] It appears that non-domestic firms in the non-Internet sample supress the mean and median values for all four observations. Yet, it is questionable that this is only due to illiquidity reasons, since the mean and median values for the Internet portfolio remain almost unchanged with the exclusion of non-domestic firms. This implies that investors are more interested in shorting non-domestic Internet firms than non-domestic non-Internet firms listed on the U.S. stock exchanges. Although these indirect findings do not allow for a general inference, they point to non-domestic Internet firms being short sale constrained, which would be at least one of two requirements for overvaluation. Different regulatory aspects of non-domestic firms may cause this effect.

In terms of the ownership breadth, Table 4.4 shows an increase in mean and median values for all four observations when compared to Table 4.2. This points to the fact that there are less institutional owners that hold stakes above 5% in non-domestic firms than in domestic firms. Interestingly, Internet firms still report higher institutional ownership than non-Internet firms for all four observations (different from Table 4.3 even for the median values). Yet, the proxy remains of limited explanatory power and since the differences are not statistically significant, both null hypotheses for this proxy are retained.

Based on the above findings for domestic firms only, the inference can be made that Internet companies are not short sale constrained. As pointed out by Boehme *et al.* (2006), overvaluation can only appear when both prerequisites for Miller's (1977) model, *i.e.* short sale constraints *and* divergence in investors' opinion, are met. This, already, leads to the conclusion that based on the aforementioned model, Internet firms are not overvalued. Nevertheless, it makes sense to take a look at the second dimension, divergence in investors' opinion, especially to assess the changes in the analysts' forecasts proxy after excluding non-domestic firms.

[23] Ofek and Richardson (2003) do not explicitly state whether their list of Internet firms includes only the U.S. domestic firms or also non-domestic companies listed on the U.S. stock markets. Although a list of stock tickers of their study is available at http://people.stern.nyu.edu/eofek, many of the companies are not listed anymore, which makes it difficult to spot out potential non-domestic firms.

***Table 4.4** Measures of short sale constraints of Internet and non-Internet firms (U.S. firms only)*

Proxy	Non-Internet / Internet	Median	Mean	Z	Asymp. Sig. (2-tailed)
RSI_PRE	non-Internet	0.023	0.034		
	Internet	0.032	0.039		
	Difference	**-0.008**	**-0.005**	**-1.593**	**0.111**
RSI_POST1	non-Internet	0.024	0.035		
	Internet	0.033	0.045		
	Difference	**-0.009**	**-0.010**	**-1.893**	**0.058[c]**
RSI_POST2	non-Internet	0.026	0.036		
	Internet	0.037	0.045		
	Difference	**-0.011**	**-0.009**	**-1.758**	**0.079[c]**
RSI_POST3	non-Internet	0.026	0.037		
	Internet	0.037	0.047		
	Difference	**-0.011**	**-0.009**	**-1.802**	**0.072[c]**
INST_OWNER_PRE	non-Internet	0.150	0.210		
	Internet	0.275	0.271		
	Difference	**-0.125**	**-0.061**	**-1.291**	**0.197**
INST_OWNER_POST1	non-Internet	0.150	0.213		
	Internet	0.350	0.291		
	Difference	**-0.200**	**-0.078**	**-1.632**	**0.103**
INST_OWNER_POST2	non-Internet	0.150	0.213		
	Internet	0.350	0.285		
	Difference	**-0.200**	**-0.072**	**-1.576**	**0.115**
INST_OWNER_POST3	non-Internet	0.150	0.215		
	Internet	0.365	0.284		
	Difference	**-0.215**	**-0.069**	**-1.570**	**0.116**

[c] significant at 10% level

The table shows the proxies for short sale constraints, measured only for domestic Internet and non-Internet companies, for one date prior to the lock-up expiration and 3 dates after the lock-up expiration. The observation dates coincide with the short interest reporting dates, i.e. the mid and the end of the respective months. For institutional ownership (INST_OWNER) 1.000 represents 100%.

The comparison of the two portfolios of Internet and non-Internet firms is conducted using SPSS 20 and the non-parametric Mann-Whitney U-test. A detailed list of abbreviations is available in Appendix B.

Source: created by authors using SPSS 20

Table 4.5 below reports the proxies for divergence in investors' opinion for domestic firms only. Interestingly the relative trading volume for the Internet portfolio is now considerably lower prior and after the lock-up expiration. Prior to the lock-up expiration the mean and median become even lower for Internet firms than for non-Internet companies, which points to a less diverged opinion of investors for Internet than for non-Internet firms. However, the difference is not statistically significant and after the lock-up expiration the values are almost equal. Since there is no statistically significant difference between the two portfolios the null hypothesis for this proxy is retained.

Yet, a comparison of Table 4.3 and Table 4.5 reveals that non-domestic Internet firms must have a high relative trading volume to explain the shifts in the mean and median values. On the one hand this questions the argument of illiquidity that has been mentioned by authors like Geczy *et al.* (2002). On the other hand, it points to a strong divergence in investors' opinion about non-domestic Internet firms of which the majority comprises Chinese companies.

When looking at the findings for dispersion of analysts' forecast it seems that non-domestic firms were not the main reason for the outliers in the observations. The mean and media values still differ remarkably from each other. However, compared to the full sample including non-domestic firms, the statistically significant difference of the first observation after the lock-up expiration (ANAL_FC_POST1) disappears. Since there is no statistically significant difference prior to the lock-up expiration (ANAL_FC_PRE) the null hypothesis for this proxy is retained as well.

Comparing the mean and median values for the dispersion of analysts' forecast in Table 4.3 and Table 4.5 it appears that non-domestic firms lead to an upward bias in the figures. This upward bias is more prominent for Internet than for non-Internet companies, which implies that analysts have more dispersed opinion about non-domestic Internet firms than non-domestic non-Internet firms. This underpins the aforementioned findings on relative trading volume and the notion that investors have more dispersed beliefs about the fair value of non-domestic Internet firms.

Overall there is no evidence for domestic Internet firms to be more short sale constrained and have a higher divergence in investors' opinion on their fair value than domestic non-Internet firms. However, there is indirect evidence that investors are more interested in shorting non-domestic Internet firms than non-domestic non-Internet firms. Moreover, non-domestic Internet firms seem to have a higher dispersion of investors' belief. Taken together, latter observations point to a potential overvaluation of non-domestic Internet firms on the U.S. stock markets. Yet, to make general inferences additional research is required that incorporates the regulatory aspects of non-domestic listings, which is considered beyond the purpose of this thesis.

***Table 4.5** Measures of divergence in investors' opinion for Internet and non-Internet firms (U.S. firms only)*

Proxy	Non-Internet / Internet	Median	Mean	Z	Asymp. Sig. (2-tailed)
VOL_PRE	non-Internet	0.003	0.005		
	Internet	0.002	0.003		
	Difference	**0.001**	**0.002**	**-1.576**	**0.115**
VOL_POST1	non-Internet	0.004	0.007		
	Internet	0.004	0.006		
	Difference	**0.000**	**0.000**	**-0.291**	**0.771**
ANAL_FC_PRE	non-Internet	6.000	31.041		
	Internet	7.143	22.429		
	Difference	**-1.143**	**8.612**	**-0.489**	**0.625**
ANAL_FC_POST1	non-Internet	5.747	31.175		
	Internet	7.572	16.515		
	Difference	**-1.825**	**14.660**	**-0.628**	**0.530**
ANAL_FC_POST2	non-Internet	5.738	32.517		
	Internet	7.192	12.409		
	Difference	**-1.454**	**20.108**	**-0.332**	**0.740**
ANAL_FC_POST3	non-Internet	5.517	29.810		
	Internet	4.421	11.744		
	Difference	**1.096**	**18.066**	**-0.130**	**0.896**

Table 4.5 continued …

Proxy	Non-Internet / Internet	Median	Mean	Z	Asymp. Sig. (2-tailed)
NR_ANAL_PRE	non-Internet	5.000	5.204		
	Internet	5.500	5.571		
	Difference	**-0.500**	**-0.367**	**-1.259**	**0.208**
NR_ANAL_POST1	non-Internet	5.000	5.190		
	Internet	5.000	5.679		
	Difference	**0.000**	**-0.489**	**-1.259**	**0.208**
NR_ANAL_POST2	non-Internet	5.000	5.175		
	Internet	5.000	5.714		
	Difference	**0.000**	**-0.539**	**-1.264**	**0.206**
NR_ANAL_POST3	non-Internet	5.000	5.358		
	Internet	5.000	5.750		
	Difference	**0.000**	**-0.392**	**-0.982**	**0.326**

The table shows the proxies for the divergence in investors' opinion on the fair stock price, measured for domestic as well as non-domestic Internet and non-Internet companies. The relative trading volume (VOL) is calculated over the time periods [-44 … -6] and [+6 … +44], relative to the lock-up expiration date. The 11 days around the lock-up expiration are excluded to avoid biases by abnormal trading volumes that are reported in previous studies.

The dispersion of analysts' forecast (ANAL_FC) on the other hand is observed for the same dates as relative short interest and institutional ownership, i.e. one short interest reporting date before the lock-up expiration and three reporting dates after the expiration. For a better understanding of changes in the dispersion of analysts' forecast the number of analysts (NR_ANAL) is also included in the table.

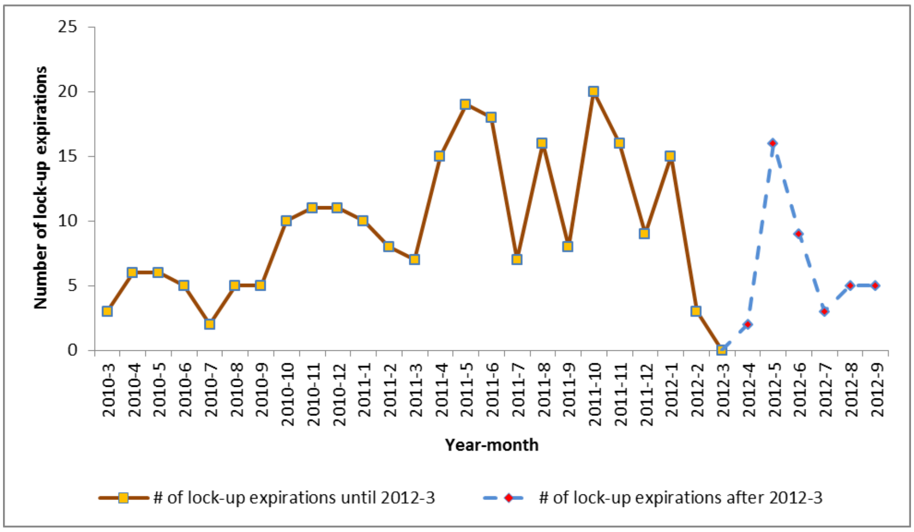
The comparison of the two portfolios is conducted using SPSS 20 and the non-parametric Mann-Whitney U-test. A full list of the used abbreviations is also available in Appendix B.

Source: created by authors using SPSS 20

In general, no matter whether non-domestic firms are included in the tests or not, the findings lead to the preliminary conclusion that lock-up periods currently do not cause severe short sale constraints (contrary to what is reported by Ofek and Richardson (2003)) and as such do not pose a threat for the emergence of a stock price bubble. Still, it makes sense to look at the pattern of lock-up expirations to see whether they start to accumulate (as also used by Ofek and Richardson (2003) in the light of the last Dot-Com bubble) and, thus, would pose a threat in case short sale constraints and divergence in investors' opinion prevail.

Figure 4.1 below depicts a graphical overview of the Internet firms' lock-up endings. As is evident, the lock-up expirations fluctuate quite remarkably over the past two years, but no serious outliers can be detected, not even in the upcoming months of 2012. This in turn infers that the expirations lock-up periods are "evenly distributed" and there are currently no signs for them to accumulate and create issues in the markets. Therefore, the lock-up periods' expirations do not pose additional problems. Even if there was an overvaluation amongst Internet companies, ending of the lock-up periods could mitigate the effect of a potential bubble based on "distribution" of the upcoming expirations of lock-up periods.

Figure 4.1 *Number of Internet companies' lock-up expirations*



Source: created by authors

However, as mentioned under the literature review, there are also other theoretical streams that may explain the creation of a bubble without companies being short sale constrained. Specifically Griffin *et al.* (2011) and Brunnermeier (2004) find some empirical evidence for rational investors riding a bubble until a certain point when they start attacking the mispricing (see subchapter 2.5).

The announcement about Facebook's IPO did have an impact on the industry and the investment community (Gapper, 2012). It thus makes sense to look at this event and explore whether it is such a warning signal that leads to rational investors gathering together to arbitrage a potential overvaluation of Internet firms away. The findings and a short discussion of the results are reported in the next subchapter.

4.2.2 Comparison of measures of pre and post the announcement about Facebook's IPO

Although there are no specific hypotheses to be tested around this event, an assessment may give some indication as to whether Internet companies are overpriced based on unobservable investor behaviour. Table 4.6 and Table 4.7 below contain all proxies used for the previous empirical findings, with the only difference that "_PRE" means in this case before the announcement about Facebook's IPO and "_POST" stands for the observations after the announcement. The two portfolios of Internet and non-Internet firms contain the same domestic as well as non-domestic firms as before. Again, the data is not normally distributed (see Appendix E).

As depicted in Table 4.6, the relative short interest of Internet firms prior to the announcement about Facebook's IPO as well as after the announcement is significantly higher than for non-Internet companies. It indicates that investors were more active in shorting Internet firms than non-Internet firms at the beginning of 2012. There is an increase in relative short interest for

Internet companies after the announcement, which is more prominent for the mean than for the median values. Still, the significance level changes from 10% before to 5% after the announcement. In terms of institutional ownership, no significant differences are observable.

***Table 4.6** Measures of short sale constraints of Internet and non-Internet firms (the announcement about Facebook's IPO)*

Proxy	Non-Internet / Internet	Median	Mean	Z	Asymp. Sig. (2-tailed)
RSI_PRE	non-Internet	0.023	0.040		
	Internet	0.031	0.047		
	Difference	**-0.009**	**-0.007**	**-1.930**	**0.054**[c]
RSI_POST1	non-Internet	0.021	0.040		
	Internet	0.031	0.048		
	Difference	**-0.010**	**-0.008**	**-2.041**	**0.041**[b]
RSI_POST2	non-Internet	0.020	0.040		
	Internet	0.032	0.051		
	Difference	**-0.012**	**-0.011**	**-2.094**	**0.036**[b]
RSI_POST3	non-Internet	0.020	0.041		
	Internet	0.032	0.051		
	Difference	**-0.013**	**-0.011**	**-2.068**	**0.039**[b]
INST_OWNER_PRE	non-Internet	0.140	0.193		
	Internet	0.155	0.198		
	Difference	**-0.015**	**-0.005**	**-0.004**	**0.997**
INST_OWNER_POST1	non-Internet	0.140	0.189		
	Internet	0.170	0.208		
	Difference	**-0.030**	**-0.019**	**-0.497**	**0.619**
INST_OWNER_POST2	non-Internet	0.140	0.191		
	Internet	0.170	0.208		
	Difference	**-0.030**	**-0.016**	**-0.545**	**0.586**
INST_OWNER_POST3	non-Internet	0.140	0.196		
	Internet	0.195	0.237		
	Difference	**-0.055**	**-0.042**	**-1.496**	**0.135**

[a] significant at 1% level
[b] significant at 5% level
[c] significant at 10% level

The table reports the proxies for short sale constraints for both domestic and non-domestic Internet and non-Internet firms before and after the announcement about Facebook's IPO. The observation dates for the proxies relative short interest (RSI) and institutional ownership (INST_OWNER) are chosen according to the short interest reporting dates, i.e. one prior to the announcement date and 3 after the announcement date. For institutional ownership (INST_OWNER) 1.000 represents 100%.

The comparison of the two portfolios is conducted using SPSS 20 and the non-parametric Mann-Whitney U-test. A full list of the used abbreviations is also available in Appendix B.

Source: created by authors using SPSS 20

Table 4.7 indicates that there is no statistically significant difference in the relative trading volume of Internet and non-Internet firms prior to the announcement. It does however become statistically significant after the announcement, which indicates that investors had a more dispersed opinion on the fair value of Internet stocks after the announcement about Facebook's IPO. However, the findings for the second proxy on this matter, the divergence in analysts' forecast, are mixed. While the divergence in analysts' forecasts for the whole observation period is statistically significantly higher for Internet companies than for non-Internet companies, it decreases directly after the announcement.

