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AN EMPIRICAL ANALYSIS OF MARKET DYNAMICS IN THE CURRENT US TECHNOLOGY SECTOR

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ABSTRACT

This thesis examines to what extent the contemporary US technology sector could find itself in a new bubble, like the one last seen at the beginning of this millennia. In this process we conceptualize a framework for thinking methodological about financial bubbles and underlying market mechanisms. We find evidence that US asset valuations are defined by a degree of behavioral shortcomings exhibited by irrational investors in the marketplace. It is further suggested that the capital market may have temporarily failed in its role as an efficient allocator of capital, with a reemergence of a *growth at all costs* mentality visible. We further assert that the US monetary policy, through historically low interest rates, have induced companies to increase leverage, of which the quality of debt is found to be declining, thus the economy is more prone to a market downturn. Based on our findings, we emphasize the need for caution when dealing with the sector, and highlight the likelihood that we are currently in a technology bubble.

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I: INTRODUCTION

1.1 PROLOGUE

When Tim Berners-Lee proposed an information management system in March 1989, little did he know how his invention, The World Wide Web, would forever change the course of history. The emergence of the Internet led to fundamental changes in culture, technology and commerce. From communicating around 1 percent of the total information flowing of two-way telecommunications in 1993, it reached the 50 percent mark by 2000 (Hilbert & López, 2011). The increased access of the Internet and the intensified adaptation by the general population, made entrepreneurs and businesses alike, aware of the opportunities associated with this newfound technology during the late 1990s. As new companies and new business models were established, the financial markets soon followed. Responding to the substantial enthusiasm and excitement for Internet-related services, the investment volumes in these companies exploded. This shift towards an information technology paradigm seemed peerless and untouchable. Yet, only two years later, the same companies that exploded in 1999 would lose more than five trillion dollars, and many had to file for bankruptcy in the following years (Geier, 2015).

Fast forward 20 years and the tech industry has comfortably regained from its previous losses and has since established itself as the dominant sector in the US economy. The NASDAQ Composite index reached at the beginning of 2018 a record high 7,000 points, a 40 percent increase since the height of the tech boom in 2000 (Sheetz, 2018). The famous FAANG group (Facebook, Apple, Amazon, Netflix and Google) now has a combined market capitalization of more than $3 trillion, more significant than the entire Gross Domestic Product (GDP) of countries like the United Kingdom, Italy and Spain (National Statistics, 2019). These companies and the tech sector, in general, are considered the main drivers of the value creation in the US stock markets. However, in the period from October 1st to December 24th last year the NASDAQ Composite Index fell almost 23 percent, retrieving it to levels last seen almost one and a half years earlier (Vlastelica & Wittenstein, 2018). The losses of the previously mentioned FAANG stocks alone amassed to a staggering $1 trillion, or approximately 5 percent of the entire GDP of the United States.

With this development in the tech industry, parallels are quickly drawn to what transpired within the same sector almost 20 years ago. Both incidents were preceded by a period of boundless optimism and the feeling of financial immortality. While in 2000, the promised land of flip phones and dial-up Internet drove market hysteria, the present-day technological landscape is defined by the developments within fields such as Artificial Intelligence, Virtual Reality and Cloud-based services. Although technology has changed, the underlying sentiment has remained the same. It is the anticipation of the boundless possibilities located just at the edge of the horizon, and the extraordinary wealth this may one day provide.

1.2 MOVING TOWARDS THE BURST OF THE DOT-COM BUBBLE

With the release of the Mosaic Web Browser in 1993, the World Wide Web was made available to the average American. At the same time, the share of households in the US owning a personal computer rose from 15 percent in 1990, to 35 percent in 1997 (Shiller, 2003). The developments and the corresponding optimism that followed resulted in investors being more than eager to invest their money in companies involved with information technology. During the late 1990s, the stock returns and market valuations reached historical levels, with the average real annual return of the weighted CRSP (Center for Research in Security Prices) index from 1995-1999 reaching 24.4 percent (Core et al., 2003). In contrast, the annual average real return on the S&P Index over the period 1872-2000 was a modest 8.81 percent (Fama & French, 2002).

Despite only reporting modest earnings, the stocks in the quaternary sector of the economy continued to grow and a consensus that tech companies would eventually turn profitable appeared. Subsequently, this resulted in an investor environment in which traditional performance metrics were overlooked, and investment decisions appeared to be exclusively based on the confidence in technological advancements. This sentiment evolved to a point where it was not necessary for a company to have a viable business plan or an actual product as long as they were to a certain extent affiliated with the Internet. The above is further emphasized by the development of the NASDAQ Composite index, reaching a Price-to-Earnings ratio of 200, thus dwarfing the Price-to-Earnings ratio of 80 for the Japanese Nikkei 225 during the Japanese asset price bubble of 1991 (Teeter & Sandberg, 2017).

From June 1995 to March 2000, the Money Zero Maturity (MZM), representing the money readily available within the economy for spending and consumption, grew by 53 percent, well ahead of the real GDP growth of 22 percent (Callahan & Garrison, 2003). The monetary policies during the 1990s had increased the access of credit which many investors and corporations utilized for investments in the rapidly growing tech market. Consumers were saving less and borrowing more, while corporations were increasing their capital spending (Callahan & Garrison, 2003). Although this allowed the economy to grow at an unprecedented rate, it eventually became clear that it was unsustainable. In February 2000, with the insecurity of *Y2K* gone, the chair of the Federal Reserve announced plans to aggressively raise the US interest rate. This imposed severe effects on the US economy as the money supply in the system fell drastically (Juneja, 2004). This reduction in money supply resulted in further uncertainty in the financial markets, especially as to what extent technology companies would be affected by higher borrowing costs. Further, as the news of a Japanese Recession reached the US stock markets, the selloff in technology stocks increased, thus marking the first signs of an impending crisis within the US technology sector. Later that year, Bloomberg published an article that stated: “It is time, at last, to pay attention to the numbers” (Yang, 2000).

1.3 THE AFTERMATH OF THE BUBBLE BURST

The Dot-com, and the corresponding bubble burst, quickly became a topic of concern within different fields of academic literature. However, the specific beginning of the Dot-com bubble is subject to dispute (DeLong & Magin, 2006; Greenwood & Nagel, 2009; Griffin et al., 2011). Nevertheless, many economists refer to the late 1990s as the first time a bubble became evident within the US technology sector. The most notable incidents during this period are argued to be the Netscape Communications Inc. IPO in 1995 and the irrational exuberance speech of Allan Greenspan in 1996 (DeLong & Magin, 2006). The Netscape IPO was significant in terms of that is was among the first companies that went public without being profitable (Harvard Business School, 1996). Further, this IPO was remarkable in a sense that the share price increased from an opening of $28 to a closing price of $58.25 during its first day of trading, despite possessing little operational experience (Goodnight & Green, 2010) or any projection of when it would expect to become profitable (Cassidy, 2002). Additionally, the IPO served as a visible symbol for the potential of the Internet, and the profits it could potentially offer investors, given they arrived at the Dot-com party early (Callahan & Garrison, 2003). The other notable incident, the irrational exuberance speech of Allan Greenspan in 1996, in which he warned that the stock market might have taken speculative directions towards a bubble was also noteworthy due to the substantial authority Greenspan possessed as FED chairman (DeLong & Magin, 2006). Conversely, investors proceeded with business as usual, leading to the increased mispricing in the market resulting in the creation of a bubble, just as Greenspan had predicted.

At the center of the bubble were publicly traded Internet-based companies that experienced rapid inflation and deflation (Valliere & Peterson, 2004). Following Cunado et al. (2009), the burst of the bubble could be dated to March 10th, 2000 when the NASDAQ Composite Index peaked at a level of 5,048. By the end of October 2002, the same index had lost approximately 78 percent of its value, marking the end of the bear-market period. It is estimated that the complete loss in market value stemming from the Dot-com bubble exceeded 5 trillion dollars (Gewirtz, 2009). The Bloomberg Internet Index, containing 280 direct and indirect internet stocks, made a loss of $1.7 trillion in value between March and September 2000, a period less than six months (Writer & Kleinbard, 2000). During the aftermath of the bubble, investments in tech companies decreased significantly (Howcroft, 2001). The irrational exuberance of the Dot-com era would soon be replaced by a general suspicion and cautiousness concerning the promises of new technologies and the long-term financial viability of start-ups within the technology sphere (Shiller, 2003). Whereas in 1999, when 476 internet and technology related companies went public, of which 25 percent doubled their share price in the first day of trading, only 76 firms chose to do the same in 2001, and the notion of first-day trading multiplication was nonexistent (Goodnight & Green, 2010). Consequently, due to this increased cautiousness, it would take years for the tech industry to fully recover (Ning et al., 2014).

The Dot-com bubble had significant ramifications for multiple parts of the US economy. In terms of the labor market, it has been estimated that, between 2001 and early 2004, Silicon Valley alone lost more than 200.000 jobs, while the entire US unemployment rate almost doubled from 3.8 percent to 6.3 percent (McCullough, 2018). Due to the interconnection with other related business fields, such as consulting, advertising, computer hardware and software, the effects were not limited to the tech sector but had severe implications for supporting industries (Rovenpor, 2003). As business investments rapidly decreased, consumer spending did, however, remain stable through waves of mortgage refinancing, zero-interest auto loans, and continued strength in the housing market (Callahan & Garrison, 2003). Nevertheless, as Corrigan (2002) points out regarding the ominous debt shadow, looming over consumer finances, more than 1.5 million bankruptcy filings, of which most were individual filings, were logged. Despite the cut in interest rates, the unprecedented high outstanding debt as a proportion of personal disposable income had significant ramifications for the average American, with GDP growth falling from 4.68 percent in 1999 to 0.97 percent in 2001.

Additionally, several repercussions for US corporations followed. For instance, in the aftermath of the bubble, the Securities Exchange Commission (SEC) accused several companies and their managers, of fraud through the misuse of shareholder equity and manipulating accounting procedures. Most notably, David F. Myers, the controller of internet giant WorldCom, was found guilty of criminal fraud based on overstating revenues and understating expenditures, marking one of the biggest accounting scandals in US history (Sidak, 2003). As Krugman (2004) and Stiglitz (2004) argue, the poor accounting standards of the 1990s bull market failed to incorporate actual asset values in any meaningful way. Furthermore, the SEC, scrutinizing the role of the investment banks during the bubble, came to the conclusion that many of these banks, including Citigroup and Merrill Lynch, had been misleading investors with buy recommendations and IPO spinning through selective favoritism (Levine et al., 2014). In order to regain confidence in the US stock market, Government regulators and legislators introduced the Sarbanes-Oxley Act in 2002, providing increased investor protection through more transparent accounting and financial reporting standards (Borgia & Siegel, 2008). The aftermath of the bubble has induced a broad body of empirical research and academic literature regarding the mistaken valuations of tech companies in the period, and how these valuation strategies could be altered to better reflect the *new economy* paradigm.

1.4 THE CONTEMPORARY ENVIRONMENT FOR TECH-FIRMS

Today, technology firms are cementing their position in the US equity markets. The S&P 500 Information Technology Sector Index currently constitutes 27 percent of the total S&P 500 Index, almost twice as much as the second and third largest sectors combined (Dow Jones, 2019). Tech stocks have enjoyed abnormal returns and are proving the dominant sector within the US economy, emphasized through the fact that during the two first quarters of 2018, tech stocks contributed to 97 percent of the total gain on the S&P 500 (Brown, 2018). Considering how five out of the six largest companies on the S&P 500 Index, in terms of market capitalization,

are technology oriented, this trend is further illustrated. The current largest company, Apple Inc. is now almost three times larger than Exxon Mobil, the integrated Oil & Gas Company which was the largest company in the US as recently as in 2011.

Driven by Artificial Intelligence, Virtual Reality and Cloud-based services, investors seek tech shares due to the significant potential it possesses for future business opportunities. Consequently, as investors in tech firms are increasingly concerned with the potential of technology, rather than the fundamental value in terms of the cash flows these firms generate, differences in the balance sheet and equity values have again become apparent. Amazon, for instance, is currently priced almost 70 times their yearly earnings. Nevertheless, despite trading significantly above its earnings, the company has consistently generated profits. This helps to rationalize a potential investment and may justify their current market capitalization, equal to UPS, Oracle, IBM, Walmart and B&N combined (Winkler, 2018). However, other tech companies, including Snap Inc. and more recently, LYFT, have both received significant market valuations through IPO listings, despite never generating profits. Furthermore, technology acquisitions, such as the 2014 WhatsApp acquisition by Facebook, valued at $19bn, makes little sense in terms of fundamentals, considering WhatsApp was bringing in a mere $20m in annual revenue, and losing $139m in 2013 (Olson, 2014).

Tech investments have in recent years, both accelerated and increased in volume, and memories of the Dot-com bubble has again resurfaced (Mims, 2016). It appears the same investor mentality of latching on proposed business models too hastily may again be present (DaSilva & Trkman, 2014). Newly founded companies are being valued at billions of dollars within a short timeframe, despite having unclear or even questionable business models (Lashinsky, 2015). For instance, start-ups founded between 2012 and 2015 saw their valuations grow more than twice as fast as start-ups founded between 2000 and 2013 (Wright, 2018). Consequently, as we are now eight years into the second-longest bull market in history, only behind the run-up to the Dot-com bubble, economists have started to draw parallels between the current financial tech markets and that of the late 1990s, calling for increased caution (Curwen, 2016).

Following the events taking place during the latter stages of 2018, the valid question of whether the technology sector is again standing at the edge of the precipice arises. Were the negative market trends observed in 2018 merely a market correction or rather a preview of an impending tech bubble? Have investors again lost track of the actual value of tech companies, and are blinded by the potential future upside that these companies may provide? Are we in good hands of sound and rational investors, or have the lessons learned in 2000 been wholly forgotten? Perhaps George Santayana had a point when he wrote in his 1905 classic, Life of Reason:

"*Those who cannot remember the past are condemned to repeat it*" (Santayana, 1905)

1.5 PROBLEM STATEMENT

The definition of a clear and proper research problem is a crucial part of any research study (Kothari, 2004). It established the interaction by two or more factors that produce a dilemma or predicament that cause for further examination (Grant & Osanloo, 2014). As formalized in the introduction, tech investments have both accelerated and increased in volume, and it exists concerns that investors are latching on proposed business models too hastily. Further, a resurgence of multi-billion Initial Public Offerings has become evident despite unclear or questionable business models. Concerning these overall market developments, many economists have called for increased caution, warning that parallels could be drawn between the investments in contemporary technology and that of the late 1990s. Consequently, in order to validate or falsify whether the call for increased caution by economists is justified, research on the impediments of the technology sector of today in relation to new bubble developments is needed.

With respect to this, this thesis intends to provide an educated opinion of whether we may be on the verge of a new market correction by investigating the same variables literature suggest were critical to the creation of the Dot-com bubble. In this process, as a consistent and chronological formalization of the thesis is a prerequisite for the ability to draw valid inferences, the thesis will develop a conceptual framework grounded in academic literature. Hence, it will structure and guide the problem statement which the thesis formalizes as:

"Is the contemporary technology sector currently in a new bubble similar to the one during 2000?"

In order to answer the preliminary problem statement, the thesis has formulated the subsequent sub-questions, each covering a considered central theme of bubble creation:

- Are behavioral shortcomings currently defining US asset valuations?
- Is the *growth at all costs* mentality, which defined the latter parts on the 1990s, once again visible in the US capital market?
- Have the developments within US monetary policy resulted in an economy becoming more prone to a market downturn?

II: METHODOLOGY

2.1 INTRODUCTION

This chapter concerns the methodology and design applied in the thesis. It elaborates on the objective and purpose of the research, the research philosophy, the research design and strategy, and the rationalization of propositions and the conceptual framework. Additionally, it constitutes the delimitation of the research utilized by the thesis regarding the ability to draw valid inferences. Lastly, a formalized structure of the thesis is provided, stipulating the framework for the line of reasoning and argumentation for the subsequent analysis and conclusion.

2.2 RESEARCH OBJECTIVE AND PURPOSE

Through the above-formulized problem statement, this paper will, by identifying the fundamental factors responsible for the Dot-com, investigate whether it exists a tendency of a market correction in the near future. Hence, the paper attempts to fill the research gap identified by providing an empirical analysis of the development of market factors contributing to the Dot-com bubble, within a new timeframe. The objective of the thesis is further to achieve a broad understanding of the current market situation and thus be able to present an educated opinion on the likelihood of a new technology bubble

By answering the problem statement through conducting empirical analysis, the thesis further aims to extend the current literature concerning the underlying factors causing bubbles. Additionally, through the respective subcomponents of the problem statement, the thesis will evaluate the trends of key market factors and investigate the development in comparison with the Dot-com era. If parallels regarding the development of market factors are identified, it may suggest that a new market correction could become reality. Should this be the case, it may have significant impact on the economy in the long run. Following the events which transpired after the Dot-com bubble, many companies ultimately failed and were forced to file for bankruptcy.

The inferences drawn from this thesis are likely to be of interest to academics, regulators and investors. From the academic perspective, the shortcomings related to investor behavior, the health of the capital market, and the developments within monetary policy are all aspects which call for scrutiny of contemporary valuation models. Furthermore, from the policymaker perspective, if policies established in the aftermath of the bubble, to mitigate the risk of new bubbles, is found to have a limited effect on trading patterns, it may call for the revision of established regulation and policies. Lastly, from an investor perspective, the results of this thesis may be useful for investment decisions. More specifically, it is in the interest of the investor to understand the market mechanisms underlying the creation of a bubble, especially concerning the potential economic consequences a burst may have.

2.3 RESEARCH PHILOSOPHY

An extensive literature on the Dot-com bubble illustrates the wide variety of identified factors influencing the bubble creation, and as an approach to further investigate this derived fact, the thesis will adopt both a theoretical and empirical approach. This interaction between theory and empiricism embodies the vital aspect of how this subject formerly has been researched, including which of the theoretical findings that could be accepted empirically. In this process, one of the most pivotal choices for any researcher is the formalization of research design through the ratification of research philosophy (Saunders et al., 2009). The aim of the problem statement is, by leveraging existing knowledge, to create an enhanced understanding of the factors leading to the creation of the Dot-com bubble and the repercussions it may induce on the contemporary tech company environment. With regards to this, the research philosophy of the thesis will be based on Objectivism, incorporating assumptions of the natural sciences. It further entails realist ontology, epistemology focused on the discovery of truth through observable, measurable facts, and have value-free, detached axiology (Saunders, 2015). Further, the choice of method and subsequent research findings are based on the research philosophy of positivism, stating that problems are best solved through a rational scientific approach with knowledge being obtained through an objective point of view (Andersen, 2008). This assumption is following the quantitative research method of the thesis, with subsequent research findings being likely to be considered objective and generalizable but will also be less likely to propose a radically new understanding of the world (Saunders, 2015).