***Table 4.7** Measures of divergence in investors' opinion for Internet and non-Internet firms (the announcement about Facebook's IPO)*

Proxy	Non-Internet / Internet	Median	Mean	Z	Asymp. Sig. (2-tailed)
VOL_PRE	non-Internet	0.003	0.005		
	Internet	0.003	0.006		
	Difference	**0.000**	**-0.001**	**-0.322**	**0.748**
VOL_POST1	non-Internet	0.003	0.006		
	Internet	0.005	0.009		
	Difference	**-0.002**	**-0.003**	**-2.392**	**0.017**[b]
ANAL_FC_PRE	non-Internet	4.110	12.926		
	Internet	6.381	15.624		
	Difference	**-2.271**	**-2.698**	**-2.130**	**0.033**[b]
ANAL_FC_POST1	non-Internet	4.110	12.718		
	Internet	6.070	13.321		
	Difference	**-1.960**	**-0.603**	**-1.689**	**0.091**[c]
ANAL_FC_POST2	non-Internet	4.110	12.718		
	Internet	6.070	13.321		
	Difference	**-1.960**	**-0.603**	**-1.689**	**0.091**[c]
ANAL_FC_POST3	non-Internet	5.539	12.954		
	Internet	7.060	21.173		
	Difference	**-1.521**	**-8.219**	**-1.420**	**0.156**
NR_ANAL_PRE	non-Internet	5.000	5.746		
	Internet	6.000	6.370		
	Difference	**-1.000**	**-0.624**	**-1.541**	**0.123**
NR_ANAL_POST1	non-Internet	5.000	5.947		
	Internet	6.000	6.891		
	Difference	**-1.000**	**-0.944**	**-1.670**	**0.095**[c]
NR_ANAL_POST2	non-Internet	5.000	5.947		
	Internet	6.000	6.891		
	Difference	**-1.000**	**-0.944**	**-1.670**	**0.095**[c]
NR_ANAL_POST3	non-Internet	5.000	6.265		
	Internet	6.500	7.109		
	Difference	**-1.500**	**-0.844**	**-1.645**	**0.100**

[a] significant at 1% level
[b] significant at 5% level
[c] significant at 10% level

The table reports the proxies for divergence in investors' opinion for both domestic and non-domestic Internet and non-Internet firms before and after the announcement about Facebook's IPO. The observation dates for the proxy dispersion of analysts' forecast (ANAL_FC) is chosen according to the short interest reporting dates, i.e. one prior to the announcement date and 3 after the announcement date. Furthermore, the number of analysts (NR_ANAL) is included to give a better understanding of changes in the proxy ANAL_FC.

The relative trading volume (VOL) is calculated over the time periods [-44 ... -6] and [+6 ... +44], relative to the announcement date. For consistency with the other empirical findings the window of 11 days around the announcement date is excluded in this case too.

The comparison of the two portfolios is conducted using SPSS 20 and the non-parametric Mann-Whitney U-test. A full list of the used abbreviations is also available in Appendix B.

Source: created by authors using SPSS 20

In summary, the findings on the announcement about Facebook's IPO indicate that investors were more active in shorting Internet than non-Internet firms' shares at the beginning of 2012 and they also had more dispersed beliefs on the fair value of Internet stocks. This all refers to a potential overvaluation.

To draw an overall conclusion on the findings of short sale constraints and divergence in investors' belief, it is necessary to look at them in the context of abnormal returns around the respective event. Besides being useful for the announcement about Facebook's IPO, it is also beneficial for the expirations of the lock-up periods. Given the inference that Internet firms are neither subject to a higher divergence in investors' belief nor short sale constrained (at least in case of the domestic ones) at their lock-up periods' expirations, their abnormal returns should *not* be significantly different from non-Internet firms at the expirations of lock-ups. However, as the announcement about Facebook's IPO gives indications for a plausible overvaluation amongst Internet companies, the abnormal returns of Internet firms are expected to be significantly different from non-Internet companies. The findings of these event studies are presented in the next subchapter.

4.3 Abnormal returns around the event

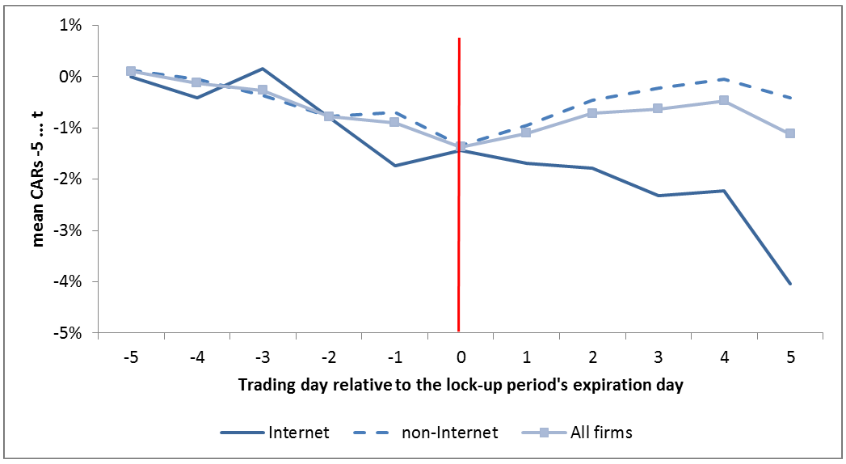
4.3.1 Abnormal returns around the expiration of lock-up period

An analysis of abnormal returns is implemented to strengthen the overall results and complement the outcome of the market-based approach. As Field and Hanka (2001) showed and Klungerbo *et al.* (2012) confirmed later, negative abnormal returns occur around the expiration of lock-up periods in the U.S. market. To add more to this, high beta companies (*i.e.* mostly high-tech and often NASDAQ companies) suffer from more negative abnormal firms than other firms (Field & Hanka, 2001; Klungerbo*, et al.*, 2012).

Cumulative excess returns are scrutinized to detect whether these findings can also be found in the current study and observe if there is a statistically significant difference between Internet and non-Internet firms in regards to abnormal returns. CARs are calculated and statistical tests are conducted as described in subchapter 3.4. The results are shown in Table 4.8 and Table 4.9. Detailed results for normality tests are shown in Appendix F.

Figure 4.2 below depicts average CARs as of day -5 until respective day relative to the lock-up expiration day. The pattern for non-Internet firms' average CARs is similar to one shown by Field and Hanka (2001), decreasing before the unlock day and showing a "recovery" after it. However, Internet companies' average CARs continue to drop also after the lock-up period has expired. Furthermore, although the non-Internet firms' average CARs show an increase after the expiry, the recovery takes place during a shorter time, that is to say pre lock-up expiration levels are achieved faster than shown by Field and Hanka (2001). This is probably due to using a different time frame around the unlock day. In Figure 4.2 average CARs are observed starting from day -5 relative to the unlock day, whereas Field and Hanka (2001) considered them as of day -50. Also, the time period in focus might play a role, because in the current thesis only the recent two year period is observed compared to a decade included in the before-mentioned study.

Figure 4.2 *Mean CARs [-5 … t] around the expiration of lock-up period*



CARs are calculated using the market model. Internet firms encompass 46, non-Internet companies 189 and all firms 235 companies (for more details about the companies see Appendix A). The time period of firms' lock-ups' expirations includes January 2010 to February 2012. CARs [-5 … t] represent respective day's CAR starting from day -5 (e.g. CAR [-5 … -2] represents the cumulative abnormal return as of day -5 until day -2 relative to the lock-up expiration day). CARs depicted on the graph are average CARs for the respective portfolio.

Source: created by authors

It is evident from Table 4.8 below that at the 5% level all of the Internet firms' event windows' CARs follow a non-normal distribution except for [-5 … -1] and [-5 … +5]. Wilcoxon signed rank test's significance levels indicate however that despite the median CARs being mostly negative, they are statistically insignificant. This retains the null hypothesis, *i.e.* median CARs are not significantly different from 0 for Internet companies at the 5% level. Even the returns for five days prior to the unlock day are insignificant. Thus, CARs' statistical insignificance is not in line with the findings of Field and Hanka (2001), Klungerbo *et al.* (2012) nor with Ofek and Richardson (2003). On the one hand, a reason could be a separation between the Internet and non-Internet firms that is done in the current thesis, but not in first of the two mentioned studies. On the other hand, the results still oppose the ones of Ofek and Richardson (2003), who in the light of the last Dot-Com bubble find statistically significant negative excess returns around the lock-up expiration for Internet firms. There may be several explanations for the discrepancy between the prior studies and the results of the current one. One cause for the difference may be the way of selecting firms to create the sample and the model used for calculating expected returns, which might affect the results of the significance tests.[24] This, however, would corroborate the findings of Ahern (2009) who shows how different results can be arrived at, depending on the pair of model and statistical test used.[25] Even though Field and Hanka (2001) use non-parametric tests in

[24] In this study firms are picked based on specific characteristics as brought out in subchapter 3.2 and the market model is utilized, whereas Field and Hanka (2001), Klungerbo et al (2012) and Ofek and Richardson (2003) all use the market adjusted model and the former two follow a random selection approach for creating the samples. The authors of the current thesis have also tested other models in calculating abnormal returns. By using a market adjusted model – as Field and Hanka (2001), Klungerbo et al (2012) and Ofek and Richardson (2003) utilize in their studies – for deriving abnormal returns and running the analysis, gives similar results to the aforementioned three papers (regardless of whether separating between Internet and non-Internet companies or considering all firms together). However, by using the Fama-French 3 factor model or the market model, the results are as provided above.

[25] Ahern (2009) shows *e.g.* that for the firms with low prior returns, market adjusted models over-reject the null hypothesis in upper tail tests and under-reject it for the firms with high prior returns. He also points out that the market model used with a t-test produces

conjunction with parametric ones, Ofek and Richardson (2003) adhere to the t-test that is shown by Ahern (2009) to create the most errors. Thus, this in turn could increase the support for Schultz (2008) study of no significant abnormal returns for Internet firms during the last Dot-Com bubble. However, the difference between Field and Hanka (2001), who also use a non-parametric test, and the current study requires another explanation. An alternative reason behind the discrepancy might be the considered time period. In Field and Hanka (2001) and Klungerbo *et al.* (2012) several decades are in focus, whereas the current thesis concentrates on the most recent data covering the past two years. Furthermore, Ofek and Richardson (2003) observe the time of a bubble ex-post, *i.e.* knowingly looking at the time, which deviates from normal.

Table 4.8 *Internet firms' CARs and their significance (event: expiration of lock-up period)*

Event windows and separate days	CAR		Wilcoxon signed rank test	Student's t-test		Shapiro-Wilk	
	Median	Mean	Sig.	t-statistic	Sig.	Statistic	Sig.
CAR_-5_-1	-0.018	-0.017	0.145	-1.056	0.297	0.973	0.351
CAR_-5_+5	-0.037	-0.040	0.181	-1.646	0.107	0.953	0.060[c]
CAR_-1_+1	0.002	-0.009	0.723	-0.712	0.480	0.934	0.012[b]
CAR_0	-0.006	0.003	0.883	0.386	0.702	0.911	0.002[a]
CAR_+1_+10	-0.012	-0.036	0.215	-1.886	0.066[c]	0.944	0.027[b]
CAR_-5	*0.000*	*0.000*	*0.831*	*-0.003*	*0.997*	*0.984*	*0.777*
CAR_-4	*0.000*	*-0.004*	*0.650*	*-0.657*	*0.514*	*0.935*	*0.013*[b]
CAR_-3	*0.007*	*0.006*	*0.203*	*1.129*	*0.265*	*0.971*	*0.307*
CAR_-2	*-0.002*	*-0.009*	*0.170*	*-1.711*	*0.094*[c]	*0.941*	*0.021*[b]
CAR_-1	*-0.006*	*-0.009*	*0.117*	*-1.399*	*0.169*	*0.920*	*0.004*[a]

[a] *significant at 1% level*
[b] *significant at 5% level*
[c] *significant at 10% level*

Respective CARs are calculated for the period as of the starting until the ending day specified in each CAR's name (e.g. CAR [-1 …+1] is the cumulative abnormal return as of day -1 until day +1; CAR [0] represents the abnormal return on day 0, i.e. the lock-up expiration day). The Shapiro-Wilk significance figures indicate whether the data is normally distributed or not. The null hypothesis of a normal distribution is rejected if the significance figures are below the 5% level. If, however, the null hypothesis is retained (i.e. significance figures are above the 5% level), Student's t-test results are also considered in making conclusions, although, as said above, more emphasis is put on the Wilcoxon signed rank test. Wilcoxon signed rank test includes only the significance, since SPSS output does not provide a statistic.

Source: created by authors using SPSS 20

Evidently, considering Hong *et al.* (2006) – who suggest that negative abnormal returns occur due to negative beliefs about the company – in conjunction with the plausible explanations and the results given above suggests that Internet firms are not overvalued, underpinning the conclusion made for (domestic) Internet firms in subchapter 4.2.1. If they were subject to excess valuation, high negative and statistically significant abnormal returns should be visible around the lock-up expiration day referring to negative views. In the case of CARs, domestic firms are also separately analysed, but taking into account the 5% significance level, the findings are similar to the analysis when no separation is considered, which allows drawing the conclusions of Internet companies not being overvalued as mentioned before. For space-saving purposes, the detailed results of domestic Internet firms' cumulative abnormal returns are shown in Appendix G. However,

incorrect rejection rates for securities that are grouped by size and if the market model is used with a non-parametric test (rank test) the abnormal performance for low market equity firms is correctly detected twice as often compared to the t-statistic (Ahern, 2009).

making the final conclusions before considering the results of non-Internet firms and the comparison between abnormal returns of the two portfolios would be a hasty decision.

Table 4.9 below focuses on the cumulative excess returns of non-Internet companies. In this case, all the CARs follow a non-normal distribution. Subsequently, analysing the Wilcoxon signed rank test's significances indicates that median CARs for event windows [-5 … -1] and [0] are negative (though, not remarkable), but statistically significant at the 5% level only for [0]. Further, separate days' median CARs are similarly negative and statistically significant for days [-2] and [-3], though again not considerable and statistically significant at 5% level for only day [-3]. A separate analysis is also conducted for domestic non-Internet companies, resulting in similar results to the one shown in Table 4.9. Detailed findings are presented in Appendix H. This is a rather surprising outcome, since unlike non-Internet firms none of the CARs for Internet firms were significantly different from 0. In turn, the results do not specifically refer to overvalued non-Internet firms, but leave the possibility open. On the other hand, the findings might also refer to an anomaly, since the results for non-Internet firms are similar to Field and Hanka (2001) and Klungerbo *et al.* (2012), whereas the findings on Internet firms contradict the mentioned studies. Therefore, assuming some kind of anomaly, the results would support Goergen *et al.* (2006) and Espenlaub *et al.* (2001) of no consistency in the presence of abnormal returns around the lock-up expirations, however, in the current case it would also extend to the U.S. context.

Table 4.9. *Non-Internet firms' CARs and their significance (event: expiration of lock-up period)*

Event windows and separate days	CAR		Wilcoxon signed rank test	Student's t-test		Shapiro-Wilk	
	Median	Mean	Sig.	t-statistic	Sig.	Statistic	Sig.
CAR_-5_-1	-0.008	-0.007	0.069[c]	-1.137	0.257	0.920	0.000[a]
CAR_-5_+5	-0.011	-0.004	0.483	-0.483	0.630	0.977	0.004[a]
CAR_-1_+1	-0.003	-0.002	0.560	-0.372	0.710	0.960	0.000[a]
CAR_0	-0.004	-0.007	0.033[b]	-2.441	0.016[b]	0.945	0.000[a]
CAR_+1_+10	0.004	0.001	0.679	0.111	0.912	0.959	0.000[a]
CAR_-5	*0.001*	*0.001*	*0.441*	*0.483*	*0.630*	*0.941*	*0.000[a]*
CAR_-4	*-0.003*	*-0.002*	*0.120*	*-0.733*	*0.464*	*0.948*	*0.000[a]*
CAR_-3	*-0.004*	*-0.003*	*0.016[b]*	*-1.375*	*0.171*	*0.844*	*0.000[a]*
CAR_-2	*-0.003*	*-0.004*	*0.087[c]*	*-1.575*	*0.117*	*0.908*	*0.000[a]*
CAR_-1	*0.000*	*0.001*	*0.955*	*0.280*	*0.780*	*0.821*	*0.000[a]*

[a] *significant at 1% level*
[b] *significant at 5% level*
[c] *significant at 10% level*

Respective CARs are calculated for the period as of the starting until the ending day specified in each CAR's name (e.g. CAR [-1 …+1] is the cumulative abnormal return as of day -1 until day +1; CAR [0] represents the abnormal return on day 0, i.e. the lock-up expiration day). The Shapiro-Wilk significance figures indicate whether the data is normally distributed or not. The null hypothesis of a normal distribution is rejected if the significance figures are below 5% level. If, however, the null hypothesis is retained (i.e. significance figures are above the 5% level), Student's t-test results are also considered in making conclusions, although, as said above, more emphasis is put on the Wilcoxon signed rank test. The Wilcoxon signed rank test includes only the significance, since SPSS output does not provide a statistic.

Source: created by authors using SPSS 20

The results exhibited in Table 4.8 and Table 4.9 do not support the fact of overvalued Internet firms being in line with the findings of no short sale constraints and no dispersion of investors' opinion for (domestic) Internet firms around the lock-up expiration as shown in subchapter 4.2.1. The findings in Table 4.8 and Table 4.9 depict non-Internet companies being prone to more negative median CARs, though being not remarkable. Yet, the significance of the difference between the two groups should be observed further. Table 4.10 below depicts the comparison between the event windows' median CARs of Internet and non-Internet companies. As is evident, there is no statistically significant difference between the medians of the two portfolios except for CAR_-3. Surprisingly, the median excess return for Internet firms is positive (0.7%), but negative for non-Internet firms (-0.4%). This finding is difficult to explain as the other days preceding the lock-up expiration are characterised by negative median CARs and there is no crucial factor that should cause day -3 to be characterised by positive median CAR for Internet firms. Again, an analysis conducted for the difference between domestic Internet and domestic non-Internet companies gives similar results, with the exception of difference between median CAR_-5 being statistically significant instead of median CAR_-3. Further, the median CAR_-5 for domestic Internet companies is negative and for domestic non-Internet firms positive. Detailed results are shown in Appendix I. However, as mentioned in context of Table 4.8 and Table 4.9 the results may be caused by the way the CARs are calculated or by an anomaly. Additionally, as findings for median CAR_-3 or CAR_-5 (for the domestic sample) alone are not strong indicators to infer overvaluation, it essentially suggests that based on the lock-up periods' expirations Internet firms are currently not overvalued, since in general no statistically significant difference between the median CARs relative to the lock-up expirations can be detected. This is in line with the finding of (domestic) Internet firms being not short sale constrained around the lock-up expiration, shown in subchapter 4.2.1.

***Table 4.10** Comparison of CARs between Internet and non-Internet firms (event: expiration of lock-up period)*

Proxy	Non-Internet / Internet	Median	Mean	Z	Asymp. Sig. (2-tailed)
CAR_-5_-1	non-Internet	-0.008	-0.007		
	Internet	-0.018	-0.017		
	Difference	**0.011**	**0.010**	**-0.970**	**0.332**
CAR_-5_+5	non-Internet	-0.011	-0.004		
	Internet	-0.037	-0.040		
	Difference	**0.026**	**0.036**	**-1.345**	**0.179**
CAR_-1_+1	non-Internet	-0.003	-0.002		
	Internet	0.002	-0.009		
	Difference	**-0.005**	**0.007**	**-0.143**	**0.887**
CAR_0	non-Internet	-0.004	-0.007		
	Internet	-0.006	0.003		
	Difference	**0.002**	**-0.009**	**-0.559**	**0.576**
CAR_+1_+10	non-Internet	0.004	0.001		
	Internet	-0.012	-0.036		
	Difference	**0.015**	**0.037**	**-1.270**	**0.204**

Table 4.10 continued …

Proxy	Non-Internet / Internet	Median	Mean	Z	Asymp. Sig. (2-tailed)
CAR_-5	*non-Internet*	*0.001*	*0.001*		
	Internet	*0.000*	*0.000*		
	Difference	***0.002***	***0.001***	***-0.467***	***0.641***
CAR_-4	*non-Internet*	*-0.003*	*-0.002*		
	Internet	*0.000*	*-0.004*		
	Difference	***-0.003***	***0.002***	***-0.242***	***0.809***
CAR_-3	*non-Internet*	*-0.004*	*-0.003*		
	Internet	*0.007*	*0.006*		
	Difference	***-0.011***	***-0.009***	***-2.244***	***0.025***[b]
CAR_-2	*non-Internet*	*-0.003*	*-0.004*		
	Internet	*-0.002*	*-0.009*		
	Difference	***0.000***	***0.005***	***-0.626***	***0.531***
CAR_-1	*non-Internet*	*0.000*	*0.001*		
	Internet	*-0.006*	*-0.009*		
	Difference	***0.006***	***0.010***	***-1.550***	***0.121***

[b] significant at 5% level

Respective CARs are calculated for the period as of the starting until the ending day specified in each CAR's name (e.g. CAR [-1 …+1] is the cumulative abnormal return as of day -1 until day +1; CAR [0] represents the abnormal return on day 0, i.e. the lock-up expiration day). The significance in the first column on the right refers to whether the difference between the respective event windows' excess returns' medians of Internet and non-Internet firms is statistically significant or not based on the Mann-Whitney U-test. The null hypothesis of no significant difference is rejected in case the significance figure is below the 5% level. If, however, the significance figures are above the 5% level, the null hypothesis is retained. In the current case the null hypothesis is retained for all event windows except for CAR_-3 in which the alternative hypothesis is accepted referring to a significant difference between the medians of Internet and non-Internet firms' day -3 cumulative excess returns.

Source: created by authors using SPSS 20

The results of the CARs around the lock-up period provide no proof of overvalued Internet firms. However, short selling activity and divergence in investors' opinion around the announcement about Facebook's IPO indicate a potential overvaluation as shown in subchapter 4.2.2. Therefore, a further exploration of the excess returns around the announcement about Facebook's IPO is carried out next.

4.3.2 Abnormal returns around the announcement of Facebook's IPO

It is expected that the announcement about Facebook's IPO has a negative effect on the other Internet firms' CARs in case Internet companies in general are overvalued. The logic behind being Facebook's IPO as the sign for rational investors to collectively arbitrage away overpricing, *i.e.* (short) selling Internet firms' shares. This argumentation is based on the findings of Griffin *et al.* (2011).

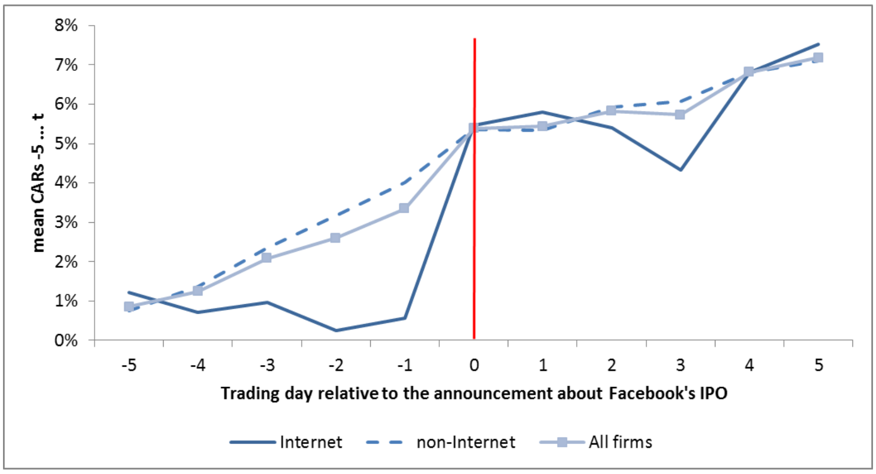
In the case of the announcement about Facebook's IPO as an event, the pre-event estimation window is limited to 106 days, in order to include all the companies into the analysis.[26] Same tests are performed for Internet and non-Internet firms as in the previous subchapter. The detailed

[26] Announcement about Facebook's IPO is earlier than some companies' expiration of lock-up periods, which decreases the possible maximum estimation window.

results about the normality test for event study using the announcement about Facebook's IPO are presented in Appendix J.

The average CARs as of day -5 until respective day relative to the announcement about Facebook's IPO are depicted in Figure 4.3 below. It seems that for the non-Internet firms, the announcement did not have any significant impact, since the pattern of average CARs follows a linear trend without any significant fluctuations. However, the effect for the Internet firms can vividly be determined. The change from average CAR [-5 … -1] to CAR [-5 … 0] is close to 5%-points, which could be considered as a high increase. Although average CAR [-5 … 3] drops, the following pattern shows a continuing increasing trend. Therefore, based on the graphical pattern, the announcement about Facebook's IPO had a positive impact on other Internet firms' share prices. This is not in line with the expected negative effect. On the other hand, an increase of average CARs could refer to a starting phase of a bubble, more specifically to the displacement phase as discussed in Table 2.1 in subchapter 2.1.

Figure 4.3 *Mean CARs [-5 … t] around the announcement about Facebook's IPO*



CARs are calculated using the market model. Internet firms encompass 46, non-Internet companies 189 and all firms 235 companies (for more details about the companies see Appendix A). CARs [-5 … t] represent respective day's CAR starting from day -5 (e.g. CAR [-5 … -2] represents the cumulative abnormal return as of day -5 until day -2 relative to the announcement about Facebook's IPO). CARs depicted on the graph are average CARs for the respective portfolio.

Source: created by authors

Table 4.11 includes the analysis of significance of respective event windows' CARs for Internet firms. All of the event windows' and separate days' CARs follow a non-normal distribution, except for day -5 CAR. Most of the event windows and separate days are characterised by positive median and mean CARs, which in turn corroborates the effect seen graphically in Figure 4.3 above. The impact of the announcement about Facebook's IPO is clearly visible from event windows [-5 … +5] and [-1 … +1], both of which exhibit considerably higher median CARs compared to the pre-announcement period. Further, day [0] represents one of the highest abnormal return, accentuating the announcement's impact. As briefly touched upon above, this effect may be an indication for the start of a bubble. The reason behind this positive influence might be entering into the displacement phase. As mentioned in Table 2.1 based on Norman and Thiagarajan (2009), the displacement phase is characterised by an increase in the asset's popularity that in turn leads to herd mentality. In the current case, Facebook as the leading social media firm, possibly considered a desired part of an investment portfolio, may be an ignition for the increased popularity of acquiring Internet firms' stocks. A similar pattern of events took place during the beginning of the last Dot-Com bubble when the development of the bubble was ignited by Netscape's IPO (Corr, 2007). Hence, noise investors who typically just follow the herd without having done proper due diligence, can be the source of this impact at the moment, potentially leading to subsequent bubble phases (*e.g.* boom and euphoria) if the increased investments continue.

Table 4.11 *Internet firms' CARs and their significance (event: the announcement about Facebook's IPO)*

Event windows and separate days	CAR		Wilcoxon signed rank test	Student's t-test		Shapiro-Wilk	
	Median	Mean	Sig.	t-statistic	Sig.	Statistic	Sig.
CAR_-5_-1	0.011	0.006	0.422	0.513	0.610	0.951	0.049[b]
CAR_-5_+5	0.061	0.075	0.000[a]	3.466	0.001[a]	0.913	0.002[a]
CAR_-1_+1	0.030	0.055	0.000[a]	4.101	0.000[a]	0.767	0.000[a]
CAR_0	0.023	0.049	0.000[a]	5.655	0.000[a]	0.820	0.000[a]
CAR_+1_+10	-0.008	0.044	0.682	1.446	0.155	0.588	0.000[a]
CAR_-5	*0.007*	*0.012*	*0.017[b]*	*2.825*	*0.007[a]*	*0.968*	*0.230*
CAR_-4	*-0.002*	*-0.005*	*0.552*	*-0.937*	*0.354*	*0.701*	*0.000[a]*
CAR_-3	*0.002*	*0.002*	*0.566*	*0.709*	*0.482*	*0.956*	*0.078[c]*
CAR_-2	*-0.005*	*-0.007*	*0.096[c]*	*-1.315*	*0.195*	*0.778*	*0.000[a]*
CAR_-1	*0.004*	*0.003*	*0.192*	*0.763*	*0.449*	*0.952*	*0.058[c]*

[a] significant at 1% level
[b] significant at 5% level
[c] significant at 10% level

Respective CARs are calculated for the period as of the starting until the ending day specified in each CAR's name (e.g. CAR [-1 ...+1] is the cumulative abnormal return as of day -1 until day +1; CAR [0] represents the abnormal return on day 0, i.e. the announcement about Facebook's IPO). The Shapiro-Wilk significance figures indicate whether the data is normally distributed or not. The null hypothesis of a normal distribution is rejected if the significance figures are below the 5% level. If, however, the null hypothesis is retained (i.e. significance figures are above the 5% level), Student's t-test results are also considered in making conclusions, although, as said above, more emphasis is put on the Wilcoxon signed rank test. The Wilcoxon signed rank test includes only the significance, since SPSS output does not provide a statistic.

Source: created by authors using SPSS 20

In order to assess whether the non-Internet firms' CARs are also significant, respective tests are conducted as shown in Table 4.12 below. All of the event windows' and separate days' CARs are non-normally distributed. Similarly to Internet firms' median and mean CARs most of the non-Internet ones are positive. However, the size of the CARs for non-Internet firms is lower than for Internet firms. Moreover, the median CAR_0 is below 1%, compared to exceeding 2% for Internet companies. Hence, regardless of the non-Internet firms' CARs being positive, the reason behind may not be the announcement about Facebook's IPO. That can be argued by observing the size of the median CARs, which remain mainly close to the 1% level, *i.e.* lower than for Internet firms. Concurrently, it again supports the fact that only Internet companies were affected by the announcement about Facebook's IPO and although there might not be a bubble at the moment, the current development might reflect a potential start of it (entrance into the displacement phase as discussed above).

Table 4.12 *Non-Internet firms' CARs and their significance (event: the announcement about Facebook's IPO)*

Event windows and separate days	CAR		Wilcoxon signed rank test	Student's t-test		Shapiro-Wilk	
	Median	Mean	Sig.	t-statistic	Sig.	Statistic	Sig.
CAR_-5_-1	0.024	0.040	0.000[a]	6.061	0.000[a]	0.740	0.000[a]
CAR_-5_+5	0.041	0.071	0.000[a]	7.254	0.000[a]	0.822	0.000[a]
CAR_-1_+1	0.013	0.022	0.000[a]	5.404	0.000[a]	0.891	0.000[a]
CAR_0	0.007	0.013	0.000[a]	4.706	0.000[a]	0.717	0.000[a]
CAR_+1_+10	0.007	0.026	0.043[b]	2.730	0.007[a]	0.894	0.000[a]
CAR_-5	*0.005*	*0.008*	*0.000[a]*	*3.378*	*0.001[a]*	*0.890*	*0.000[a]*
CAR_-4	*0.004*	*0.006*	*0.000[a]*	*3.422*	*0.001[a]*	*0.931*	*0.000[a]*
CAR_-3	*0.005*	*0.010*	*0.000[a]*	*5.037*	*0.000[a]*	*0.887*	*0.000[a]*
CAR_-2	*-0.001*	*0.008*	*0.790*	*2.209*	*0.028[b]*	*0.553*	*0.000[a]*
CAR_-1	*0.005*	*0.009*	*0.000[a]*	*3.455*	*0.001[a]*	*0.904*	*0.000[a]*

[a] *significant at 1% level*
[b] *significant at 5% level*
[c] *significant at 10% level*

Respective CARs are calculated for the period as of the starting until the ending day specified in each CAR's name (e.g. CAR [-1 …+1] is the cumulative abnormal return as of day -1 until day +1; CAR [0] represents the abnormal return on day 0, i.e. the announcement about Facebook's IPO). The Shapiro-Wilk significance figures indicate whether the data is normally distributed or not. The null hypothesis of a normal distribution is rejected if the significance figures are below the 5% level. If, however, the null hypothesis is retained (i.e. significance figures are above the 5% level), Student's t-test results are also considered in making conclusions, although, as said above, more emphasis is put on the Wilcoxon signed rank test. The Wilcoxon signed rank test includes only the significance, since SPSS output does not provide a statistic.

Source: created by authors using SPSS 20

Table 4.13 shows between which Internet and non-Internet firms' event windows' CARs there is statistically significant difference. Three of the event windows' and three of the separate days' dissimilarity in CARs between Internet and non-Internet companies are statistically significant. All the statistically significant dissimilarities between Internet and non-Internet firms for the days preceding the announcement about Facebook's IPO are positive, reflecting higher abnormal returns for non-Internet firms. However, when the event windows are observed, the situation is the opposite. Only for the period [-5 … -1] the difference in median CARs is again positive (higher abnormal returns for non-Internet companies), but this reflects the pre-announcement period. When the announcement day is considered in the event window, all the statistically significant dissimilarities are negative, referring to higher abnormal returns for Internet companies. These findings again corroborate the aspects mentioned in the context of Table 4.11 and Table 4.12 above, which in turn might not necessarily be a sign of a ubiquitous excessive valuation of Internet firms, but a threat of entering into the period of wide-spread overvaluation (*i.e.* entrance into another bubble). The stronger impact of the announcement about Facebook's IPO on Internet companies CARs and statistically significant differences between CARs of Internet and non-Internet firms might refer to emerging herd mentality, led by noise investors. It may in turn reflect the beginning of another bubble (displacement phase), which could potentially evolve further.