According to Collis & Hussey (2003), two types of research exists, namely deductive and inductive research. Moreover, it exists two different approaches, quantitative and qualitative. The combination of these approaches the researcher should utilize depends mainly on the nature of the research question in which is to be answered (Bryman & Bell, 2011). This thesis, will, however, apply the approach of abduction. As stated by Suddaby (2006), abduction combines the inductive and deductive approaches, enabling researchers to move from theory to data and vice versa. It often involves the observation of a "surprising fact", and it then works out a plausible theory of how this could have occurred (Saunders, 2015). Some plausible theories can account for what is observed better than others, and it is these theories that will help uncover more "Surprising facts" (Van Maanen et al., 2007).

2.4 RESEARCH DESIGN AND STRATEGY

Having established the research philosophy, the thesis will now further elaborate on the approach to theory development, the methodological choice, the research strategy, the time horizon and data techniques and procedures utilized. For the methodological choice, the thesis applies a mono-method quantitative stance. Through this method, it enables the advancement of the relationship among variables and positions these in terms of questions or propositions (Creswell & Creswell, 2017). It concerns with outcomes, generalization, prediction and cause-effect relationships (Yilmaz, 2013). Further, for the research strategy, the thesis follows

an exploratory position. Employing exploratory of formulation research a high degree of flexibility is enabled, thus different facets of a problem may be considered (Kothari, 2004). For the time horizon and the data techniques and procedures, secondary cross-sectional data will be utilized.

The description and collection of data for this purpose are collected from a variety of sources, including The Bloomberg Terminal and The Federal Reserve of St. Louis, which will be further explained in Section VI: Data Sample. It is believed that these data samples are reliable and possesses the high quality needed to draw valid inferences from in the empirical analysis. Moreover, the data is considered as suitable for the enquiry intended in each part of the analysis. However, it is acknowledged that due to the multiple dimensions of each part of the analysis, the definition of various terms and units may not be consistent throughout the analysis. Through scrutinizing the sample data, it is further believed that the level of accuracy achieved in data is found to be adequate. The utilization of the data sample in the analysis is, in its entirety, solely based on the calculations derived from Microsoft Excel.

2.5 PROPOSITIONS AND CONCEPTUAL FRAMEWORK

During the empirical studies, the knowledge gained from reviewing relevant theory regarding the sub research questions plays a fundamental role in the entire content of the thesis. However, the final conclusion will focus on the findings from the empirical studies. Thus, the thesis will take offset in the outcome of the empirical studies in order to provide a conclusion regarding the theoretical contributions. As specified in the formalized problem statement, the thesis will investigate whether or not the development of market factors may indicate the establishment of a new bubble. In this process, to further guide the research in structured and meaningful conduct, the thesis relies on the formalization of propositions. More specifically, through the propositions, it will effectively place limits on the scope of the study (Baxter & Jack, 2008).

Additionally, the formalized propositions may induce the obtainability of a statement of validity on the truth or falsity with respect to the overall problem statement (Snijders, 2001). For the development of the propositions, and to further enhance the ability of the thesis to form valid inferences, it is conceptualized a framework. Similar to Baxter (2003) and the principle of theory development of Whetten (1989), the conceptualized framework is grounded in academic literature. For this purpose, a critical analysis of a comprehensive review of the existent literature on factors deemed as significant for the Dot-com bubble is conducted. In conjunction with the propositions, the framework enables the creation of intellectual "bins" (Miles et al. 1994) and provides the structure for the scope and structure of the analysis. However, one of the drawbacks with this conceptual framework is that it may limit the research to become deductive (Baxter & Jack, 2008). It is therefore acknowledged that the research process could be compelled and affected by the framework.

2.6 DELIMITATIONS

The problem statement induces the applicability of a comprehensive analysis with multiple factors. Consequently, to limit the foundation for empirical data and corresponding analysis, the paper will rely on the following delimitations.

We will in this thesis examine the underlying factors considered responsible for the Dot-com bubble. Thus, the paper will exclude other academic fields of interest and reasons for other financial bubbles or market corrections. This thesis does not attempt to identify and address all market factors that had an impact on the bubble creation in the late 1990s, nor does it provide any antecedes for the factors beyond the US market. Further, through the analysis, the reliance on the factors identified is limited to the effects it has on the technology sector and bubble creation. Hence, the broader long-term macroeconomic implications are not further elaborated in detail, although it is acknowledged that the factors have ramifications for other sectors and domestic markets.

Further, as the main objective of this thesis is to shed light on the interplay between different factors, these will be investigated in relation to each other. The analysis will thus focus only on the most central elements within each factor. It is acknowledged that there is a possibility that a more thorough and profound analysis could be achieved by focusing solely on a reduced amount of factors. However, as a financial bubble is a complex event, it is established that the thesis will provide the best understanding of the investigated phenomena by covering multiple factors, and establishing an overview of how they work in relation to each other (Borio & Lowe, 2003). This will be done in the context of evaluating to what extent the market of Dot-com era resembles the one in 2019. As it is not the primary objective of this thesis to prove causality or any conclusive relationship the attention will be towards how the selected factors might affect the financial landscape of today. The individual factors, including their delimitations, will be highlighted and discussed throughout the thesis. The paper will only engage in the investigation of the factors included in this framework. Additionally, it is not the aim of this thesis to conclusively predict a new Dot-com bubble. Instead, it will engage itself in presenting different sections of analysis in an orderly and structured fashion, drawing on newfound knowledge, thus producing an overview that might be difficult to obtain if only investigating isolated factors. It is further stressed that the objective of the thesis is not to determine the set of events that will cause the existence of a potential bubble to burst. The thesis is therefore solely interested in whether we are in fact in a new bubble, with no regard for what will result in the bubble bursting or the potential consequences of such a burst.

For the basis of the analysis, data from multiple US indices are applied. The selection of these stock-indices derives from the formalized problem statement. Considering the notion that the Dot-com bubble started in the

US, it would be required to utilize the very same indices in order to derive at a valid conclusion. It is acknowledged that the effects of the Dot-com bubble was not restricted to this market, but had far-reaching global effects. However, being the largest and most liquid stock market in the world, a new bubble in the US would have severe repercussions for the global market, which may rationalize the decision to exclusively focus on this location. The selection and exclusion of US indices will be further elaborated on in the Data sample section of this paper.

With the basis of the paper being the investigation of the Dot-com bubble, which was driven by the technology sector, this paper will rely on the contemporary sectors under the classification of technology. The contemporary technological environment is however considerably different from the period of the bubble. Most notably is the increasing degree of technological applicability in a wide array of sectors such as industry and service. Consequently, it is acknowledged that the term "technology companies" may be ambiguous due to the broader utilization of technology. Nevertheless, it is argued that, due to this broader applicability, the contagion effect in the case of a new technology bubble would have more significant ramifications to the overall market. For this, the selection of solely "technology companies" does not limit the findings of the thesis to the specific sector but has applicability to the overall market. The selection of sector-specific stocks will be further elaborated on in the Data sample section of this thesis.

2.7 STRUCTURE

A consistent and chronological formalization of the thesis is considered a prerequisite for the ability to draw valid conclusions. With regards to this, the thesis will be structured accordingly. In section (3), a description of the theoretical foundation on the topic of financial bubbles (3.1), and how these may be created and endure (3.2) is introduced. Further, in section (4), a comprehensive review of existing literature on the central topics of this thesis is presented, from which theoretical underpinnings will be utilized in the subsequent sections. In Section (5), our conceptualized framework and propositions for evaluating whether there is a new tech-bubble is presented. Furthermore, Section (6), the data selection and processing is presented. Following the data-selection of the thesis, Section (7) concerns about the specific analyses, testing the formulized propositions.

Firstly, the developments concerning the *Asset Valuations & Investor Behavior* is presented to answer the first formalized sub-question (7.1). Further, section (7.2) investigates the *Capital Market Mechanisms* related to the second sub-question of this thesis. For the last part of the analysis, section (7.3) *Monetary Policy & Corporate Lending,* an examination of the effect of US monetary policy on US corporate debt is provided, forming the basis to answer the third and final formalized sub-question of the thesis. This forms the foundation for the further discussion and interpretation of results presented in section (8). Moreover, the limitations of the thesis and suggestion for further research will be elaborated on in section (9). Lastly, section (10) provides a formalized conclusion to the findings of the thesis.