Table 4.13 *Comparison of CARs between Internet and non-Internet firms (event: the announcement about Facebook's IPO)*

Proxy	Non-Internet / Internet	Median	Mean	Z	Asymp. Sig. (2-tailed)
CAR_-5_-1	non-Internet	0.024	0.040		
	Internet	0.011	0.006		
	Difference	**0.013**	**0.035**	**-2.278**	**0.023**[b]
CAR_-5_+5	non-Internet	0.041	0.071		
	Internet	0.061	0.075		
	Difference	**-0.021**	**-0.004**	**-0.781**	**0.435**
CAR_-1_+1	non-Internet	0.013	0.022		
	Internet	0.030	0.055		
	Difference	**-0.018**	**-0.034**	**-2.462**	**0.014**[b]
CAR_0	non-Internet	0.007	0.013		
	Internet	0.023	0.049		
	Difference	**-0.016**	**-0.036**	**-4.721**	**0.000**[a]
CAR_+1_+10	non-Internet	0.007	0.026		
	Internet	-0.008	0.044		
	Difference	**0.015**	**-0.018**	**-0.631**	**0.528**
CAR_-5	*non-Internet*	*0.005*	*0.008*		
	Internet	*0.007*	*0.012*		
	Difference	***-0.002***	***-0.005***	***-0.762***	***0.446***
CAR_-4	*non-Internet*	*0.004*	*0.006*		
	Internet	*-0.002*	*-0.005*		
	Difference	***0.006***	***0.011***	***-2.077***	***0.038***[b]
CAR_-3	*non-Internet*	*0.005*	*0.010*		
	Internet	*0.002*	*0.002*		
	Difference	***0.003***	***0.007***	***-1.780***	***0.075***[c]
CAR_-2	*non-Internet*	*-0.001*	*0.008*		
	Internet	*-0.005*	*-0.007*		
	Difference	***0.004***	***0.015***	***-1.828***	***0.068***[c]
CAR_-1	*non-Internet*	*0.005*	*0.009*		
	Internet	*0.004*	*0.003*		
	Difference	***0.001***	***0.005***	***-0.638***	***0.523***

[a] significant at 1% level
[b] significant at 5% level
[c] significant at 10% level

Respective CARs are calculated for the period as of the starting until the ending day specified in each CAR's name (e.g. CAR [-1 …+1] is the cumulative abnormal return as of day -1 until day +1; CAR [0] represents the abnormal return on day 0, i.e. the announcement about Facebook's IPO). The significance in the first column on the right refers to whether the difference between the respective event windows' excess returns' medians of Internet and non-Internet firms is statistically significant or not based on the Mann-Whitney U-test. The null hypothesis of no statistically significant difference is rejected in case the significance figure is below the 5% . If, however, the significance figures are above 5% level, the null hypothesis is retained. In the current case the null hypothesis is retained for CAR_-5_+5, CAR_+1_+10, CAR_-5 and CAR_-1. For other event windows and separate days the alternative hypothesis is accepted referring to a statistically significant difference between the medians of Internet and non-Internet firms' CARs.

Source: created by authors using SPSS 20

The argument of possibly entering into a bubble is supported by both, the findings of this event study as well as the results of the market-based approach based on the announcement about Facebook's IPO. The increase in relative short interest points to high short selling, which in turn reflects the presence of investors with negative views on Internet firms. That further indicates opinions of overvalued Internet companies. An increased dispersion of analysts' forecast coupled with relative trading volume point to the aspect of optimistic as well as pessimistic investors in the market. The positive CARs around the announcement about Facebook's IPO, however, indicate that optimistic investors more than offset pessimistic investors, regardless of the increased short selling. That in turn enables to infer that there is a threat of entering into another bubble (first phase that could already be accompanied by some overvalued firms). It also explains why the results contradict what was expected based on Griffin *et al.* (2011). That is to say, a bubble may not exist yet, instead, it can be the start of it.

The analysis of CARs around the lock-up periods' expirations does not provide any signs of overvalued Internet firms. Even when the market-based approach's findings are included, the results of overvalued Internet firms are rather weak. However, by focusing on the announcement about Facebook's IPO instead, some evidence for overvalued Internet companies can be detected. Considering the mentioned event gives signs of plausibly entering into a bubble. Together with the market-based approach's results (when the announcement about Facebook's IPO is analysed instead of lock-up periods' expirations), the indications for a next bubble are further spurred.

Therefore, the event study and the market-based approach, both, provide somewhat similar results in terms of indications for entering into another bubble. As mentioned in the beginning of this thesis, the results are controlled with a test method to add credibility and enable drawing overall conclusions. For this matter, M&A intensity is observed in the next subchapter.

4.4 M&A intensity analysis

Subchapter 2.6 mentioned M&A activity as one of the control methods for determining overvaluation. In the current subchapter the number of M&A through 2002-2012[27] are analysed to compare the results of the above-used market-based approach and event study. Only deals reported as "complete" are considered in this analysis, which may underestimate the extrapolated total number of M&A for 2012. However, the authors provide the extrapolation for a rough comparison and the plausible increase in the deals is believed not be rapid enough to significantly alter the overall results. The data is retrieved from Reuters 3000 XTRA database.[28] All deals are allocated between two portfolios out of which the first comprises M&A of Internet and the other of non-Internet industries. Table 4.14 includes respective sectors' M&A that are considered as Internet and non-Internet.

[27] The time period of 2002-2012 is chosen to analyse the M&A pattern after the last Dot-Com bubble burst and to provide with the trend with regards to the latest deals that is relevant for capturing indications for a bubble. The total figure for 2012 is extrapolated based on the first three months of this year.

[28] The data includes global M&A, *i.e.* acquirer's/target's origin is not necessarily U.S. This should not bias the analysis' results as M&A have become global (as suggested by Gaughan (2011)) and an increase in M&A, regardless of the origin, still refers to acquirer's and target's overvaluation, which is in core focus.

Table 4.14 *Sector allocation for Internet and non-Internet M&A*

Sector	Internet	non-Internet
Information Technology (Software and Services):	√	
-Internet Software and Services	√	
-IT Consulting & Other Services	√	
-Data Processing & Outsourced Services	√	
-Application Software	√	
-Systems Software	√	
-Home Entertainment Software	√	
Consumer Discretionary		√
Consumer Staples		√
Energy		√
Financials		√
Health Care		√
Industrials		√
Information Technology (non-Internet)		√
Materials		√
Telecommunication Services		√
Utilities		√

Source: created by authors.

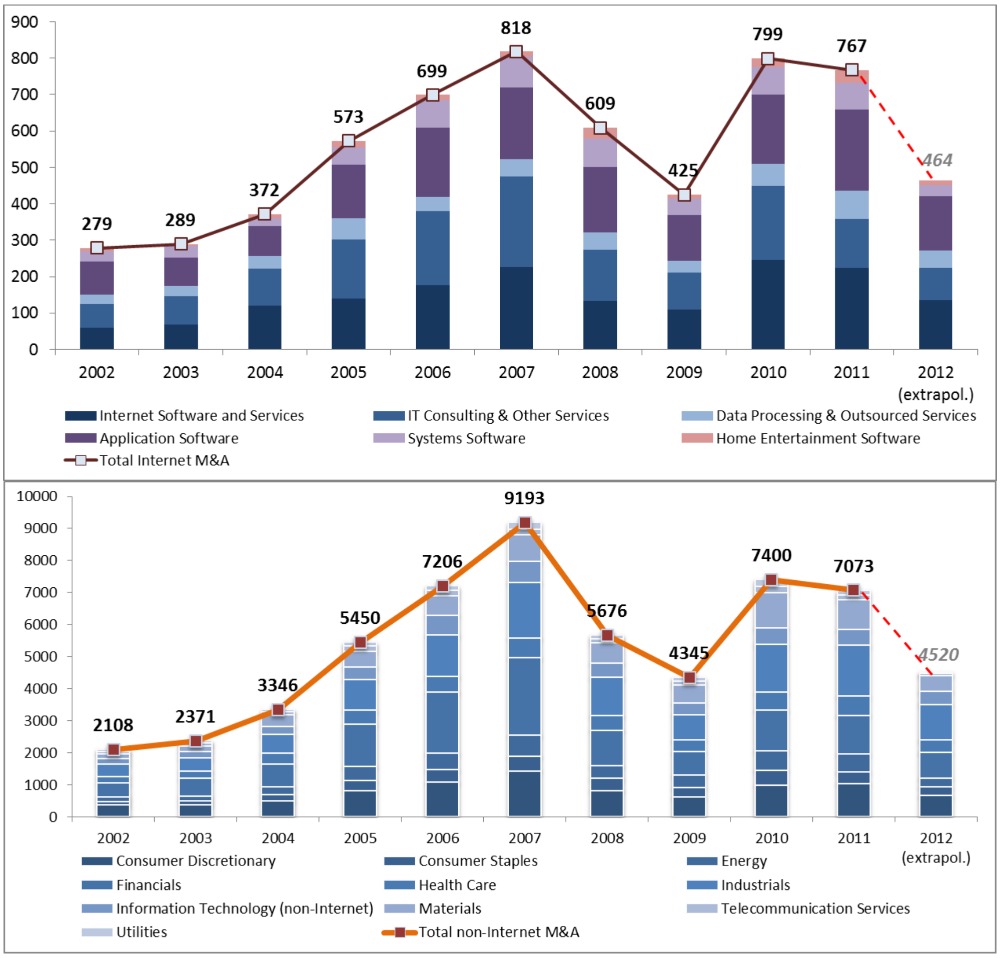
Software and Services (subsector of IT) is taken as a representative of Internet firms' M&A and the other subsectors of IT coupled with the rest of the sectors are considered to reflect non-Internet M&A. The choice is reasoned being closest to the criteria used for determining Internet firms in the market-based approach and event study. As discussed in subchapter 3.2.1 some Internet companies can be allocated to other than computer related sectors. However, considering the amount of data, filtering out those cases of M&A would be too time-consuming. For that reason these sectors are not included under Internet M&A. The authors do acknowledge the fact that there might be some Internet M&A excluded due to this mentioned factor, but this error is considered to be miniscule.

Subchapter 2.6 hinted that the number of M&A has been proven to increase during boom markets and overvaluation. Thus, an increasing trend in the number of Internet M&A is expected to be found if these companies are currently overvalued. Figure 4.4 below depicts the patterns of M&A intensity, which, however, indicate that there is no discrepancy between Internet and non-Internet M&A, as the structures overlap.[29] Further, it is evident that the number of M&A seems to accompany economic cycles, supporting the evidence provided by Gaughan (2011). An increasing trend can be seen until 2007, followed by a decrease, reaching the bottom in 2009. Subsequently M&A is characterised by a soar in 2010 and a stabilisation in 2011. Rhodes-Kropf *et al.* (2005) show that M&A peak during the times when firms are overvalued, but results in Figure 4.4 specify this, referring to a stronger relationship with the economic cycles. That is to say, M&A increase due to overvaluation that is caused by the economic boom, but a potential overvaluation during a recession or during stable times and its effect on M&A is left an open question.

[29] For a robustness check, the authors also compared the patterns for deals where the acquirer was from the U.S. (focus is on the acquirer, since target's origin info is unavailable in Reuters 3000 XTRA database), but the result still showed no difference between Internet and non-Internet M&A.

Therefore, based on the available knowledge about the relationship between M&A and overvaluation, the indifference in patterns of Internet and non-Internet M&A gives no proof of excessive valuation, but rather indicates to fair valuation of Internet firms at the moment. This, however, contradicts the results of the previous two methods around the announcement about Facebook's IPO (market-based approach and event study).

***Figure 4.4** Internet and non-Internet M&A intensity through 2002-2012*

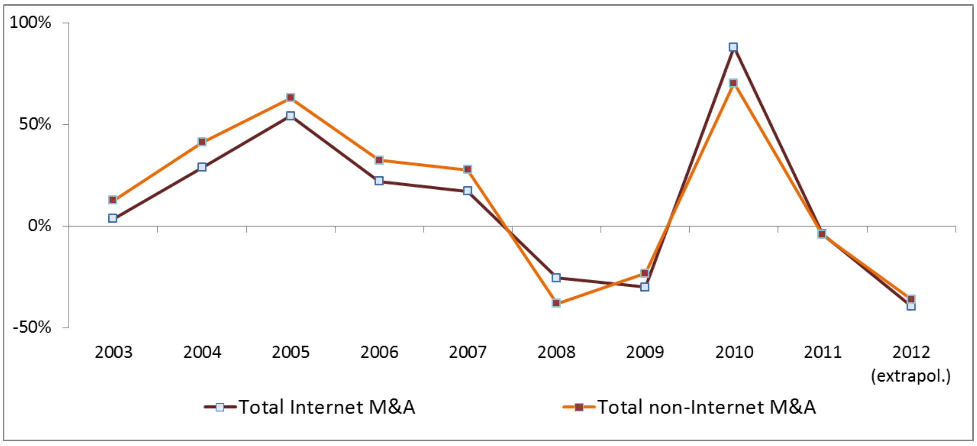


**2012 extrapolation based on 2012 first quarter*
***Authors' analysis based on historical data suggests that weight for first quarter's M&A makes on average 23% of total year's M&A*

Source: created by authors

In conjunction with the pattern for the number of M&A, the annual change in M&A is depicted in Figure 4.5 below. Figure 4.5 shows that even the annual percentage changes in the number of M&A follow the same path, which gives no basis for assuming an overvaluation of Internet firms. The significant increase in 2010 is probably the result of an economic improvement in that year coupled with a low base in 2009. Although the 2010 increase is more significant for Internet M&A, the subsequent drop is the same as for non-Internet transactions. Furthermore, the extrapolated 2012 figure also reflects a decrease rather than a potential increase like the number of M&A in Figure 4.4.

Figure 4.5 *Annual change in Internet and non-Internet M&A (in %)*



Source: created by authors

Current subchapter's M&A analysis confronts the market-based approach's and the event study's results around the announcement about Facebook's IPO. The market-based approach and the event study show signs of plausible entrance into another bubble, whereas M&A data does not provide any such evidence about overvalued Internet firms. The reason behind might be the fact that M&A activity comes with a lag and observing the intensity may not enable to capture the beginning of a bubble. Hence, there could still be overvalued Internet companies, but as it might be the start of a bubble, an overvaluation may not be ubiquitous yet, which makes this information too detailed to be captured by using M&A activity analysis. Moreover, the number of M&A can be an indication for overvaluation, but more detailed information could be gotten by exploring the premium paid per deal. However, as this data is rarely published and most often requires separate valuation of the participating firms, it is considered to be too time-consuming to be included into the current thesis.

The subsequent chapter comprises a summarizing discussion to conclude this study's results, give the authors' recommendations and also general explanations. Furthermore, possible extensions to this study are proposed in the next chapter.

5 CONCLUDING DISCUSSION

The following chapter comprises a discussion of the results of this study in conjunction with the authors' views about the findings and recommendations. Moreover, proposals are given with regards to a potential further development of this thesis.

5.1 Discussion

The purpose of this thesis was to add further knowledge in regards to whether indications for a bubble can be determined ex-ante by answering the following questions: "To what degree can there be observed indications for an overvaluation of Internet companies that may lead to an asset price bubble in the Internet industry?" and "What influence do lock-up periods have on an overvaluation that could contribute to formation of a potential asset price bubble?"

To give answers to the posed questions and fulfil the purpose of this study, a discussion of different valuation methods was provided. Amongst the covered techniques, the market-based approach, which focuses on short sale constraints and divergence in investors' opinion, was utilized for the empirical analysis. The mentioned approach was chosen since it is considered the best fit to be applied for Internet companies and further enables analysing the potential emergence of a bubble ex-ante, something, which is rarely applied in business and economics. Firms with lock-up periods expiring between January 2010 and February 2012 were selected for the analysis. They were in turn allocated into either Internet or non-Internet portfolios, including a marker for "domestic" (U.S.) and "non-domestic" (non-U.S.) companies. The analysis was conducted around the expiration of lock-up periods as well as the announcement about Facebook's IPO (as an alternative event). Additionally, cumulative abnormal returns around the mentioned days were observed for periods of [-5 … +5], [-5 … -1], [-1 … +1], [0] and [+1 … +10], relative to either the lock-up expiration day or the announcement about Facebook's IPO. M&A intensity was moreover observed to test the results and add credibility to the findings.

The findings of this thesis suggest that domestic Internet companies are not short sale constrained before the expiry of lock-up periods and neither is there a divergence in investors' opinion about these firms. Indirect evidence is found for non-domestic Internet firms (comprising largely Chinese companies) listed on U.S. stock markets being overvalued. The findings around the announcement about Facebook's IPO hint a higher shorting activity as well as an increase in divergence in investors' opinion after the event.

When observing CARs around the lock-up periods' expiration, no significant deviation from 0 for Internet firms is detected, regardless of whether the differentiation is made between domestic and non-domestic companies. This in turn suggests no overvalued Internet companies, being in line with the results of the market-based approach for (domestic) Internet firms. Analysing non-

Internet companies' CARs gives surprising results. Some median CARs (specifically for period [-5 … -1] and days [0], [-2], [-3]) are found to be negative and statistically significant, whereas none of the median CARs for Internet firms are characterised by similar findings. Differentiating between domestic and non-domestic non-Internet firms does not alter the core results. When the CARs are compared between Internet and non-Internet portfolios, no strong indications are found that allow making a solid conclusions on overvaluation.

Yet, higher shorting activity and increased dispersion of investors' opinion around the announcement about Facebook's IPO in conjunction with the statistically significant positive median CARs for Internet companies around the same event suggest the presence of the first phase of a bubble (*i.e.* displacement phase). Moreover, the dissimilarity between the two portfolios is significant for [-1 … +1], [0], [-4], [-3], [-2]. Regardless of the increase in short sale activity the results are interpreted as the potential entrance to a bubble, led by optimistic noise investors who more than offset the pessimistic traders.

The analysis of M&A activity provided no evidence of overvalued Internet companies, contradicting the findings of the market-based approach and the event study. However, the intensity in M&A activity might come with a lag, which would not show overvaluation at the moment. Additionally, excess valuation might be difficult for the M&A method to capture, owing to it not being ubiquitous yet.

Overall, considering the purpose of this thesis, the authors conclude that there can be seen signs of occurring overvaluation of Internet firms along with the entrance into another bubble. Although, an overvaluation might not be ubiquitous yet, due to being potentially in the beginning of a bubble, it could possibly develop further. In terms of lock-up expirations the results are mixed. When looking at domestic and non-domestic firms together, short sale constraints are visible for Internet companies, but after differentiating based on the origin, the constraints vanish for domestic Internet firms. However, the expiration of lock-up periods might still have a magnifying effect on overvaluation and, thus, the formation of a bubble, in case they were to accumulate in long run.

Following the previous discussion, the authors recommend underwriters to observe the time trend of lock-up periods' expirations and in case at the time of filing the prospectus with SEC an accumulation of expiration dates is detected, the duration of lock-up period should be chosen so that a magnifying effect of lock-up expirations could be avoided. Moreover, if the accumulation is detected after filing the prospectus with SEC, then SEC should be given the authority to intervene and control the expiration to disable the accumulation.

Authors also find it essential to accentuate avoiding herd mentality and doing proper due diligence prior to making an investment. Though it might sound as a generally known aspect, it should be seriously considered, especially taking into account the findings of this thesis, *i.e.* detected signs of entering into another Dot-Com bubble.

Finally, the area of forecasting bubbles in advance is rather uncovered, due to the difficulty behind it. Thus, considering the results of this thesis in conjunction with the fact that the ex-ante analysis regards to determining emergence of a bubble was carried out, the current study is thought to be a perceptible contribution to the available knowledge.

5.2 Proposals for further research

Given the findings of this thesis the following topics for further research are suggested:

- Extended research may include the proxies, which were excluded in the current study due to unavailable access to the data, and enhance data precision for some of the current ones (institutional ownership) to provide additional insights on the effect of the lock-up period on overvaluation, and strengthen the results.
- The study revealed some indirect evidence that non-domestic Internet firms are more heavily shorted and subject to a higher dispersion of investors' belief than domestic Internet firms. However, since non-domestic companies listed on the U.S. stock markets may be subject to different regulations, additional research on this topic is needed to build general inferences and conclusions.
- The event studies in this thesis were carried out using the market model. To assess the robustness of the results, different models, such as the characteristic-based benchmark model, could additionally be applied to the events.
- Further research may also extend the findings on M&A by using not only M&A intensity but also M&A premiums to assess the emergence of a stock price bubble.

REFERENCES

Abreu, D. & Brunnermeier, M. K., 2002. Synchronization risk and delayed arbitrage. *Journal of Financial Economics,* 66(2), p. 341–360.

Abreu, D. & Brunnermeier, M. K., 2003. Bubbles and Crashes. *Econometrica,* 71(1), pp. 173-204.

Ahern, K. R., 2009. Sample selection and event study estimation. *Journal of Empirical Finance,* 16(3), pp. 466-482.

Ajinkya, B. B., Atiase, R. K. & Gift, M. J., 1991. Volume of Trading and the Dispersion in Financial Analysts' Earnings Forecasts. *The Accounting Review,* 66(2), pp. 389-401.

Anderson, A. M. & Dyl, E. A., 2007. Trading Volume: NASDAQ and the NYSE. *Financial Analysts Journal,* 63(3), pp. 79-86.

Anderson, D. R., Sweeney, D. J. & Williams, T. A., 2011. *Statistics for Business and Economics.* 2nd ed. Mason: South-Western CENGAGE Learning.

Asquith, P., Pathak, P. A. & Ritter, J. R., 2005. Short interest, institutional ownership, and stock returns. *Journal of Financial Economics,* 78(2), pp. 243-276.

Bailey, W., Kumar, A. & Ng, D., 2011. Behavioral biases of mutual fund investors. *Journal of Financial Economics,* 102(1), pp. 1-27.

Battalio, R. & Schultz, P., 2006. Options and the Bubble. *The Journal of Finance,* 61(5), pp. 2071-2102.

Boehme, R. D., Danielsen, B. R. & Sorescu, S. M., 2006. Short-Sale Constraints, Differences of Opinion, and Overvaluation. *The Journal of Financial and Quantitative Analysis,* 41(2), pp. 455-487.

Bontis, N. & Mill, J., 2004. Dot-bomb Post-mortem: Web-based metrics and internet stock prices. *Quarterly Journal of Electronic Commerce,* 4(1), pp. 1-25.

Broughton, P. D., 2011. Bubble 2.0 - Ten years after the dot-com bust, investors are wild for the web again. *The Spectator*, 9 April, p. 18.

Brunnermeier, M. K. & Nagel, S., 2004. Hedge Funds and the Technology Bubble. *The Journal of Finance,* 59(5), pp. 2013-2040.

Bryman, A., 2008. *Social Research Methods.* 3rd ed. Oxford: Oxford University Press.

Campbell, J. Y., Lettau, M., Malkiel, B. G. & Xu, Y., 2001. Have Individual Stocks Become More Volatile? An Empirical Exploration of Idiosyncratic Risk. *The Journal of Finance,* 56(1), pp. 1-43.

Cassidy, J., 2002. *Dot.con: How America Lost Its Mind and Money in the Internet Era.* 1st ed. New York: HarperCollins Publishers Inc.

Chen, J., Hong, H. & Stein, J. C., 2002. Breadth of ownership and stock returns. *Journal of Financial Economics,* 66(2), pp. 171-205.

Cochrane, J. H., 2005. Stocks as Money: Convenience Yield and the Tech-Stock Bubble. In: *Asset Price Bubbles.* 1. Edition ed. Massachusetts: MIT Press, pp. 175-203.

Conover, W. J., 1999. *Practical nonparametric statistics.* New York: Wiley.

Corrado, C. J., 2011. Event studies: A methodology review. *Accounting & Finance,* 51(1), pp. 207-234.

Corrado, C. J. & Zivney, T. L., 1992. The Specification and Power of the Sign Test in Event Study Hypothesis Tests Using Daily Stock Returns. *The Journal of Financial and Quantitative Analysis,* 27(3), pp. 465-478.

Corr, T. A., 2007. Boom, Bust, Boom: Internet Company Valuations - From Netscape to Google. *The Financier,* Volume 13/14, pp. 66-84.

Danielsen, B. R. & Sorescu, S. M., 2001. Why Do Option Introductions Depress Stock Prices? A Study of Diminishing Short Sale Constraints. *The Journal of Financial and Quantitative Analysis,* 36(4), pp. 451-484.

D'Avolio, G., 2002. The market for borrowing stock. *Journal of Financial Economics,* 66(2), pp. 271-306.

De Long, B. J., Shleifer, A., Summers, L. H. & Waldmann, R. J., 1990. Positive Feedback Investment Strategies and Destabilizing Rational Speculation. *The Journal of Finance,* 45(2), pp. 379-395.

Diether, K. B., Malloy, C. J. & Scherbina, A., 2002. Differences of Opinion and the Cross Section of Stock Returns. *The Journal of Finance,* 57(5), pp. 2113-2141.

Dodge, Y., 2008. *The Concise Encyclopedia of Statistics.* 1st ed. Neuchatel: Springer Science + Business Media, LLC.

Espenlaub, S., Goergen, M. & Khurshed, A., 2001. IPO Lock-in Agreements in the UK. *Journal of Business Finance & Accounting,* 28(9-10), pp. 1279-1284 .

Field, L. C. & Hanka, G., 2001. The Expiration of IPO Share Lockups. *The Journal of Finance,* 56(2), pp. 471-500.

Figlewski, S., 1981. The Informational Effects of Restrictions on Short Sales: Some Empirical Evidence. *The Journal of Financial and Quantitative Analysis,* 16(4), pp. 463-476.

French, N. & Gabrielli, L., 2005. Discounted cash flow: accounting for uncertainty. *Journal of Property Investment & Finance,* 23(1), pp. 75-89.

Gapper, J., 2012. *Financial Times: Facebook ought to ditch its public offering.* [Online] Available at: http://www.ft.com/intl/cms/s/0/cd03c402-4dba-11e1-a66e-00144feabdc0.html#axzz1s8BLkBw6
[Accessed 28 March 2012].

Gaughan, P. A., 2011. *Mergers, Acquisitions and Corporate Restructurings.* 5th ed. Hoboken: John Wiley & Sons, Inc.

Gavious, I. & Schwartz, D., 2011. Market valuations of start-up ventures around the technology bubble. *International Small Business Journal,* 24(4), pp. 399-415.

Geczy, C. C., Musto, D. K. & Reed, A. V., 2002. Stocks are special too: an analysis of the equity lending market. *Journal of Financial Economics,* 66(2), p. 241–269.

Gel, Y. R., Miao, W. & Gastwirth, J. L., 2007. Robust directed tests of normality against heavy-tailed alternatives. *Computational Statistics and Data Analysis,* 51(5), pp. 2734-2746.

Goergen, M., Renneboog, L. & Khurshed, A., 2006. Explaining the diversity in shareholder lockup agreements. *Journal of Financial Intermediation,* 15(2), pp. 254-280.

Greenwood, R. & Nagel, S., 2009. Inexperienced Investors and Bubbles. *Journal of Financial Economics,* 93(2), pp. 239-258.

Griffin, J. M., Harris, J. H. & Topaloglu, S., 2011. Who Drove and Burst the Tech Bubble?. *The Journal of Finance*, 66(4), pp. 1251-1290.

Gupta, J. & Chevalier, A., 2002. Pertinence of real options approach to the valuation of internet companies. *Operational Research,* 2(2), pp. 187-207.

Gupta, S., 2009. Customer-Based Valuation. *Journal of Interactive Marketing,* 23(2), pp. 169-178.

Gupta, S., Lehmann, D. R. & Stuart, J. A., 2004. Valuing Customers. *Journal of Marketing Research,* 41(1), pp. 7-18.

Hirschorn, M., 2007. The Web 2.0 Bubble. *The Atlantic Monthly*, April, p. 134.

Hong, H., Scheinkman, J. & Xiong, W., 2006. Asset Float and Speculative Bubbles. *The Journal of Finance,* 61(3), pp. 1073-1117.

Hong, H. & Stein, J., 2003. Differences of opinion, short-sales constraints and market crashes,. *Review of Financial Studies,* 16(2), pp. 487 - 525.

Ibbotson, R. G., Sindelar, J. L. & Ritter, J. R., 1988. Initial Public Offerings. *Journal of Applied Corporate Finance,* 1(2), pp. 37-45.

Jones, C. M., Kaul, G. & Lipson, M. L., 1994. Transactions, Volume, and Volatility. *The Review of Financial Studies,* 7(4), pp. 631-651.

Jones, C. M. & Lamont, O. A., 2002. Short-sale constraints and stock returns. *Journal of Financial Economics,* 66(2), pp. 207-239.

Jägle, A. J., 1999. Shareholder Value, Real Options, and Innovation in Technology-Intensive Companies. *R&D Management,* 29(3), pp. 271-288.

Kindleberger, C. P., Aliber, R. Z. & Solow, R., 2011. *Manias, Panics and Crashes: A History of Financial Crises.* 6th ed. New York: Palgrave Macmillan.

Klungerbo, B., Poteat, S. & Woo, J., 2012. *A Persistent Anomaly: Negative abnormal returns following the expiry of IPO share lock-up periods.* [Online] Available at: http://beta-iima.com/publications/the-efficient-frontier/ [Accessed 12 April 2012].

Knowledge@Wharton, 2006. *Knowledge@Wharton.* [Online] Available at: http://knowledge.wharton.upenn.edu/article.cfm?articleid=1570 [Accessed 30 March 2012].

Koller, T., Goedhart, M. & Wessels, D., 2010. *Valuation - Measuring and Managing The Value of Companies.* 5th ed. New Jersey: John Wiley & Sons, Inc.

Kossecki, P., 2009. *Valuation and Value Creation of Internet Companies.* Mrągowo, International Multiconference on Computer Science and Information Technology, pp. 321-323.

Lamont, O. A. & Stein, J. C., 2004. Aggregate Short Interest and Market Valuations. *The American Economic Review,* 94(2), pp. 29-32.

Lamont, O. A. & Thaler, R. H., 2003. Can the Market Add and Subtract? Mispricing in Tech Stock Carve-outs. *Journal of Political Economy,* 111(2), pp. 227-268.

Lee, C. M. C. & Swaminathan, B., 2000. Price Momentum and Trading Volume. *The Journal of Finance,* 55(5), pp. 2017-2069.

MacKinlay, A. C., 1997. Event Studies in Economics and Finance. *Journal of Economic Literature,* 35(1), pp. 13-39.

Makan, A. & Demos, T., 2012. *Financial Times: Short sellers target social network stocks.* [Online]
Available at: http://www.ft.com/intl/cms/s/0/f5283586-51ab-11e1-a99d-00144feabdc0.html#axzz1s8BLkBw6
[Accessed 15 April 2012].

Miller, E. M., 1977. Risk, Uncertainty, and Divergence of Opinion. *The Journal of Finance,* 32(4), pp. 1151-1168.

NASDAQ, 2012. *NASDAQ Short Interest Data Fields & Definitions.* [Online]
Available at: http://www.nasdaqtrader.com/Trader.aspx?id=ShortIntDefs
[Accessed 24 April 2012].

Norman, J. H. & Thiagarajan, S. R., 2009. Asset Bubbles and Market Crises. *Journal of Investing,* 18(4), pp. 6-22.

Ofek, E. & Richardson, M., 2000. The IPO Lock-Up Period: Implications for Market Efficiency And Downward Sloping Demand Curves. *Working Paper, New York University.*

Ofek, E. & Richardson, M., 2003. DotCom Mania: The Rise and Fall of Internet Stock. *The Journal of Finance,* 58(3), pp. 1113-1138.

Ofek, E., Richardson, M. & Whitelaw, R. F., 2004. Limited arbitrage and short sales restrictions: evidence from the options markets. *Journal of Financial Economics,* 74(2), pp. 305-342.

O'Reilly, T., 2005. *What Is Web 2.0.* [Online]
Available at: http://oreilly.com/web2/archive/what-is-web-20.html
[Accessed 27 April 2012].

PricewaterhouseCoopers, 2011. *PwC. Valuation Index: Tracking the market to understand value.* [Online]
Available at: http://www.ukmediacentre.pwc.com/imagelibrary/downloadMedia.ashx?MediaDetailsID=1886
[Accessed 7 January 2012].

Rhodes-Kropf, M., Robinson, D. & Viswanathan, S., 2005. Valuation waves and merger activity: The empirical evidence. *Journal of Financial Economics,* 77(3), pp. 561-603 .

Rosser, J. B., 2000. *From Catastrophe to Chaos: A General Theory of Economic Discontinuities.* 2nd ed. Massachusetts: Kluwer Academic Publishers.

Rushe, D., 2011. *The Guardian: Is this the start of the second dotcom bubble?*. [Online] Available at: http://www.guardian.co.uk/business/2011/feb/20/is-this-the-start-of-the-second-dotcom-bubble
[Accessed 7 March 2012].

Schultz, P., 2008. Downward-Sloping Demand Curves, the Supply of Shares, and the Collapse of Internet Stock Prices. *The Journal of Finance,* 63(1), pp. 351-378.

Shefrin, H., 2007. *Behavioral corporate finance: decisions that create value.* Boston: The McGraw-Hill/Irwin.

Siegel, J. J., 2003. What is an Asset Price Bubble? An Operational Definition. *European Financial Management,* 9(1), pp. 11-24.

Strong, N., 1992. Modelling Abnormal Returns: A Review Article. *Journal of Business Finance & Accounting,* 19(4), pp. 533-553.

The Economist, 2010. *Another bubble? Some tech start-ups look over-valued.* [Online] Available at: http://www.economist.com/node/17733145
[Accessed 7 March 2012].

The Economist, 2011. *Another digital gold rush. Internet companies are booming again. Does that mean it is time to buy or to sell?.* [Online] Available at: http://www.economist.com/node/18680048
[Accessed 7 March 2012].

U.S. Securities and Exchange Commission, 2008. *SEC Halts Short Selling of Financial Stocks to Protect Investors and Markets.* [Online] Available at: http://www.sec.gov/news/press/2008/2008-211.htm
[Accessed 15 April 2012].

U.S. Securities and Exchange Commission, 2012. *Initial Public Offerings: Lockup Agreements.* [Online]
Available at: http://www.sec.gov/answers/lockup.htm
[Accessed 23 April 2012].