III: THEORETICAL FOUNDATIONS

3.1 FINANCIAL BUBBLES

From the agitated buying of tulips during the Dutch tulip mania in 1637 to the Housing Crisis of 2008, the world has seen many bubbles and severe market corrections. Some of the most notable include the Mississippi and South Sea bubbles of 1719-20, the Wall Street crash of 1929, the Japanese bubble of the 1980s and the Dot-com bubble of 2000 (Neal & Weidenmier, 2003). While large asset bubbles can result in distinct, long-term financial and societal repercussions, even the seemingly benign asset bubbles lead to the misallocation of resources and fiscal problems for governments. Historically, financial crises, crashes and bubbles have occurred with striking regularity (Brunnermeier & Oehmke, 2013). Financial markets have often exhibited sharply rising prices and subsequent declines that may not be justified by realistic or fundamental economic assessments (Dreman & Lufkin, 2000). These financial bubbles have for long been a topic of interest for economists and have induced a large body of literature (Phillips & Yu, 2011). The prediction of financial bubbles is in particular important, not solitary because it may result in substantial financial losses for investors, but also due to how several of these extreme financial cycles can disrupt the financial system and induce severe economic contractions (Mishkin & White, 2002). However, the unambiguous identification of the presence of a bubble remains a conceptually challenging problem in standard financial economic and econometric approaches, as the fundamental value is in general poorly constrained. (Lux & Sornette, 2002; Gürkaynak, 2008). Additionally, as it exists several factors that allow persistent deviation from efficient prices observed under bubbles, the identification of the most significant factors is hard to assess (Borio & Lowe, 2003). Further, although financial bubbles command enormous attention, there exists little consensus of their causes or the identification of the main characteristics allowing the prevention of busts (Bolton et al. 2006).

3.1.1 Defining Financial bubbles

A standard definition of a financial bubble is when assets are traded at a price that sharply surpasses their fundamental value (Sornette, 2003; Kindleberger & Aliber, 2011; Sornette, 2017). According to Brunnermeier & Oehmke (2013), this mispricing of assets becomes a bubble when it is sustained over an extended period. The separation of market and fundamental values evident in bubbles is, according to Lahart (2008), a result of the profound disagreement regarding the significance of economic development by investors. In line with this, Krugman (2013) defines a financial bubble as a situation in which asset prices appear to be based on implausible or inconsistent views about the future. Through the introduction of new developments, an inherent uncertainty about the future is created, thus increasing the likelihood that investors may derive at implausible views (King et al., 1993; Shiller, 2000). Such implausible views are reflected in the Dutch tulip *mania* represented by a new virus strings causing tulips to break in color (Day, 2004), the introduction of the World

Wide Web in the Dot-com bubble (Valliere & Peterson, 2004), and the novel ways of pooling and tranching loans during the 2008 Housing Crisis (Lahart, 2008). The most common explanation for such bubble events has been to regard them as outbursts of irrational speculation or manias (Zeira, 1999). Even though the distribution and availability of information has significantly improved, prices several times the most realistic valuations, under even optimistic estimates, becomes evident (Caginalp et al. 2001). Hence, this emphasizes the fundamental behavior nature of the bubble phenomenon and correspondingly casts suspicion to the notion that bubbles may be a result of limited availability of information.

3.1.2 Efficient market hypothesis and bubbles

In the most strictly theoretical perspective, the creation of bubbles should not be possible if investors behave rationally. This notion derives from one of the most central theoretical pillars within economic and financial literature, the Efficient Market Hypothesis (EMH). The EMH postulates that individuals make rational and utility-maximizing investment decision and states that security markets are efficient in reflecting information about individual stocks and the stock market as a whole (Fama, 1965). The accepted view is that, when information arises, it is incorporated into the prices of the securities without delay (Malkiel, 2003). Consequently, it denies the existence of any systematic deviations of stock prices from their fundamental value (Lux, 1995). Hence, assuming rational investor behavior and efficient markets encapsulating information, the creation of asset bubbles should be limited as mispricing would be aggressively mitigated towards correct price equilibrium.

However, according to DeBondt & Thaler (1985), investors are subject to waves of pessimism and optimism, causing prices to systematically deviate from their fundamental values and later exhibit mean reversion characteristics. Such overreaction to past events is further suggested to be consistent with the behavioral decision theory conceptualized by Kahneman & Tversky (1979), where it is argued that investors are systematically overconfident in their ability to forecast future corporate earnings or future stock prices. Critics of EMH argue that, in recent market history, several instances where market prices could not plausibly have been set by rational investors and that psychological consideration must have played the dominant role (Malkiel, 2003). Thus, it is widely believed that the pricing could only be explained by the behavior of irrational investors, in contradiction to the EMH assumption that all investors are rational and utility maximizing. Undoubtedly, academics, such as Shiller (2000), provide empirical evidence to this notion, which may condemn the established EMH assumption.

3.2 HOW BUBBLES MAY BE CREATED AND ENDURE - BEHAVIORAL FINANCE

The emergence of criticism concerning the EMH and its neglecting of bubble occurrence gave rise to the development of behavioral finance, which was typically disregarded in traditional financial literature. According to Fromlet (2001), behavioral finance seeks to combine conventional market theory with the psychological and behavioral factors of individuals. Additionally, the behaviorists assert that traditional paradigms of finance are incomplete as it fails to account for the idiosyncrasies of individual behavior in financial markets, thus deeming behavioral finance as conceptually superior (Olsen, 1998; Singh, 2012). Within behavioral finance, it is argued that some features of asset prices could be plausibly interpreted as deviations from fundamental values and that these deviations are established by the presence of traders who are not fully rational (Barberis & Thaler, 2003). Within the financial landscape, a long-standing objection to this view derives from the work of Friedman (1953), where it is assumed that rational traders will swiftly undo any dislocations triggered by irrational traders. However, in line with the argumentation of Barberis & Thaler (2003), an asset may be widely mispriced, but strategies designed to correct mispricing can be both costly and risky, rendering them unattractive, hence enabling mispricing to persist.

3.2.1 Rational Investors

Under the assumption that all actors in the marketplace act rationally and seek to maximize individual utility, the creation of bubbles may seem theoretically impossible. However, market forces do not always allow efficient pricing to persist. Additionally, the literature suggests, in contradiction to EMH, that rational investors may allow mispricing in bubbles to occur as they seem to be better off with its development rather than engaging in aggressive price correction strategies. Following the insights of Blanchard (1979) and Blanchard & Watson (1982) through the formulation of a bubble theory in a stochastic environment, it was hypothesized that when asset prices are on a dangerous bubble path, rational agents expect a future crash but does not know its specific timing. Consequently, they deemed the creation of bubbles, defined as a dangerous path of the asset price, as a theoretical possibility, even if investors were indeed acting rationally. Subsequently, it has spurred a large amount of literature for the emergence of bubbles in rational expectation models.

Limits to arbitrage and the survival of irrational investors

As stated in the section above, mispricing may persist with investors acting rationally. One reason suggested as explanatory for this notion is how strategies designed to correct mispricing may be both risky and costly for arbitrageurs (Daniel et al., 2001). Shleifer & Vishny (1997) suggest that arbitrage, under circumstances where assets are priced at levels far beyond their actual fundamental values, can turn out to be ineffective. The EMH, states that irrational investors would cease to be influential in the long run as rational investors (arbitrageurs) would exploit any mispricing, thus bringing the market prices back to equilibrium. However, as DeLong et al. (1991) argue, irrational investors, being overconfident, can end up bearing more risk than rational investors

making them able to generate higher expected returns in the long-run. Even if investors are risk-neutral, overconfidence functions as a pre-commitment to act aggressively, causing the rational agent to moderate their trading activity (Kyle & Wang, 1997). According to Hong & Stein (2003), this may explain why bearish investors are more likely to be reflected in the market when prices are declining than when they are increasing. These considerations form the basis for the theory of limited arbitrage, which emphasizes that if irrational traders cause deviations from fundamental values, rational traders may be powerless to do anything about it (Malkiel, 2003).

Short sale constraints and fundamental risk

A commonly cited limitation for arbitrage efficiency in eradicating mispricing is the impediments and costs of short-selling, collectively referred to as short-sale constraints (Jones & Lamont, 2002). These have, within the efficient market theories, often been neglected and not accounted for (Miller, 1977). However, short-sale as a mispricing eradicating mechanism is limited due to several constraints. The most apparent risk or constraint for arbitrage efficiency is according to Barberis & Thaler (2003) the notion that fundamental risks of stocks are somewhat different. When engaging in short-selling, a rational investor, aware of the risk of an increase in the stock price, would buy and hold a substitute security to hedge against the systematic risk of that sector. However, as substitute securities are often highly imperfect and could in itself be mispriced, it is impossible to remove all the fundamental risk. Further, arbitrageurs may not be able to find shares to borrow at any price and may be limited by legal constraints for short-selling which is evident for many pension fund and mutual funds (Barberis & Thaler, 2003). Miller (1977) argues that stocks subject to short-sale constraints could prevent negative information from being impounded in the stock prices and consequently be prone to overvaluation.

Synchronization Risk

Even with all investors in the market having mutual knowledge that the prices are too high for stocks it does not imply that arbitrageurs will jointly engage in eradicating the mispricing. Conversely, as Obstfeld (1996) notes regarding currency mispricing, coordination among speculators is required in order to eradicate it. Extending this rationale to the limits of arbitrage theory, Abreu & Brunnermeier (2002) argue that a critical mass of arbitrageurs, and hence coordination among these, is needed to burst a bubble. Even though investors may identify a bubble, they will only take advantage of the mispricing if they are sure other sceptics are on board (Abreu & Brunnermeier, 2003). If this critical mass is not achieved, arbitrageurs seeking to exploit the mispricing may not have the required influence to revert prices to fundamental equilibrium, hence entailing the risk of negative - rather than positive returns. This risk, which Abreu & Brunnermeier (2002) formalizes as "synchronization risk", does, in contradiction to noise trader risk, not pertain with how prices might move further away from fundamental values. Instead, it describes how the uncertainty about the market decisions of other rational arbitrageurs may enable mispricing to persist. Formalizing this synchronization problem in a

model, Abreu & Brunnermeier (2003) further argue that the significant and long-lasting departure from fundamental values, observed during bubbles, is a consequence of the dispersion of opinion among rational arbitrageurs concerning the timing of the burst of the bubble. As a result of the synchronization problem, bubbles may be difficult to prevent at early stages despite the presence of rational investors that, theoretically, could jointly act as price correcting arbitrageurs as soon as any mispriced asset is identified.