Waters, R. & Nuttall, C., 2012. *Financial Times: Facebook to buy Instagram for $1bn.* [Online] Available at: http://www.ft.com/intl/cms/s/0/052cc7c4-8269-11e1-9242-00144feab49a.html#axzz1s1ihq2oM
[Accessed 10 April 2012].

Werner, S. P., 2010. The Event Study Methodology. In: U. Wrasmann & B. Göhrisch-Radmacher, eds. *Short Selling Activities and Convertible Bond Arbitrage. Empirical Evidence from the New York Stock Exchange.* Heidelberg: Gabler Verlag, pp. 53-66.

Villiger, R. & Bogdan, B., 2005. Getting real about valuations in biotech. *Nature biotechnology,* 23(4), pp. 423-428.

Xiong, W. & Yu, J., 2011. The Chinese Warrants bubble. *American Economic Review,* 101(6), pp. 2723-2753.

APPENDICES

Appendix A. Companies in the data sample

Name	Ticker	Non-Internet / Internet	Country	Domestic / non-domestic*
American Assets Trust, Inc.	AAT	non-Internet	U.S.	domestic
Demand Media, Inc.	DMD	Internet	U.S.	domestic
Nielsen Holdings N.V.	NLSN	non-Internet	Netherlands	non-domestic
BCD Semiconductor Manufacturing Limited	BCDS	non-Internet	China	non-domestic
InterXion Holding N.V.	INXN	non-Internet	Netherlands	non-domestic
BankUnited, Inc.	BKU	non-Internet	U.S.	domestic
Adecoagro S.A.	AGRO	non-Internet	Luxembourg	non-domestic
Epocrates, Inc.	EPOC	non-Internet	U.S.	domestic
NeoPhotonics Corporation	NPTN	non-Internet	U.S.	domestic
Trunkbow International Holdings Ltd.	TBOW	Internet	China	non-domestic
Tornier B.V.	TRNX	non-Internet	Netherlands	non-domestic
Pacira Pharmaceuticals, Inc.	PCRX	non-Internet	U.S.	domestic
BG Medicine, Inc.	BGMD	non-Internet	U.S.	domestic
Endocyte, Inc.	ECYT	non-Internet	U.S.	domestic
Imperial Holdings, Inc.	IFT	non-Internet	U.S.	domestic
China Century Dragon Media, Inc.	CDM	non-Internet	China	non-domestic
Summit Hotel Properties, Inc.	INN	non-Internet	U.S.	domestic
Gevo, Inc.	GEVO	non-Internet	U.S.	domestic
Fluidigm Corporation	FLDM	non-Internet	U.S.	domestic
AcelRx Pharmaceuticals, Inc.	ACRX	non-Internet	U.S.	domestic
Kinder Morgan, Inc.	KMI	non-Internet	U.S.	domestic
Kips Bay Medical, Inc.	KIPS	non-Internet	U.S.	domestic
Zuoan Fashion Limited	ZA	non-Internet	China	non-domestic
HCA Holdings, Inc.	HCA	non-Internet	U.S.	domestic
MagnaChip Semiconductor Corporation	MX	non-Internet	South Korea	non-domestic
Cornerstone OnDemand, Inc.	CSOD	Internet	U.S.	domestic
ServiceSource International, Inc.	SREV	non-Internet	U.S.	domestic
Preferred Apartment Communities, Inc.	APTS	non-Internet	U.S.	domestic
Apollo Global Management, LLC	APO	non-Internet	U.S.	domestic
Qihoo 360 Technology Co. Ltd	QIHU	Internet	China	non-domestic
SandRidge Mississippian Trust I	SDT	non-Internet	U.S.	domestic
GNC Holdings, Inc. (former GNC Acquisition Holdings Inc.)	GNC	non-Internet	U.S.	domestic
Tranzyme, Inc.	TZYM	non-Internet	U.S.	domestic
CVR Partners, LP	UAN	non-Internet	U.S.	domestic
Golar LNG Partners, LP	GMLP	non-Internet	Bermuda	non-domestic
Arcos Dorados Holdings, Inc.	ARCO	non-Internet	Argentina	non-domestic
Zipcar, Inc.	ZIP	Internet	U.S.	domestic
Box Ships, Inc.	TEU	non-Internet	Greece	non-domestic
TMS International Corp.	TMS	non-Internet	U.S.	domestic
Ellie Mae, Inc.	ELLI	Internet	U.S.	domestic
Sequans Communications S.A.	SQNS	non-Internet	France	non-domestic
STAG Industrial, Inc.	STIR	non-Internet	U.S.	domestic
Air Lease Corporation	AL	non-Internet	U.S.	domestic
Sagent Pharmaceuticals, Inc.	SGNT	non-Internet	U.S.	domestic
Tesoro Logistics LP	TLLP	non-Internet	U.S.	domestic
21Vianet Group, Inc.	VNET	non-Internet	China	non-domestic
Responsys, Inc.	MKTG	Internet	U.S.	domestic
Boingo Wireless, Inc.	WIFI	non-Internet	U.S.	domestic
Renren Inc.	RENN	Internet	China	non-domestic
RPX Corporation	RPXC	non-Internet	U.S.	domestic
NetQin Mobile Inc.	NQ	Internet	China	non-domestic
Thermon Group Holdings, Inc.	THR	non-Internet	U.S.	domestic
VOC Energy Trust	VOC	non-Internet	U.S.	domestic

Name	Ticker	Non-Internet / Internet	Country	Domestic / non-domestic*
FriendFinder Networks Inc.	FFN	Internet	U.S.	domestic
Jiayuan.com International Ltd.	DATE	Internet	China	non-domestic
Kosmos Energy Ltd.	KOS	non-Internet	Bermuda	non-domestic
RLJ Lodging Trust	RLJ	non-Internet	U.S.	domestic
China Zenix Auto International Limited	ZX	non-Internet	China	non-domestic
NGL Energy Partners LP	NGL	non-Internet	U.S.	domestic
Phoenix New Media Limited	FENG	non-Internet	China	non-domestic
LinkedIn Corporation	LNKD	Internet	U.S.	domestic
Yandex N.V.	YNDX	Internet	Netherlands	non-domestic
The Active Network, Inc.	ACTV	Internet	U.S.	domestic
Spirit Airlines, Inc.	SAVE	non-Internet	U.S.	domestic
Freescale Semiconductor Holdings I, Ltd.	FSL	non-Internet	U.S.	domestic
Lone Pine Resources Inc.	LPR	non-Internet	Canada	non-domestic
Solazyme, Inc.	SZYM	non-Internet	U.S.	domestic
Fusion-io, Inc.	FIO	Internet	U.S.	domestic
Taomee Holdings Limited	TAOM	non-Internet	China	non-domestic
Compressco Partners, LP	GSJK	non-Internet	U.S.	domestic
Pandora Media, Inc.	P	Internet	U.S.	domestic
Bankrate, Inc.	RATE	Internet	U.S.	domestic
Vanguard Health Systems, Inc.	VHS	non-Internet	U.S.	domestic
KiOR, Inc.	KIOR	non-Internet	U.S.	domestic
HomeAway, Inc.	AWAY	Internet	U.S.	domestic
AG Mortgage Investment Trust, Inc.	MITT	non-Internet	U.S.	domestic
Oiltanking Partners, LP	OILT	non-Internet	U.S.	domestic
Skullcandy, Inc.	SKUL	non-Internet	U.S.	domestic
Zillow, Inc.	Z	Internet	U.S.	domestic
SunCoke Energy, Inc.	SXC	non-Internet	U.S.	domestic
Apollo Residential Mortgage, Inc.	AMTG	non-Internet	U.S.	domestic
Francesca's Holdings Corporation	FRAN	non-Internet	U.S.	domestic
Dunkin' Brands Group, Inc.	DNKN	non-Internet	U.S.	domestic
Tangoe, Inc.	TNGO	Internet	U.S.	domestic
American Midstream Partners, LP	AMID	non-Internet	U.S.	domestic
Horizon Pharma, Inc.	HZNP	non-Internet	U.S.	domestic
Wesco Aircraft Holdings, Inc.	WAIR	non-Internet	U.S.	domestic
Chefs' Warehouse Holdings, LLC	CHEF	non-Internet	U.S.	domestic
Teavana Holdings, Inc.	TEA	non-Internet	U.S.	domestic
C&J Energy Services, Inc.	CJES	non-Internet	U.S.	domestic
American Capital Mortgage Investment	MTGE	non-Internet	U.S.	domestic
Carbonite, Inc.	CARB	Internet	U.S.	domestic
SandRidge Permian Trust	PER	non-Internet	U.S.	domestic
Tudou Holdings Limited	TUDO	Internet	China	non-domestic
Shanda Games Limited	GAME	Internet	China	non-domestic
Education Management Corporation	EDMC	non-Internet	U.S.	domestic
Echo Global Logistics, Inc.	ECHO	non-Internet	U.S.	domestic
Ossen Innovation Co. Ltd.	OSN	non-Internet	China	non-domestic
Fortegra Financial Corporation	FRF	non-Internet	U.S.	domestic
Ventrus Biosciences, Inc.	VTUS	non-Internet	U.S.	domestic
QR Energy, LP	QRE	non-Internet	U.S.	domestic
Fleetcor Technologies, Inc.	FLT	non-Internet	U.S.	domestic
Swift Transportation Company (former Swift Holdings Corp.)	SWFT	non-Internet	U.S.	domestic
RigNet, Inc.	RNET	Internet	U.S.	domestic
GAIN Capital Holdings, Inc.	GCAP	non-Internet	U.S.	domestic
iSoftStone Holdings Limited	ISS	non-Internet	China	non-domestic
Walker & Dunlop, Inc.	WD	non-Internet	U.S.	domestic
Sky-mobi Limited	MOBI	Internet	China	non-domestic
Bona Film Group Limited	BONA	non-Internet	China	non-domestic
SemiLEDs Corporation	LEDS	non-Internet	Taiwan	non-domestic
Youku.com, Inc.	YOKU	Internet	China	non-domestic
CTPartners Executive Search, LLC	CTP	non-Internet	U.S.	domestic

Name	Ticker	Non-Internet / Internet	Country	Domestic / non-domestic*
E-Commerce China Dangdang, Inc.	DANG	Internet	China	non-domestic
Targa Resources Investments, Inc.	TRGP	non-Internet	U.S.	domestic
FXCM, Inc.	FXCM	non-Internet	U.S.	domestic
Anacor Pharmaceuticals, Inc.	ANAC	non-Internet	U.S.	domestic
Syswin, Inc.	SYSW	non-Internet	China	non-domestic
Zogenix, Inc.	ZGNX	non-Internet	U.S.	domestic
China Xiniya Fashion Limited	XNY	non-Internet	China	non-domestic
Aeroflex Holding Corp.	ARX	non-Internet	U.S.	domestic
Lizhan Environmental Corp.	LZEN	non-Internet	China	non-domestic
LPL Investment Holdings, Inc.	LPLA	non-Internet	U.S.	domestic
General Motors Company	GM	non-Internet	U.S.	domestic
Booz Allen Hamilton, Inc.	BAH	non-Internet	U.S.	domestic
Bitauto Holdings Limited	BITA	Internet	China	non-domestic
Noah Holdings Limited	NOAH	non-Internet	China	non-domestic
Complete Genomics, Inc.	GNOM	non-Internet	U.S.	domestic
Lentuo International, Inc.	LAS	non-Internet	China	non-domestic
The Fresh Market, Inc.	TFM	non-Internet	U.S.	domestic
Primo Water Corporation	PRMW	non-Internet	U.S.	domestic
Costamare, Inc.	CMRE	non-Internet	Greece	non-domestic
SodaStream International Ltd.	SODA	non-Internet	Israel	non-domestic
SinoTech Energy Limited	CTE	non-Internet	China	non-domestic
Xueda Education Group	XUE	Internet	China	non-domestic
ExamWorks Group, Inc.	EXAM	non-Internet	U.S.	domestic
SeaCube Container Leasing Ltd.	BOX	non-Internet	U.S.	domestic
Pacific Biosciences of California, Inc.	PACB	non-Internet	U.S.	domestic
Mecox Lane Limited	MCOX	Internet	China	non-domestic
Aegerion Pharmaceuticals, Inc.	AEGR	non-Internet	U.S.	domestic
Vera Bradley, Inc.	VRA	non-Internet	U.S.	domestic
Bravo Brio Restaurant Group, Inc.	BBRG	non-Internet	U.S.	domestic
TAL Education Group	XRS	non-Internet	China	non-domestic
NetSpend Holdings, Inc.	NTSP	non-Internet	U.S.	domestic
ShangPharma Corporation	SHP	non-Internet	China	non-domestic
Body Central Corp. (former Body Central Acquisition Corp.)	BODY	non-Internet	U.S.	domestic
Tower International, Inc.	TOWR	non-Internet	U.S.	domestic
Campus Crest Communities, Inc.	CCG	non-Internet	U.S.	domestic
Ellington Financial, LLC	EFC	non-Internet	U.S.	domestic
Daqo New Energy Corp.	DQ	non-Internet	China	non-domestic
ChinaCache International Holdings Ltd.	CCIH	non-Internet	China	non-domestic
The KEYW Holding Corporation	KEYW	non-Internet	U.S.	domestic
Elster Group SE	ELT	non-Internet	Germany	non-domestic
Envestnet, Inc.	ENV	non-Internet	U.S.	domestic
SciQuest, Inc.	SQI	Internet	U.S.	domestic
Camelot Information Systems, Inc.	CIS	Internet	China	non-domestic
SouFun Holdings Limited	SFUN	non-Internet	China	non-domestic
RealD, Inc.	RLD	non-Internet	U.S.	domestic
Electromed, Inc.	ELMD	non-Internet	U.S.	domestic
Ambow Education Holding Ltd.	AMBO	Internet	China	non-domestic
Trius Therapeutics, Inc.	TSRX	non-Internet	U.S.	domestic
Whitestone REIT	WSR	non-Internet	U.S.	domestic
MakeMyTrip Limited	MMYT	non-Internet	India	non-domestic
RealPage, Inc.	RP	Internet	U.S.	domestic
China Kanghui Holdings	KH	non-Internet	China	non-domestic
IntraLinks Holdings, Inc.	IL	Internet	U.S.	domestic
NXP Semiconductors N.V.	NXPI	non-Internet	Netherlands	non-domestic
Gordmans Stores, Inc.	GMAN	non-Internet	U.S.	domestic
Chesapeake Midstream Partners, LP	CHKM	non-Internet	U.S.	domestic
Molycorp, Inc.	MCP	non-Internet	U.S.	domestic
Ameresco, Inc.	AMRC	non-Internet	U.S.	domestic
Green Dot Corp.	GDOT	non-Internet	U.S.	domestic