Herd behavior

Whereas the synchronization problem may explain why bubbles may persist over time, it does not justify how investors collectively engage in the mispricing during the development of bubbles. According to Banerjee (1992), one such explanation may be due to a phenomenon he frames as herd behavior. Bikhchandani & Sharma (2000) defines herd behavior as the decision of the individual to make an investment he would otherwise not based on his knowledge, engage in. In other words, herd behavior becomes observable when individuals conform to the majority of others by imitating their actions, instead of using their own independent decisions. Such behavior may be evident in the case where individuals observe positive stock returns and correspondingly are drawn to the stock in a "bandwagon effect" (Malkiel, 2003). However, herd behavior is not necessarily irrational in the sense that it is compatible with the optimizing behavior of the agents (Shleifer & Summers, 1990). The literature suggests a variety of antecedents to herd behavior. Scharfstein & Stein (1990) finds evidence of managers, under certain circumstances, simply mimics the investment decisions of other managers, ignoring substantive private information. Dass et al. (2008) further extend this notion to the case of mutual fund managers, arguing that managers incline towards herding behavior as they are more concerned with the risk of being rated the worst fund, as opposed to being the top earner. In essence, the typical rationale for the individual is that it is unlikely that a large group could be wrong (Shiller, 2000). Herd behavior, although individually arguably rational, entails irrational group behavior which may stipulate bubble developments (Johnsson et al., 2002)

Riding the Bubble

The notion that it is always optimal for rational investors to attack asset mispricing, an underlying assumption of the EMH, may be doubtful. According to Brunnermeier & Nagel (2004), the aversion to arbitrage risk and frictions such as short-sale constraints is not adequate to understand the failure of rational speculative activity to contain bubbles. As Allen & Gorton (1993) note regarding fund managers in bubble environments, they seemed to be engaging in *churning of bubbles*, at the expense of their less informed client investors. Rather than eradicating mispricing in bubbles, it was proposed that rational speculators actually may drive a bubble (Griffin et al., 2011). DeLong et al. (1990a) suggest that speculators may initiate and contribute to price movements based on the expectation that positive-feedback traders will later purchase the already overpriced securities at even higher prices. Potential arbitrageurs, perhaps able to eradicate mispricing, may thus be

reluctant to sell short a stock, despite believing it trades significantly above its fundamental value. When the existence of the bubble becomes common knowledge, the arbitrageurs simply abandons the overpriced asset, thus realizing the proceeds from the prevalence of the bubble (Lahart, 2008). Hence, arbitrageurs knowing that the market is overvalued may maximize profit by riding the bubble (Abreu & Brunnermeier, 2002, 2003). As a result, when the discrepancy between bullish and bearish investor beliefs become considerable, the bullish tend to prevail (Hong & Stein, 2003). With the dominance of bullish investors in the market, the price of the asset will continue to increase, and the emergence of a bubble may be evident. Consequently, it may explain why sophisticated investors would buy into an already overpriced market that they knew would eventually deflate (Brunnermeier & Nagel, 2004).

Distribution of information and bubbles

Rational bubbles under symmetric information are studied within a context where it is assumed that all agents have rational expectations and share the same information (Brunnermeier, 2001). Under the general equilibrium reasoning, Tirole (1982) argues that bubbles cannot exist if it is known that the initial allocation is interim Pareto-efficient, as it would imply that a bubble would make the seller of the "bubble asset" better off and hence the buyer of the asset worse off. Thus, no individual would be willing to buy the asset. However, as conceptualized by Blanchard & Watson (1982), rational bubbles may persist if the general expectation of bubble growth rate, conditional on not bursting, increases over time. Hence, within a rational bubble setting, this would imply that an investor only holds a bubble asset if the bubble grows in expectation ad infinitum. However, even when it exists symmetric information, and all market participants know the probability distribution, it exists vigorous trading, and prices initially rise even though the fundamental value firmly declines (Brunnermeier, 2001).

In contrast, the theories concerning asymmetric information bubbles state that an investor may hold an overpriced asset if he thinks he can resell it in the future to a less informed trader or a "greater fool", preferably at a higher price (Flood & Hodrick, 1990; Kindleberger & Aliber, 2011). Brunnermeier (2001) argues that asymmetric information bubbles can occur in a setting in which investors share a common prior distribution, but possess different information. Hence, the presence of a bubble does not necessarily need to be commonly known. Even though all market participants individually act in a fully rational manner, the stock prices perceived as correct by some actors may differ from the actual fundamental value of the stock. This could be reasoned with that it exists a disparity of information available for different investment groups. This lack of high-order mutual knowledge makes it possible for finite bubbles to exist under certain conditions (Allen et al., 1993). However, as the EMH induces that all investors are rational and possess the same information, it fails to take account for the deviations from fundamental value observed in bubbles. Further, the assumption of Brunnermeier (2001) concerning that investors would only buy and hold a bubble asset if the bubble can be

expected to continue ad infinitum is conceptually unrealistic. Consequently, bubble creations must contain some form of irrationality or irrational investor behavior, to explain why deviations from fundamental values persist (Barberis & Thaler, 2003).

3.2.2 Irrational Investors

The assumption that investors are to be seen as irrational in their behavior, at least to a certain extent, may help explain market trends that traditional financial literature fail to ratify (Johansson, 2002). Additionally, it may describe why traditional accounting and financial measures reflected a decline in value relevance (Collins et al., 1997; Brown et al., 1999; Francis & Schipper, 1999). According to Fuller (1998), people systematically make mental errors and misjudgments when they invest their money. Contrary to the beliefs by the likes of Friedman (1953), Malkiel & Fama (1970) and Keynes et al. (1971) stating that investors are rational to their best extent, and that irrational investors would cease to have any influence on market prices, behavioralists or advocates of investor irrationality argue that this offsetting of impact is not always successful (Shiller, 2003). Behavioral finance thus attempts to understand the reasoning patterns of investors, including emotional processes involved, and how this influences the decision-making process that offsets the impact of rational investors (Ricciardi & Simon, 2000). Financial markets are a real game and an arena of fear and greed; hence prices are not always rational, and efficiency may be a textbook hoax (Wood, 1995).

Investor Overconfidence

Human beings, investors and managers alike, tend to overestimate their own skills and predictions for success (Ricciardi & Simon, 2000). This *overconfidence* could, according to Mahajan (1992), be defined as the overestimation of the probabilities for a set of events. In the psychology of judgement, the perhaps most robust finding is that people are inherently overconfident (DeBondt & Thaler, 1995). Evidence of overconfidence derives from a wide variety of fields, including negotiators, managers, investment bankers and market professionals such as security analysts (Oskamp, 1965; Wagenaar & Keren, 1986; DeBondt, 1991; Neale & Bazerman, 1992; Russo & Schoemaker, 1992). Further, it appears that overconfidence is greatest for complicated tasks, for forecasts with low probability, and undertakings lacking rapid and precise feedback (Fischhoff et al., 1977; Lichtenstein et al., 1981; Griffin & Tversky, 1992). As the selection of common stocks that will outperform the market is a difficult task with low predictability and noisy feedback, it represents the type of task for which people are most overconfident (Barber & Odean, 2001). Through the development of models in which overconfident investors overestimate the precision of their knowledge about the value of a financial security, Odean (1998) argues that investors overestimate the probability that their assessments are more accurate than that of others. Consequently, he further asserts that overconfident investors put more trust in their own valuations, and concern themselves less about the beliefs of other investors. This intensifies differences of opinions, a prerequisite causing the volume of trade to increase (Varian, 1989).

Noise trading risk

A further limitation to arbitrage efficiency is noise trader risk, conceptualized by DeLong et al. (1990a), which concerns about the risk that mispricing being exploited by arbitrageurs worsens in the short-run. In their model, it is suggested that mispricing may be able to persist due to risk-averse, short-lived arbitrageurs that are only concerned about the price of the next period, which is affected by irrational noise-trader demand instead of the riskless long-run fundamental value (Abreu & Brunnermeier, 2002). Shleifer & Vishny (1997) further suggest that fund managers limit their arbitrage as a consequence of the inherent fear that their investors may withdraw their money if they suffer intermediate short-term losses, despite the arbitrage strategy providing a riskless real payoff in the long-run. These noise-traders have a high influence as it may force arbitrageurs to liquidate their positions prematurely, thus realizing potentially steep losses (Barberis & Thaler, 2003). The "separation of brains and capital", namely how the majority of real-world arbitrageurs such as fund managers, do not manage their own assets, has significant consequences as investors, lacking the specialized knowledge to evaluate the strategy of the arbitrageur, may merely evaluate him on his generated returns (Shleifer & Vishny, 1997). Further, Gümbel (2005) reveals that individual investors prefer fund managers who primarily search for short-term information and exploit short-term arbitrage opportunities, allowing quick inference of the ability of the fund manager. As a result, if an arbitrageur is trying to exploit mispricing and this worsens in the short-run, investors may deem the fund manager to be incompetent and subsequently withdraw their funds, resulting in a forced liquidation for the arbitrageur (Barberis & Thaler, 2003). Hence, the fund manager may only partially exploit the arbitrage opportunity, making him less aggressive in eradicating mispricing (Abreu & Brunnermeier, 2003).