Name	Ticker	Non-Internet / Internet	Country	Domestic / non-domestic*
Qlik Technologies, Inc.	QLIK	Internet	U.S.	domestic
SMART Technologies, Inc.	SMT	non-Internet	Canada	non-domestic
Oxford Resource Partners, LP	OXF	non-Internet	U.S.	domestic
AutoNavi Holdings Limited	AMAP	Internet	China	non-domestic
HiSoft Technology International Limited	HSFT	Internet	China	non-domestic
Tesla Motors, Inc.	TSLA	non-Internet	U.S.	domestic
Fabrinet	FN	non-Internet	Cayman Islands	non-domestic
Hudson Pacific Properties, Inc.	HPP	non-Internet	U.S.	domestic
Oasis Petroleum, Inc.	OAS	non-Internet	U.S.	domestic
Motricity, Inc.	MOTR	Internet	U.S.	domestic
Higher One Holdings, Inc.	ONE	non-Internet	U.S.	domestic
BroadSoft, Inc.	BSFT	Internet	U.S.	domestic
CBOE Holdings, Inc.	CBOE	non-Internet	U.S.	domestic
China New Borun Corporation	BORN	non-Internet	China	non-domestic
GenMark Diagnostics, Inc.	GNMK	non-Internet	U.S.	domestic
ReachLocal, Inc.	RLOC	Internet	U.S.	domestic
Noranda Aluminum Holding Corp.	NOR	non-Internet	U.S.	domestic
JinkoSolar Holding Co. Ltd.	JKS	non-Internet	China	non-domestic
Kingtone Wirelessinfo Solution Holding Ltd.	KONE	non-Internet	China	non-domestic
Roadrunner Transportation Systems, Inc. (former Roadrunner Transportation Services Holdings, Inc.)	RRTS	non-Internet	U.S.	domestic
Express, Inc. (former Express Parent, LLC)	EXPR	non-Internet	U.S.	domestic
TeleNav, Inc.	TNAV	Internet	U.S.	domestic
Niska Gas Storage Partners, LLC	NKA	non-Internet	U.S.	domestic
Douglas Dynamics, Inc.	PLOW	non-Internet	U.S.	domestic
Charm Communications, Inc.	CHRM	non-Internet	China	non-domestic
PAA Natural Gas Storage, LP	PNG	non-Internet	U.S.	domestic
Alpha & Omega Semiconductor Limited	AOSL	non-Internet	U.S.	domestic
Convio, Inc.	CNVO	Internet	U.S.	domestic
Codexis, Inc.	CDXS	non-Internet	U.S.	domestic
Global Geophysical Services, Inc.	GGS	non-Internet	U.S.	domestic
Alimera Sciences, Inc.	ALIM	non-Internet	U.S.	domestic
DynaVox, Inc.	DVOX	non-Internet	U.S.	domestic
Excel Trust, Inc.	EXL	non-Internet	U.S.	domestic
Mitel Networks Corporation	MITL	non-Internet	Canada	non-domestic
SPS Commerce, Inc.	SPSC	Internet	U.S.	domestic
Primerica, Inc.	PRI	non-Internet	U.S.	domestic
Meru Networks, Inc.	MERU	non-Internet	U.S.	domestic
Scorpio Tankers, Inc.	STNG	non-Internet	Monaco	non-domestic
MaxLinear, Inc.	MXL	non-Internet	U.S.	domestic
Financial Engines, Inc.	FNGN	non-Internet	U.S.	domestic
Anthera Pharmaceuticals, Inc.	ANTH	non-Internet	U.S.	domestic
Generac Holdings, Inc.	GNRC	non-Internet	U.S.	domestic
QuinStreet, Inc.	QNST	Internet	U.S.	domestic
Terreno Realty Corporation	TRNO	non-Internet	U.S.	domestic
Piedmont Office Realty Trust, Inc.	PDM	non-Internet	U.S.	domestic
IFM Investments Limited	CTC	non-Internet	China	non-domestic
Verisk Analytics, Inc.	VRSK	non-Internet	U.S.	domestic
Banco Santander (Brasil) S.A.	BSBR	non-Internet	Brazil	non-domestic
Mistras Group, Inc.	MG	non-Internet	U.S.	domestic
RailAmerica, Inc.	RA	non-Internet	U.S.	domestic
ZST Digital Networks, Inc.	ZSTN	non-Internet	China	non-domestic
Vitamin Shoppe, Inc. (former The Vitamin Shoppe, Inc.)	VSI	non-Internet	U.S.	domestic
Hyatt Hotels Corporation	H	non-Internet	U.S.	domestic
STR Holdings, Inc. (former STR Holdings, LLC)	STRI	non-Internet	U.S.	domestic
Fortinet, Inc.	FTNT	non-Internet	U.S.	domestic
Cloud Peak Energy, Inc.	CLD	non-Internet	U.S.	domestic
7 Days Group Holdings Limited	SVN	non-Internet	China	non-domestic

Name	Ticker	Non-Internet / Internet	Country	Domestic / non-domestic*
Archipelago Learning, Inc.	ARCL	Internet	U.S.	domestic
Pebblebrook Hotel Trust	PEB	non-Internet	U.S.	domestic
China Nuokang Bio-Pharmaceutical, Inc.	NKBP	non-Internet	China	non-domestic
Chesapeake Lodging Trust	CHSP	non-Internet	U.S.	domestic
Cobalt International Energy, Inc.	CIE	non-Internet	U.S.	domestic
Team Health Holdings, LLC	TMH	non-Internet	U.S.	domestic
Kraton Performance Polymers, Inc.	KRA	non-Internet	U.S.	domestic

**domestic refers to the U.S. companies*

Source: created by authors

Appendix B. Definitions of abbreviations used in statistical tests

Abbreviation	Definition
RSI_PRE	Relative short interest on the closest short interest reporting date before lock-up expiration or before the announcement about Facebook's IPO
RSI_POST1	Relative short interest on the closest short interest reporting date after lock-up expiration or after the announcement about Facebook's IPO
RSI_POST2	Relative short interest on the 2nd closest short interest reporting date after lock-up expiration or after the announcement about Facebook's IPO
RSI_POST3	Relative short interest on the 3rd closest short interest reporting date after lock-up expiration or after the announcement about Facebook's IPO
INST_OWNER_PRE	Total institutional ownership on the closest short interest reporting date before lock-up expiration or before the announcement about Facebook's IPO
INST_OWNER_POST1	Total institutional ownership on the closest short interest reporting date after lock-up expiration or after the announcement about Facebook's IPO
INST_OWNER_POST2	Total institutional ownership on the 2nd closest short interest reporting date after lock-up expiration or after the announcement about Facebook's IPO
INST_OWNER_POST3	Total institutional ownership on the 3rd closest short interest reporting date after lock-up expiration or after the announcement about Facebook's IPO
VOL_PRE	Relative trading volume proxy before lock-up expiration or before the announcement about Facebook's IPO
VOL_POST1	Relative trading volume proxy after lock-up expiration or after the announcement about Facebook's IPO
ANAL_FC_PRE	Coefficient of variation for analysts' annual forecasts (estimated from I/B/E/S) on the closest short interest reporting date before lock-up expiration or before the announcement about Facebook's IPO
ANAL_FC_POST1	Coefficient of variation for analysts' annual forecasts (estimated from I/B/E/S) on the closest short interest reporting date after lock-up expiration or after the announcement about Facebook's IPO
ANAL_FC_POST2	Coefficient of variation for analysts' annual forecasts (estimated from I/B/E/S) on the 2nd closest short interest reporting date after lock-up expiration or after the announcement about Facebook's IPO
ANAL_FC_POST3	Coefficient of variation for analysts' annual forecasts (estimated from I/B/E/S) on the 3rd closest short interest reporting date after lock-up expiration or after the announcement about Facebook's IPO
NR_ANAL_PRE	Number of analysts following the firm on the closest short interest reporting date before lock-up expiration or before the announcement about Facebook's IPO
NR_ANAL_POST1	Number of analysts following the firm on the closest short interest reporting date after lock-up expiration or after the announcement about Facebook's IPO
NR_ANAL_POST2	Number of analysts following the firm on the 2nd closest short interest reporting date after lock-up expiration or after the announcement about Facebook's IPO
NR_ANAL_POST3	Number of analysts following the firm on the 3rd closest short interest reporting date after lock-up expiration or after the announcement about Facebook's IPO

Source: created by authors

Appendix C. Normality tests for the whole sample

Proxy	Non-Internet / Internet	*Kolmogorov-Smirnov***			Shapiro-Wilk		
		Statistic	*df*	*Sig.*	Statistic	df	Sig.
RSI_PRE	non-Internet	*0.239*	*189*	*0.000*[a]	0.646	189	0.000[a]
	Internet	*0.228*	*46*	*0.000*[a]	0.684	46	0.000[a]
RSI_POST1	non-Internet	*0.227*	*189*	*0.000*[a]	0.681	189	0.000[a]
	Internet	*0.231*	*46*	*0.000*[a]	0.676	46	0.000[a]
RSI_POST2	non-Internet	*0.228*	*189*	*0.000*[a]	0.689	189	0.000[a]
	Internet	*0.271*	*46*	*0.000*[a]	0.662	46	0.000[a]
RSI_POST3	non-Internet	*0.231*	*189*	*0.000*[a]	0.677	189	0.000[a]
	Internet	*0.250*	*46*	*0.000*[a]	0.648	46	0.000[a]
INST_OWNER_PRE	non-Internet	*0.207*	*189*	*0.000*[a]	0.805	189	0.000[a]
	Internet	*0.254*	*46*	*0.000*[a]	0.797	46	0.000[a]
INST_OWNER_POST1	non-Internet	*0.202*	*189*	*0.000*[a]	0.812	189	0.000[a]
	Internet	*0.244*	*46*	*0.000*[a]	0.812	46	0.000[a]
INST_OWNER_POST2	non-Internet	*0.204*	*189*	*0.000*[a]	0.810	189	0.000[a]
	Internet	*0.227*	*46*	*0.000*[a]	0.811	46	0.000[a]
INST_OWNER_POST3	non-Internet	*0.196*	*189*	*0.000*[a]	0.824	189	0.000[a]
	Internet	*0.229*	*46*	*0.000*[a]	0.807	46	0.000[a]
VOL_PRE	non-Internet	*0.266*	*189*	*0.000*[a]	0.504	189	0.000[a]
	Internet	*0.341*	*46*	*0.000*[a]	0.370	46	0.000[a]
VOL_POST1	non-Internet	*0.249*	*189*	*0.000*[a]	0.563	189	0.000[a]
	Internet	*0.388*	*46*	*0.000*[a]	0.287	46	0.000[a]
ANAL_FC_PRE	non-Internet	*0.429*	*189*	*0.000*[a]	0.116	189	0.000[a]
	Internet	*0.342*	*46*	*0.000*[a]	0.371	46	0.000[a]
ANAL_FC_POST1	non-Internet	*0.430*	*189*	*0.000*[a]	0.116	189	0.000[a]
	Internet	*0.299*	*46*	*0.000*[a]	0.526	46	0.000[a]
ANAL_FC_POST2	non-Internet	*0.430*	*189*	*0.000*[a]	0.125	189	0.000[a]
	Internet	*0.238*	*46*	*0.000*[a]	0.610	46	0.000[a]
ANAL_FC_POST3	non-Internet	*0.434*	*189*	*0.000*[a]	0.110	189	0.000[a]
	Internet	*0.259*	*46*	*0.000*[a]	0.606	46	0.000[a]
NR_ANAL_PRE	non-Internet	*0.170*	*189*	*0.000*[a]	0.854	189	0.000[a]
	Internet	*0.150*	*46*	*0.011*[b]	0.954	46	0.067[c]
NR_ANAL_POST1	non-Internet	*0.155*	*189*	*0.000*[a]	0.870	189	0.000[a]
	Internet	*0.192*	*46*	*0.000*[a]	0.943	46	0.026[b]
NR_ANAL_POST2	non-Internet	*0.147*	*189*	*0.000*[a]	0.877	189	0.000[a]
	Internet	*0.180*	*46*	*0.001*[a]	0.932	46	0.010[b]
NR_ANAL_POST3	non-Internet	*0.132*	*189*	*0.000*[a]	0.883	189	0.000[a]
	Internet	*0.204*	*46*	*0.000*[a]	0.942	46	0.023[b]

***. Lilliefors Significance Correction*

[a] significant at 1% level
[b] significant at 5% level
[c] significant at 10% level

In the table above "Statistic" refers to either Kolmogorov-Smirnov or Shapiro-Wilk statistics that are used to calculate the significance levels and determine normality of the distribution. "df" represents degrees of freedom. In this case to decide whether the distribution is normal, The Shapiro-Wilk test significance figures are looked at, since being the most used normality test. The significance levels are all below 5% except for number of analysts before lock-up expiration for Internet firms. Thus, the null hypothesis is rejected in all cases except for the mentioned one. Accepting the alternative hypothesis infers that the data is not normally distributed. Accepting the null hypothesis for number of analysts pre lock-up refers to normal distribution at the 5% level. Nonetheless, since this applies to only part of one proxy and Internet firms, but not to non-Internet companies, the overall analysis is still conducted using Mann-Whitney U-test.

Source: created by authors using SPSS 20

Appendix D. Normality tests for the domestic only sample

Proxy	Non-Internet / Internet	*Kolmogorov-Smirnov***			Shapiro-Wilk		
		Statistic	*df*	*Sig.*	Statistic	df	Sig.
RSI_PRE	non-Internet	*0.218*	*137*	*0.000*[a]	0.661	137	0.000[a]
	Internet	*0.200*	*28*	*0.005*[a]	0.827	28	0.000[a]
RSI_POST1	non-Internet	*0.206*	*137*	*0.000*[a]	0.699	137	0.000[a]
	Internet	*0.199*	*28*	*0.006*[a]	0.791	28	0.000[a]
RSI_POST2	non-Internet	*0.207*	*137*	*0.000*[a]	0.708	137	0.000[a]
	Internet	*0.242*	*28*	*0.000*[a]	0.767	28	0.000[a]
RSI_POST3	non-Internet	*0.208*	*137*	*0.000*[a]	0.692	137	0.000[a]
	Internet	*0.215*	*28*	*0.002*[a]	0.793	28	0.000[a]
INST_OWNER_PRE	non-Internet	*0.169*	*137*	*0.000*[a]	0.860	137	0.000[a]
	Internet	*0.173*	*28*	*0.031*[b]	0.892	28	0.008[a]
INST_OWNER_POST1	non-Internet	*0.162*	*137*	*0.000*[a]	0.868	137	0.000[a]
	Internet	*0.156*	*28*	*0.078*[c]	0.900	28	0.011[b]
INST_OWNER_POST2	non-Internet	*0.164*	*137*	*0.000*[a]	0.866	137	0.000[a]
	Internet	*0.160*	*28*	*0.065*[c]	0.887	28	0.006[a]
INST_OWNER_POST3	non-Internet	*0.157*	*137*	*0.000*[a]	0.877	137	0.000[a]
	Internet	*0.177*	*28*	*0.025*[b]	0.873	28	0.003[a]
VOL_PRE	non-Internet	*0.246*	*137*	*0.000*[a]	0.532	137	0.000[a]
	Internet	*0.277*	*28*	*0.000*[a]	0.706	28	0.000[a]
VOL_POST1	non-Internet	*0.247*	*137*	*0.000*[a]	0.579	137	0.000[a]
	Internet	*0.212*	*28*	*0.002*[a]	0.727	28	0.000[a]
ANAL_FC_PRE	non-Internet	*0.428*	*137*	*0.000*[a]	0.127	137	0.000[a]
	Internet	*0.393*	*28*	*0.000*[a]	0.301	28	0.000[a]
ANAL_FC_POST1	non-Internet	*0.428*	*137*	*0.000*[a]	0.128	137	0.000[a]
	Internet	*0.314*	*28*	*0.000*[a]	0.540	28	0.000[a]
ANAL_FC_POST2	non-Internet	*0.427*	*137*	*0.000*[a]	0.140	137	0.000[a]
	Internet	*0.325*	*28*	*0.000*[a]	0.550	28	0.000[a]
ANAL_FC_POST3	non-Internet	*0.431*	*137*	*0.000*[a]	0.124	137	0.000[a]
	Internet	*0.357*	*28*	*0.000*[a]	0.532	28	0.000[a]
NR_ANAL_PRE	non-Internet	*0.189*	*137*	*0.000*[a]	0.841	137	0.000[a]
	Internet	*0.179*	*28*	*0.022*[b]	0.956	28	0.286
NR_ANAL_POST1	non-Internet	*0.170*	*137*	*0.000*[a]	0.857	137	0.000[a]
	Internet	*0.202*	*28*	*0.005*[a]	0.925	28	0.046[b]
NR_ANAL_POST2	non-Internet	*0.148*	*137*	*0.000*[a]	0.873	137	0.000[a]
	Internet	*0.207*	*28*	*0.003*[a]	0.886	28	0.005[a]
NR_ANAL_POST3	non-Internet	*0.128*	*137*	*0.000*[a]	0.883	137	0.000[a]
	Internet	*0.214*	*28*	*0.002*[a]	0.927	28	0.052[c]

***. Lilliefors Significance Correction*

[a] significant at 1% level
[b] significant at 5% level
[c] significant at 10% level

In the table above "Statistic" refers to either Kolmogorov-Smirnov or Shapiro-Wilk statistics that are used to calculate the significance levels and determine normality of the distribution. "df" represents degrees of freedom. In this case to decide whether the distribution is normal, The Shapiro-Wilk test significance figures are looked at, since being the most used normality test. The significance levels are all below 5% except for number of analysts before lock-up expiration and number of analysts post 3rd closest lock-up expiration for Internet firms. Thus, the null hypothesis is rejected in all cases except for the mentioned two. Accepting the alternative hypothesis infers that the data is not normally distributed. Accepting the null hypothesis for number of analysts pre and 3rd closest post lock-up refers to normal distribution at the 5% level. Nonetheless, since this applies to only part of one proxy and Internet firms, but not to non-Internet companies, the overall analysis is still conducted using Mann-Whitney U-test.

Source: created by authors using SPSS 20

Appendix E. Normality tests for the announcement about Facebook's IPO sample

Proxy	Non-Internet / Internet	Kolmogorov-Smirnov**			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
RSI_PRE	non-Internet	0.245	189	0.000[a]	0.641	189	0.000[a]
	Internet	0.209	46	0.000[a]	0.730	46	0.000[a]
RSI_POST1	non-Internet	0.251	189	0.000[a]	0.631	189	0.000[a]
	Internet	0.220	46	0.000[a]	0.731	46	0.000[a]
RSI_POST2	non-Internet	0.245	189	0.000[a]	0.650	189	0.000[a]
	Internet	0.230	46	0.000[a]	0.730	46	0.000[a]
RSI_POST3	non-Internet	0.243	189	0.000[a]	0.661	189	0.000[a]
	Internet	0.211	46	0.000[a]	0.726	46	0.000[a]
INST_OWNER_PRE	non-Internet	0.174	189	0.000[a]	0.859	189	0.000[a]
	Internet	0.226	46	0.000[a]	0.853	46	0.000[a]
INST_OWNER_POST1	non-Internet	0.175	189	0.000[a]	0.858	189	0.000[a]
	Internet	0.195	46	0.000[a]	0.873	46	0.000[a]
INST_OWNER_POST2	non-Internet	0.173	189	0.000[a]	0.860	189	0.000[a]
	Internet	0.179	46	0.001[a]	0.884	46	0.000[a]
INST_OWNER_POST3	non-Internet	0.162	189	0.000[a]	0.876	189	0.000[a]
	Internet	0.116	46	0.148	0.921	46	0.004[a]
VOL_PRE	non-Internet	0.197	189	0.000[a]	0.657	189	0.000[a]
	Internet	0.234	46	0.000[a]	0.653	46	0.000[a]
VOL_POST1	non-Internet	0.239	189	0.000[a]	0.603	189	0.000[a]
	Internet	0.250	46	0.000[a]	0.682	46	0.000[a]
ANAL_FC_PRE	non-Internet	0.297	189	0.000[a]	0.549	189	0.000[a]
	Internet	0.239	46	0.000[a]	0.663	46	0.000[a]
ANAL_FC_POST1	non-Internet	0.298	189	0.000[a]	0.541	189	0.000[a]
	Internet	0.240	46	0.000[a]	0.665	46	0.000[a]
ANAL_FC_POST2	non-Internet	0.298	189	0.000[a]	0.541	189	0.000[a]
	Internet	0.240	46	0.000[a]	0.665	46	0.000[a]
ANAL_FC_POST3	non-Internet	0.266	189	0.000[a]	0.604	189	0.000[a]
	Internet	0.322	46	0.000[a]	0.424	46	0.000[a]
NR_ANAL_PRE	non-Internet	0.147	189	0.000[a]	0.888	189	0.000[a]
	Internet	0.123	46	0.076[c]	0.968	46	0.238
NR_ANAL_POST1	non-Internet	0.146	189	0.000[a]	0.888	189	0.000[a]
	Internet	0.120	46	0.096[c]	0.952	46	0.058[c]
NR_ANAL_POST2	non-Internet	0.146	189	0.000[a]	0.888	189	0.000[a]
	Internet	0.120	46	0.096[c]	0.952	46	0.058[c]
NR_ANAL_POST3	non-Internet	0.139	189	0.000[a]	0.882	189	0.000[a]
	Internet	0.111	46	0.200	0.952	46	0.058[c]

***. Lilliefors Significance Correction*

[a] significant at 1% level
[b] significant at 5% level
[c] significant at 10% level

In the table above "Statistic" refers to either Kolmogorov-Smirnov or Shapiro-Wilk statistics that are used to calculate the significance levels and determine normality of the distribution. "df" represents degrees of freedom. In this case to decide whether the distribution is normal, The Shapiro-Wilk test significance figures are looked at, since being the most used normality test. The significance levels are all below 5% except for number of analysts for Internet firms. Thus, the null hypothesis is rejected in all cases except for the mentioned one. Accepting the alternative hypothesis infers that the data is not normally distributed. Accepting the null hypothesis for number of analysts refers to normal distribution at the 5% level. Nonetheless, since this applies to only one proxy and Internet firms, but not to non-Internet companies, the overall analysis is still conducted using Mann-Whitney U-test.

Source: created by authors using SPSS 20

Appendix F. Normality tests for CARs (event: expiration of lock-up period)

Proxy	Non-Internet / Internet	*Kolmogorov-Smirnov***			Shapiro-Wilk		
		Statistic	*df*	*Sig.*	Statistic	df	Sig.
CAR_-5_-1	non-Internet	*0.090*	*189*	*0.001*[a]	0.920	189	0.000[a]
	Internet	*0.116*	*46*	*0.147*	0.973	46	0.351
CAR_-5_+5	non-Internet	*0.054*	*189*	*0.200**	0.977	189	0.004[a]
	Internet	*0.142*	*46*	*0.021*[b]	0.953	46	0.060[c]
CAR_-1_+1	non-Internet	*0.086*	*189*	*0.002*[a]	0.960	189	0.000[a]
	Internet	*0.134*	*46*	*0.038*[b]	0.934	46	0.012[b]
CAR_0	non-Internet	*0.094*	*189*	*0.000*[a]	0.945	189	0.000[a]
	Internet	*0.131*	*46*	*0.048*[b]	0.911	46	0.002[a]
CAR_+1_+10	non-Internet	*0.069*	*189*	*0.030*[b]	0.959	189	0.000[a]
	Internet	*0.147*	*46*	*0.015*[b]	0.944	46	0.027[b]
CAR_-5	*non-Internet*	*0.107*	*189*	*0.000*[a]	*0.941*	*189*	*0.000*[a]
	Internet	*0.076*	*46*	*0.200**	*0.984*	*46*	*0.777*
CAR_-4	*non-Internet*	*0.132*	*189*	*0.000*[a]	*0.948*	*189*	*0.000*[a]
	Internet	*0.140*	*46*	*0.024*[b]	*0.935*	*46*	*0.013*[b]
CAR_-3	*non-Internet*	*0.138*	*189*	*0.000*[a]	*0.844*	*189*	*0.000*[a]
	Internet	*0.114*	*46*	*0.164*	*0.971*	*46*	*0.307*
CAR_-2	*non-Internet*	*0.104*	*189*	*0.000*[a]	*0.908*	*189*	*0.000*[a]
	Internet	*0.161*	*46*	*0.004*[a]	*0.941*	*46*	*0.021*[b]
CAR_-1	*non-Internet*	*0.119*	*189*	*0.000*[a]	*0.821*	*189*	*0.000*[a]
	Internet	*0.147*	*46*	*0.014*[b]	*0.920*	*46*	*0.004*[a]

**. This is a lower bound of the true significance.*
***. Lilliefors Significance Correction*

[a] significant at 1% level
[b] significant at 5% level
[c] significant at 10% level

In the table above "Statistic" refers to either Kolmogorov-Smirnov or Shapiro-Wilk statistics that are used to calculate the significance levels and determine normality of the distribution. "df" represents degrees of freedom. In this case to decide whether the distribution is normal, The Shapiro-Wilk test significance figures are looked at, since being the most used normality test. The significance levels are all below 5% for non-internet firms and, thus, the null hypothesis is rejected. For Internet firms CAR_-5_-1, CAR_-5_+5, CAR_-5 and CAR_-3 follow normal distribution and thus null hypothesis is accepted for these cases. For other cases, accepting the alternative hypothesis infers that the data is not normally distributed.

Source: created by authors using SPSS 20

Appendix G. Domestic Internet firms' CARs and their significance (event: expiration of lock-up period)

Event windows and separate days	CAR		Wilcoxon signed rank test	Student's t-test		Shapiro-Wilk	
	Median	Mean	Sig.	t-statistic	Sig.	Statistic	Sig.
CAR_-5_-1	-0.018	-0.025	0.092	-1.531	0.137	0.964	0.438
CAR_-5_+5	-0.041	-0.035	0.187	-1.652	0.110	0.967	0.505
CAR_-1_+1	0.005	-0.008	0.964	-0.591	0.559	0.827	0.000[a]
CAR_0	-0.006	-0.001	0.649	-0.188	0.852	0.944	0.142
CAR_+1_+10	-0.018	-0.038	0.202	-1.636	0.113	0.952	0.224
CAR_-5	*-0.018*	*-0.012*	*0.062*[c]	*-1.785*	*0.086*[c]	*0.974*	*0.689*
CAR_-4	*0.000*	*-0.002*	*0.750*	*-0.301*	*0.766*	*0.956*	*0.273*
CAR_-3	*0.002*	*0.005*	*0.682*	*0.775*	*0.445*	*0.958*	*0.311*
CAR_-2	*-0.004*	*-0.011*	*0.106*	*-1.792*	*0.084*[c]	*0.960*	*0.357*
CAR_-1	*-0.001*	*-0.006*	*0.399*	*-1.144*	*0.263*	*0.920*	*0.035*[b]

[a] *significant at 1% level*
[b] *significant at 5% level*
[c] *significant at 10% level*

Respective CARs are calculated for the period as of the starting until the ending day specified in each CAR's name (e.g. CAR [-1 ...+1] is the cumulative abnormal return as of day -1 until day +1; CAR [0] represents abnormal return on day 0, i.e. the lock-up expiration day). Shapiro-Wilk significance figures indicate whether the data is normally distributed or not. Null hypothesis of normal distribution is rejected if the significance figures are below 5% level. If, however null hypothesis is retained (i.e. significance figures are above 5% level), Student's t-test results are also considered in making conclusions, although as said above, more emphasis is put on Wilcoxon signed rank test. Wilcoxon signed rank test includes only the significance, since SPSS output does not provide a statistic.

Source: created by authors using SPSS 20

Appendix H. Domestic non-Internet firms' CARs and their significance (event: expiration of lock-up period)

Event windows and separate days	CAR		Wilcoxon signed rank test	Student's t-test		Shapiro-Wilk	
	Median	Mean	Sig.	t-statistic	Sig.	Statistic	Sig.
CAR_-5_-1	-0.005	-0.008	0.154	-1.331	0.185	0.987	0.216
CAR_-5_+5	-0.011	-0.001	0.776	-0.104	0.917	0.993	0.721
CAR_-1_+1	0.000	0.000	0.997	0.089	0.929	0.972	0.006[a]
CAR_0	0.000	-0.004	0.263	-1.441	0.152	0.898	0.000[a]
CAR_+1_+10	0.010	0.007	0.167	0.809	0.420	0.945	0.000[a]
CAR_-5	*0.002*	*0.003*	*0.313*	*1.158*	*0.249*	*0.899*	*0.000*[a]
CAR_-4	*-0.001*	*-0.002*	*0.260*	*-0.772*	*0.442*	*0.954*	*0.000*[a]
CAR_-3	*-0.004*	*-0.004*	*0.044*[b]	*-1.939*	*0.055*[c]	*0.968*	*0.003*[a]
CAR_-2	*-0.003*	*-0.005*	*0.095*[c]	*-1.448*	*0.150*	*0.883*	*0.000*[a]
CAR_-1	*0.000*	*0.000*	*0.886*	*-0.141*	*0.888*	*0.965*	*0.002*[a]

[a] *significant at 1% level*
[b] *significant at 5% level*
[c] *significant at 10% level*

Respective CARs are calculated for the period as of the starting until the ending day specified in each CAR's name (e.g. CAR [-1 ...+1] is the cumulative abnormal return as of day -1 until day +1; CAR [0] represents abnormal return on day 0, i.e. the lock-up expiration day). Shapiro-Wilk significance figures indicate whether the data is normally distributed or not. Null hypothesis of normal distribution is rejected if the significance figures are below 5% level. If, however null hypothesis is retained (i.e. significance figures are above 5% level), Student's t-test results are also considered in making conclusions, although as said above, more emphasis is put on Wilcoxon signed rank test. Wilcoxon signed rank test includes only the significance, since SPSS output does not provide a statistic.

Source: created by authors using SPSS 20

Appendix I. Comparison of CARs between domestic Internet and domestic non-Internet firms (event: expiration of lock-up period)

Proxy	Non-Internet / Internet	Median	Mean	Z	Asymp. Sig. (2-tailed)
CAR_-5_-1	non-Internet	-0.005	-0.008		
	Internet	-0.018	-0.025		
	Difference	**0.013**	**0.017**	**-1.229**	**0.219**
CAR_-5_+5	non-Internet	-0.011	-0.001		
	Internet	-0.041	-0.035		
	Difference	**0.029**	**0.034**	**-1.563**	**0.118**
CAR_-1_+1	non-Internet	0.000	0.000		
	Internet	0.005	-0.008		
	Difference	**-0.005**	**0.008**	**-0.017**	**0.986**
CAR_0	non-Internet	0.000	-0.004		
	Internet	-0.006	-0.001		
	Difference	**0.006**	**-0.003**	**-0.260**	**0.795**
CAR_+1_+10	non-Internet	0.010	0.007		
	Internet	-0.018	-0.038		
	Difference	**0.028**	**0.045**	**-1.593**	**0.111**
CAR_-5	*non-Internet*	*0.002*	*0.003*		
	Internet	*-0.018*	*-0.012*		
	Difference	***0.020***	***0.015***	***-2.340***	***0.019[b]***
CAR_-4	*non-Internet*	*-0.001*	*-0.002*		
	Internet	*0.000*	*-0.002*		
	Difference	***-0.001***	***0.000***	***-0.069***	***0.945***
CAR_-3	*non-Internet*	*-0.004*	*-0.004*		
	Internet	*0.002*	*0.005*		
	Difference	***-0.005***	***-0.009***	***-1.129***	***0.259***
CAR_-2	*non-Internet*	*-0.003*	*-0.005*		
	Internet	*-0.004*	*-0.011*		
	Difference	***0.000***	***0.006***	***-0.803***	***0.422***
CAR_-1	*non-Internet*	*0.000*	*0.000*		
	Internet	*-0.001*	*-0.006*		
	Difference	***0.001***	***0.005***	***-0.912***	***0.362***

[b] significant at 5% level

Respective CARs are calculated for the period as of the starting until the ending day specified in each CAR's name (e.g. CAR [-1 …+1] is the cumulative abnormal return as of day -1 until day +1; CAR [0] represents abnormal return on day 0, i.e. the lock-up expiration day). Significance in the first column on the right refers to whether the difference between respective event windows' excess returns' medians of Internet and non-Internet firms is statistically significant or not based on Mann-Whitney U-test. The null hypothesis of no significant difference is rejected in case the significance figure is below 5% level. If, however, significance figures are above 5% level, the null hypothesis is retained. In the current case null hypothesis is retained for all event windows except for CAR_-5 in which the alternative hypothesis is accepted referring to significant difference between the medians of domestic Internet and domestic non-Internet firms' day -5 cumulative excess returns.

Source: created by authors using SPSS 20

Appendix J. Normality tests for CARs (event: the announcement about Facebook's IPO)

Proxy	Non-Internet / Internet	*Kolmogorov-Smirnov***			Shapiro-Wilk		
		Statistic	*df*	*Sig.*	Statistic	df	Sig.
CAR_-5_-1	non-Internet	0.138	189	0.000[a]	0.740	189	0.000[a]
	Internet	0.110	46	0.200*	0.951	46	0.049[b]
CAR_-5_+5	non-Internet	0.171	189	0.000[a]	0.822	189	0.000[a]
	Internet	0.159	46	0.005[a]	0.913	46	0.002[a]
CAR_-1_+1	non-Internet	0.130	189	0.000[a]	0.891	189	0.000[a]
	Internet	0.204	46	0.000[a]	0.767	46	0.000[a]
CAR_0	non-Internet	0.175	189	0.000[a]	0.717	189	0.000[a]
	Internet	0.191	46	0.000[a]	0.820	46	0.000[a]
CAR_+1_+10	non-Internet	0.120	189	0.000[a]	0.894	189	0.000[a]
	Internet	0.257	46	0.000[a]	0.588	46	0.000[a]
CAR_-5	*non-Internet*	*0.103*	*189*	*0.000[a]*	*0.890*	*189*	*0.000[a]*
	Internet	*0.101*	*46*	*0.200**	*0.968*	*46*	*0.230*
CAR_-4	*non-Internet*	*0.092*	*189*	*0.000[a]*	*0.931*	*189*	*0.000[a]*
	Internet	*0.179*	*46*	*0.001[a]*	*0.701*	*46*	*0.000[a]*
CAR_-3	*non-Internet*	*0.113*	*189*	*0.000[a]*	*0.887*	*189*	*0.000[a]*
	Internet	*0.100*	*46*	*0.200**	*0.956*	*46*	*0.078[c]*
CAR_-2	*non-Internet*	*0.237*	*189*	*0.000[a]*	*0.553*	*189*	*0.000[a]*
	Internet	*0.167*	*46*	*0.003[a]*	*0.778*	*46*	*0.000[a]*
CAR_-1	*non-Internet*	*0.125*	*189*	*0.000[a]*	*00.904*	*189*	*0.000[a]*
	Internet	*0.128*	*46*	*0.059[c]*	*00.952*	*46*	*0.058[c]*

**. This is a lower bound of the true significance*
***. Lilliefors Significance Correction*

[a] *significant at 1% level*
[b] *significant at 5% level*
[c] *significant at 10% level*

In the table above "Statistic" refers to either Kolmogorov-Smirnov or Shapiro-Wilk statistics that are used to calculate the significance levels and determine normality of the distribution. "df" represents degrees of freedom. In this case to decide whether the distribution is normal, The Shapiro-Wilk test significance figures are looked at, since being the most used normality test. The significance levels are all below 5% for non-internet firms and, thus, the null hypothesis is rejected. For Internet firms CAR_-5, CAR_-4 and CAR_-1 follow normal distribution and thus null hypothesis is accepted for these cases. For other cases, accepting the alternative hypothesis infers that the data is not normally distributed.

Source: created by authors using SPSS 20