Prospect Theory

The expected utility theory, a core pillar of the EMH, has for long been the dominant normative and descriptive model of rational decision making (Tversky & Kahneman, 1992). This conventional treatment of normative and descriptive theories for thinking in decision theories was fundamentally changed by the conceptualization of Prospect Theory, proposed by Kahneman and Tversky in 1979 (Wakker, 2010). In contrast to the rational expected utility theory, prospect theory assumes irrational behavior. Kahneman & Tversky (1979) argue that the choices among risky prospects exhibit several pervasive effects that are inconsistent with the basic tenets of utility theory. Particularly, how people tend to underweight outcomes that are merely probable in comparison with outcomes that are obtained with certainty. In terms of framing effects, the rational theory of choice should give rise to the same preference order (Arrow, 1982). In contradiction to this assumption, Tversky & Kahneman (1989) note that the variations in the framing of options yield systematically different preferences. Investors evaluate outcomes, not according to final wealth levels, but based on their own perception of gains and losses, relative to a reference point such as the purchase price (Li & Yang, 2013).

Further, Tversky & Kahneman (1992) argue that, whereas the utility expectation principle assumes the utility of risky prospects is linear in outcome probabilities, empirical evidence indicates nonlinear preferences. As Allais (1953) conceptualizes, the difference between probabilities of .99 and 1.00 has more impact on preferences for choice than the difference between 0.10 and 0.11. Moreover, although risk aversion is generally assumed in an economic analysis of decisions under uncertainty, Tversky & Kahneman (1992) state that individuals are prone to risk-seeking choices in decision problems. They articulate that individuals prefer a small probability of large gains, over the expected value of the prospect, and that risk-seeking becomes prevalent when individuals must choose between a sure loss and a substantial probability of a more extensive loss. Lastly, loss aversion, the phenomena that under both risk and uncertainty, losses appear larger than gains, is contradictory to the rational expected utility model (Kahneman & Tversky, 1984; Tversky & Kahneman, 1991). The exhibited asymmetry between the values individuals put on gains and losses is far too extreme to be explained by rational income effects or decreased risk aversion.

Disposition Effect

Building on the hypothesis of prospect theory, and how investors display a disposition to sell winners and ride losers when standard theory would suggest otherwise, Shefrin & Statman (1985) coined the term *disposition effect* to explain these irregularities. The disposition effect has become a widely documented empirical regularity, and several studies find that investors are reluctant to unload assets at a loss relative to the price they were purchased at (Frazzini, 2006). Empirically, the available evidence reveals that despite greater investor sophistication is associated with less susceptibility to the disposition effect professional traders are not immune to it. For instance, Locke & Mann (2000) analyzed the trading behavior of professional traders and concluded that while all traders held losers longer than winners, the least successful traders held losers the longest. Further, Wermers (2003) found that managers of underperforming mutual funds appeared reluctant to sell their losing stocks, hence consistent with managers being disposition prone. Similar studies conducted by Coval & Shumway (2005) and Shapira & Venezia (2001) derive at the same conclusions, namely, that the disposition effect is evident among all investor classes - *smart money* or not.

IV: LITERATURE REVIEW

4.1 INTRODUCTION AND SELECTION OF AREAS OF CONCERN

As emphasized in the theoretical foundations section, the theoretical underpinnings of bubble creation may be diffuse and conceptually challenging to assess. Due to the specific nature of the Dot-com bubble, a large empirical body of research has investigated the antecedent factors leading up, and eventually bursting the bubble. When viewed as a whole, research and financial literature highlights seven main areas of concern all related to the creation, the persistence and, ultimately, the burst of the Dot-com bubble. Some areas are generally attributable to the whole economy and may thus not be exclusively accredited to the bubble. Nevertheless, these exhibit an underlying influence on other antecedents of the bubble which vindicates the inclusion. The areas identified are as follows: (1) Financial Fundamentals & Valuation; (2) Intangible Assets; (3) Investor Behavior; (4) Initial Public Offerings; (5) Venture Capital; (6) Interest Rates; and finally (7) Corporate Debt. These areas, and their relevance to a potential new bubble will now be further elaborated.

4.2 FINANCIAL FUNDAMENTALS & VALUATION

The value relevance of fundamentals

Equity valuation is one of the most widely researched topics in accounting and finance. A considerable amount of empirical literature emphasizes the ability of financial variables such as cash flows, earnings and balance sheet items to explain equity values (Core et al., 2003). Such value relevance, defined by Hung (2000) as the ability of accounting measure to capture or summarize information affecting firm value, has induced a wide array of accounting and financial metrics. Following the model and intuition of Downes & Heinkel (1982), and further extended by Hughes (1986), concerning value relevance, it is conceptualized that initial market value of equity is a function of net income and other metrics of firm quality.

Similar to the stock market crash in 1929 and 1987, the Dot-com bubble is characterized by investors neglecting the fundamental values in the pricing of financial assets, hence fundamental value irrelevance (White, 1990; Rappoport & White, 1994; Shiller, 2000). For the Dot-com period, this was particularly evident as even firms with an absence of recorded earnings experienced significant increases in stock price (Morris & Alam, 2012). Throughout the 1990s, an increasing number of academic studies documented this decline in the linear relationship between earnings and stock returns (Brown et al., 1999; Ely & Waymire, 1999; Lev & Zarowin, 1999). When new technology-associated companies started emerging during the 1990s, a problem arose, as these possessed completely different characteristics than the industrial companies that dominated the 1900s. Due to the nature of Internet-companies, regularly having limited sales and a narrow product portfolio,

investors lamented from the classical accounting principles and valuations of companies as adherence to these models was problematic (Gavious & Schwartz, 2011).

This *new economy* period, marked a general decrease in the value relevance of accounting and financial information (Demers & Lev, 2001; Core et al., 2003; Trueman et al., 2003). A large body of empirical research suggests that, due to the wholesale changes in the economy, the traditional financial statements became less relevant for assessing shareholder value (Rimerman, 1990; Sever & Boisclair, 1990; Jenkins, 1994). According to Amir & Lev (1996), on a stand-alone basis, earnings, book values and cash flows were mainly considered irrelevant when valuing firms in intangible intensive industries. Penman (2002) postulated that fundamental metrics were no longer applicable for the *new economy* paradigm, suggesting other metrics such as *Enterprise Value / Total clicks* and *Price / Web traffic* encapsulated firm value to a higher degree. However, the web-traffic related indicators as proxies for future demand of tech companies turned out to be misguiding as the conversion from traffic to earnings did not happen at the anticipated rate.

As an alternative approach to the *new economy* metrics, investors engaged in the adjustment of traditional metrics to determine intrinsic value. For instance, Ofek & Richardson (2002) noted how the discounted cash flow model was utilized on tech startups, although the companies had no recorded earnings, by assuming profit margins of comparable *old economy* companies as a proxy for the margins a mature tech company could achieve. In addition, they note that investors assumed that whereas costs would only rise by a negligible amount, profit margins would increase in proportion to scaling of the business, which was very unorthodox outside of the tech market and which in the end turned out to be wrong for most internet companies (Ofek & Richardson, 2003). Additionally, traditional performance benchmarks were often inverted in the investment decision. For instance, according to Mudambi & Treichel (2005), it became an accepted view that negative cash flows indicated a long-term investment in the asset base of the firm. Hence, implying that a more substantial negative cash flow was considered better which is contradictory to the traditional view of negative cash flows as an indicator of poor performance. Basu (1997) and Elliott & Hanna (1996) argue that negative earnings adversely affected the value-relevance of earnings, and note that firms, to a more considerable extent, reported negative earnings. These applied metrics became key indicators for valuation and anticipated growth rates, despite conveying minimal insight into the financial potential of these companies (Golloto & Kim, 2003).

Financial metrics

The Price-to-Earnings ratio (P/E) has become the benchmark when addressing valuation questions involving firm performance, initial public offerings (IPOs), and corporate restructurings (Alford, 1992). According to Nicholson (1960), being among the first to highlight this ratio, it represents a logical methodology for an investor seeking companies with higher productivity and performance as represented by a lower P/E ratio.

Further, according to Cragg & Malkiel (1982) and Zarowin (1990), it captures the market forecasts of earnings growth prospects and the risk associated with the company. The ratio indicates future growth in earnings, being positively related to expected future return on equity and negatively related to current return on equity (Penman, 1996). Supporting the notion on P/E, Shiller (1996) finds that the ratio alone could explain more than half of the variance of the price change of stocks in the period from 1901 to 1986. The ratio was, however widely lamented by investors in the Dot-com era. As Gollotto & Kim (2003) and Teeter & Sandberg (2017) assert, the P/E ratio reached unprecedented levels during this period. According to Foster (2004), the factors that affected the relationship between earnings and stock prices were not entirely understood by the investors at the time. Additionally, the P/E has the weakness in that it requires the existence of actual earnings, something that the majority of tech companies at the time did not possess, making adherence to the metric difficult (Berkman et al. 2000).

As an alternative to the classic P/E ratio, Campbell & Shiller (1998), by extending to some of their earlier work on stock market predictability, argued that the long-term stock market returns were not random walks but, could instead be forecasted through their conceptualized "cyclically adjusted price-earnings ratio" (CAPE). When calculating the CAPE ratio, the earnings are replaced by the average of the last ten years of Earnings per Share (EPS), with earnings and stock prices measured in real terms, thus eliminating a large part of the cyclicality of these. The utilization of the CAPE ratio limited the risk of obtaining myopic assessments of the valuation of a stock and enabled the assessment of the profits that corporations could expect to earn on average over the medium to long-run (Taboga, 2011). Indeed, by regressing the 10-year real stock returns against the CAPE ratio, Siegel (2016) found that the ratio represented a significant variable for predicting long-run stock returns. Presenting a preliminary version of the model to the Board of Governors of the Federal Reserve in 1996, Robert Shiller and John Campbell warned that stock prices were running well ahead of earnings, which later has been referred to as the inspiration for the irrational exuberance speech by Allan Greenspan later the same year (DeLong & Magin, 2006).

Another key financial metric, the Price-to-Sales ratio (P/S) has within some industries become an increasingly applied tool for equity valuation (Vruwink et al., 2007). The intuition of the ratio is that it quantifies what an investor is willing to pay in equity per $ sale of the company. According to Fisher (1984), the ratio is a good indicator of the popularity of a stock, asserting that a high P/S ratio induces volume trading from investors but that the stock will not likely earn long-term, above average returns. Conversely, stocks with low P/S ratios are deemed to be more likely to earn long-term above-average rates of returns as any unexpected improvement in the performance will significantly increase the popularity with investors (Fisher, 1984). Similar to the development of P/E in the Dot-com era, Lewellen (2003) finds that close to all internet stocks in 2000 experienced highly inflated P/S ratios, far above the other parts of the economy. According to Brunnermeier

& Nagel (2004), investors, such as hedge funds managers, were more inclined to take larger positions in companies that possessed these inflated P/S ratios. Although popular, the ratio has some notable drawbacks. For instance, Koller et al. (2005), argue that the P/S multiple is not ideal for comparing equity values of companies, as it assumes that peer companies have the same growth rates, return on investment, and similar operating margins. These assumptions are spurious at best, especially when comparing companies in vastly different industries (Koller et al., 2005). According to Alford (1992), the predictability of the P/S will, therefore, be rather moderate. However, considering how the P/S ratio does not require the notion of earnings, it may be the best alternative available when analyzing technology-intensive sectors and thus be superior to the previously mentioned P/E ratio, as was the reasoning of many investors in the Dot-com era.

4.3 INTANGIBLE ASSETS

In the contemporary business environment, production is not limited to traditional factors such as capital and labor but includes the factors of worker skills, processes, technology and other factors collectively referred to as intangible assets (Brynjolfsson et al., 2002). In the academic literature, intangible assets are defined as resources which do not possess a physical embodiment and whose industrial and economic exploitations gives claims to future benefit (Bouteiller, 2000; Smith & Parr, 2000; Lev, 2001). Further, intangible assets are, through the main factors of knowledge and constant innovation, giving rise to new processes and products, and in turn, establishing a source for further knowledge and innovation (Cañibano, 2018). Naturally, as intangible assets, in many industries, may account for the majority of firm market value, it gives rise to the fundamental question of how human knowledge, internal structures, reputation and technological know-how, among other intangible assets, should be converted into negotiable forms of value (Allee, 2008). Campbell & Shiller (1998) argue that it has become a hallmark of many companies in the new economy that they plan to attract a large volume of customers, but lose money for years, hoping that the high level of activity will enable them to build an effective high-tech organization. How much of these activities promoting intangible capital that should be considered effectively long-term investments are, however, disputed.

Shiller (2005) argues that the spread of the internet, as a new base technology amongst consumers, promised the creation and access to new markets for companies and it was widely assumed that the internet was ushering in a new technological era in business and society. Conversely, he notes that this mentality created a general sense of euphoria with supposedly unprecedented growth opportunities and an atmosphere of relative carelessness amongst investors, who became more risk-taking in their investment behavior due to the positive outlook of growth opportunities. Pavitt (1979) argues that such technological innovation is either "pushed" through scientific and technological breakthroughs, or "pulled" by social or market needs. During the Dot-com period, tech companies, funded by venture capitalists seeking short term profits, "pushed" in a higher degree innovation than being "pulled" by market needs or capability of utilization (Wheale & Amin, 2003), However,

as Mowery & Rosenberg (1979) postulate, the market must learn how to accept revolutionary new inventions that lie beyond their present competences. Hence, tech firms, who invested heavily in the innovation of technology, thereby reducing marginal revenues, found themselves in an environment where the market was unable to utilize the technological potentials fully.

Further, Greenwood & Jovanovic (1999) and Hobijn & Jovanovic (2001), suggest that this technological innovation destroy old incumbent firms once the success of the new technology is made known to the market. Additionally, they argue that new technologies are rarely formed by listed companies, and as listed companies usually resist their implementation, stock market valuations are depressed once new technologies are invented. Consequently, once the potential of this new technology is capped, market participants realize that no further growth is possible and thus cause market prices to crash (Anderson et al., 2010). This is, the result of investors shifting their attention to small innovative firms being listed on the markets which have superior growth potential compared to old technology firms.

Today, intangible assets play a critical role in determining the value of the company (Daum, 2001). This is a consequence of the increased competition among tangible assets that are prone to rapid changes and may fail to sustain competitive advantages over the long run. Consequently, an increasing emphasis is placed in the intangible technological assets of the firm (Chiesa et al., 2005). These intangible assets are becoming an influential instrument in facing competitive market forces alongside traditional assets (WIPO, 1998). However, unlike tangible assets, the value of intangible assets does not derive from their cost, but rather how well they align to the strategic priorities of the enterprise (Kaplan et al., 2004). Additionally, the literature suggests that firms with more intangible assets, on average, have less stable earnings, hence are deemed as more risky (Marsh, 1982; Titman & Wessels, 1988). Numerous efforts have been made by researchers and individual companies to develop methods and tools to account for intangible assets (Hurwitz et al., 2002; Sveiby, 2010). However, the methods are not consistent, standard or validated for applicability by industry at large (Stewart, 2001), and these models for intangible assets are under much scrutiny concerning their viability (Bontis, 2001).

Naturally, as the valuation of intangible assets is prone to subjective estimations (Cravens & Guilding, 1999), it becomes increasingly difficult to evaluate the intrinsic values of technology stocks. As technology of more innovative nature tends to be associated with more uncertain prospects, it is correspondingly difficult for analysts to evaluate its quantifiable value as it is fundamentally different from the status quo (Gu & Wang, 2005). Additionally, the question whether information on intangible assets reported under contemporary financial reporting requirements conveys information that is relevant to the valuation of firm equity by market participants is still a focus for both accounting policymakers and researchers (Choi et al., 2000). According to

Lev (2001), the accounting of intangible assets needs to be defined and standardized to convey relevant and timely information for investors. Hence, it is imperative that standard accounting of intangible assets in the accounting valuations of the company, and additionally the methods used to account for the value contributed by them, are reflected (Malone, 1997; Reilly & Schweihs, 1998).

4.4 INVESTOR BEHAVIOR

The majority of valuation techniques are grounded on the assumption that the price of securities in the financial markets must equal fundamental values as all investors are deemed to be rational and will engage in arbitrage to eliminate any abnormalities (Friedman, 1953). According to Cochrane (2005), a rational investor is defined as an individual who seeks to maximize the expected utility through maximizing the consumption, with regards to the risk associated with the specific investment opportunity. As investors act rationally, they assess each security for its fundamental value, discounted using its risk characteristics, implying that once investors learn something about fundamental values of a security they promptly react to new information (Wheale & Amin, 2003). This reaction is engrained by bidding down prices when reports are bad and bidding them up when they are good, leaving all available information reflected in the price of the security. Shiller (2000) notes that smart investors, in terms of investment performance, will not exceed the least intelligent investor as their superior understanding is already encapsulated in existing securities prices. In line with this reasoning, Chancellor (2000) emphasizes that manias or bubbles cannot exist as market prices always reflect the fundamental value. However, this assumption of rational investor behavior fails to explain all of the actual market movements in a satisfactory way (Debondt & Thaler, 1985).

Several researchers including Kahneman & Tversky (1979), Grossman & Stiglitz (1980), Malkiel (1995), Carhart (1997) and Hirshleifer & Shumway (2003) have documented numerous examples of irrational investor behavior, contradicting the EMH. These behavioral biases have become a popular explanation for a variety of asset pricing phenomena which are difficult to reconcile with a rational decision-making framework (Cornelli et al., 2006). A reoccurring finding is that it exists repeated patterns of irrationality, inconsistency, and incompetence in the manner human beings arrive at decisions and make choices under uncertainty. Thus, many academics assert that human flaws are consistent and predictable, making the basis of EMH less acknowledgeable. However, a crucial issue is how to judge investors rationally, considering incompetence and inconsistency is the way to define irrationality when it is possible that investors cannot process information quickly in the market conditions. According to Elton et al. (2011), the best indicator of investor rationality, in most cases, is to look at the stock market index, as inconsistent, irrational market movements are the best proxy of irrational investors. The intuition is simple. When the market moves inconsistently devoid of any economic reasoning, it indicates investors are investing or disinvesting inconsistently and incompetently.

The notion of non-rationalization of investments has been widely researched in the context of the Dot-com bubble. Specifically, the evidence from the market in technology stocks in the late 1990s indicate a significant deviation from economic efficiency and share prices in this sector could not be explained by fundamentals (Wheale & Amin, 2003). For instance, Cooper et al. (2005) find that firms adding a "Dot.com" to their name in 1998 and 1999 experienced substantial gains in shareholder wealth. More specifically, they find the cumulative average abnormal return to be 63 percent for the five days surpassing the name-change announcement date, and that the effect was independent of the actual level of involvement of the firm with the Internet. According to Schwartz & Moon (2000), the valuation of internet stocks was rational if growth rates in revenues were high enough. Even with a severe possibility that a company might go bankrupt, if the initial growth rates were adequately high and this growth rate contained enough volatility over time, then valuation estimations that would otherwise appear dramatically high, would be justifiable and rational. However, even by applying stretched assumptions of fundamentals when valuing Amazon, their estimated value was around 15 percent of the actual market value, indicating valuation was not rational.

Ofek & Richardson (2002) argue that the valuations seen at the time would require stellar implied growth rates, far above what could be reasonably expected, to make these estimations plausible. Regardless, investors accepted this, even when the bubble was already building. Romanova et al. (2012) argue that investors under the period assigned valuations to start-ups, without scrutinizing the profit-generating intentions or understanding of the product portfolio and the viability of products. Demers & Lev (2001) and Hand (2003), highlight that investors were favorably disposed towards aggressive cash expenditure of internet companies, finding that the more a firm lost, the higher its price to sales figures were. In related research, Keating et al. (2003) compared the relative contribution of financial measures associated with the *new economy* metrics in explaining the decline in internet stock prices observed in the first quarter of 2000. Their results gave clear indication towards annual report date being far more superior in explaining stock prices, both cross-sectional and in short event window returns, than *web traffic* metrics and other *new economy* measures commonly utilized by investors in the period.

In contrast to the abovementioned postulations for investor irrationality, some economists argue that the inflated prices of the Dot-com bubble was a rational response to the possibility that promising internet firms might one day turn into Microsofts (Lahart, 2008). It is further suggested that rational investors were constrained by market mechanisms that limited their mispricing eradication. Wurgler & Zhuravskaya (2002), for instance, argue that rational investors were reluctant to trade against mispricing in the period as close substitutes were unavailable, thus limiting their aggressiveness in risk aversion strategies. Abreu & Brunnermeier (2002, 2003) suggest that rational investors were limited by synchronization risk as each investor were uncertain when other traders would sell out, creating a synchronized problem of irrationality which

enables mispricing to persist for some time. Under such an environment, Brunnermeier & Nagel (2004) argue that it could, in fact, be optimal to invest in overpriced assets, as arbitrageurs, who conclude that other arbitrageurs are unlikely to trade against the bubble, will ride the still-growing bubble for a while. Additionally, they find evidence of hedge funds reducing their holdings prior to the price collapse, suggesting that fund managers understood that prices of certain stocks would eventually deflate. Consequently, their findings were consistent with the view that the investor sentiment driving the technology bubble was to some extent predictable. Hence, rational investors and *smart money* investors had the incentive to prolong the bubble growth by reaping gains from riding the bubble, not exerting a correcting force on stock prices, at the expense of less sophisticated investors (Abreu & Brunnermeier, 2003; Brunnermeier & Nagel, 2004).

These aspects could explain why rational investors did not trade aggressively enough to completely eradicate mispricing. However, as Brunnermeier & Nagel (2004) note, the trades of investors should still have a stabilizing effect, in terms of shorting assets that they knew to be overpriced. Conversely, this was not the case as rational investors anticipated, and utilized, demands from positive feedback traders, whose trading strategy is based on whether it is good or bad news about a particular stock (DeLong et al., 1990a). Considering how high abnormal stock returns marked the lead up to the bubble, rational investors could buy and push the price beyond fundamental values as feedback traders would be prepared to take up the position at a higher price in the next period. As a result, the stock market may have temporarily failed in its role as an efficient allocator of equity capital (Malkiel, 2003)

4.5 INITIAL PUBLIC OFFERINGS

An IPO represents a critical transition point in the development of a firm - a transition that advances the privately held firm to the public arena (Certo, 2003). Historically, empiricists have had difficulty studying why firms go public due to data constraints. Nevertheless, the academic theory suggests four motivations for going public: First, the cost of capital literature argues that firms conduct an IPO when external equity will minimize their cost of capital, hence maximizing the value of the company (Modigliani & Miller, 1963; Scott, 1976). Second, the literature suggests that an IPO may be motivated by the enabling of insiders to cash out (Mello & Parsons, 2000). Third, Zingales (1995) argues that IPOs may facilitate takeover activity, as it represents a first step toward having a company taken over at an attractive price. Fourth, Chemmanur & Fulghieri (1999) argue that IPOs broaden the ownership base of the firm. Thus, IPOs may serve as a strategic move. These motivations do, however, not account or justify the tendency documented by the literature of IPOs coming in waves, characterized by periods of cold and hot markets (Ibbotson & Jaffe, 1975; Ritter, 1984).

One suggested influential factor, is the notion that managers take advantage of bull markets and attempt to capture attractive stock prices (Brau & Fawcett, 2006). According to empirical evidence provided by Ritter (1991) and Loughran & Ritter (1995), firms time IPOs to take advantage of such favorable windows, allowing them to obtain the most attractive offering prices. Lowry & Schwert (2002) argue that the IPO decision is influenced by the recent first-day stock performance of other firms. Hence, it exists a tendency that firms prefer to go public when other good firms are currently issuing (Choe et al., 1993).

During the Dot-com era, several anomalies regarding the IPO market became visible, most notably a surge in both IPO activity and average IPO first-day returns. For instance, whereas, the average first-day return for US IPOs in 1996 reached levels of 17 percent, the average first-day return for companies going public in 1999 was in excess of 70 percent (Loughran & Ritter, 2004). For tech companies the average first-day returns were far more remarkable, averaging approximately 89 percent during 1999 and 2000. Many industry analysts have, in hindsight, attributed these unprecedented first-day returns of technology-related IPOs to the deteriorating quality of the firms that decided to go public (Peristiani & Hong, 2004). The period was marked by a considerable number of speculative firms, with poor business plans and little or no foreseeable earnings, entering the public market (Schwartz, 1998). For example, Ritter & Welch (2002) report that the percentage of unprofitable firms going public increased from 19 percent in the 1980s to 37 percent in the interval 1995-1998. This trend was further exaggerated, as exemplified by the findings of Schultz & Zaman (2001), who report that only 8.72 percent of the internet firm IPOs from January 1999 to March 2000 were profitable in the quarter preceding the IPO. As an alternative explanation for the IPO market anomalies, Ritter & Welch (2002) argue that these may derive from the conceptual demanding assessment investors faced when establishing the *true value* of an IPO firm. As Lange et al. (2001) note, investors during the Dot-com era readily accepted a mantra of *growth at all costs*, enthusiastically building up the post-IPO offering prices to irrational levels.

Firms that go public in the early stages of their growth cycle tend not to be profitable at the time of their IPO (Jain & Kini, 1999). However, in periods where the market is favorably inclined towards firms making investments rather than demonstrating profitability, post-IPO profitability is not necessarily a prerequisite for the legitimizing of firms to investors (Stuart et al., 1999; Janney & Folta, 2006). Nevertheless, the pre-IPO operating performance of survivor firms is found to be significantly higher than for non-survivors (Jain & Kini, 1999; Peristiani & Hong, 2004). Additionally, there exists a positive relationship between the pre-IPO profitability and post-IPO returns and survival rate (Bhabra & Pettway, 2003). An extended body of literature further suggests that post-IPO, profitability tend to decrease (Degeorge & Zeckhauser, 1993; Jain & Kini, 1994; Mikkelson et al., 1997). According to Pástor et al. (2008), this post-IPO drop is of greater magnitude for stocks with more volatile uncertain average profitability. Nevertheless, as unprofitable firms still go public, Degeorge & Zeckhauser (1993), reason that firms are forced to go public as their profits are insufficient to

cover their debt load. Pagano et al. (1998), on the other hand, argue the public decision comes from insider investors who anticipate worsened market conditions, meaning the IPO decision will maximize their profits. The notion that average excess profitability is likely to be more correlated across firms in the same industry and prone to industry-specific prior uncertainty can explain why IPO waves are concentrated in a given industry (Pástor & Veronesi, 2005).

One reoccurring aspect within IPO literature is the notion of significant first-day returns, which may suggest underpriced IPOs. According to Ibbotson (1975) and Ritter (1987), underpricing of IPOs is found to be systematical over the past century. In an attempt to explain this mispricing, Ritter (1984) argues that the underpricing is a result of the technological and valuation uncertainty or risk associated with the individual IPO, stating that less-risky IPOs will be less frequently underpriced. Another widely applied model to rationalize the IPO mispricing is the signaling model, which suggests that issuers are using underpricing as a mechanism to signal their quality to the market, thus making shares more liquid in the aftermarket (Allen & Faulhaber, 1989; Benveniste & Spindt, 1989; Welch, 1989; Chemmanur, 1993; Jegadeesh, 1993; Booth & Chua, 1996; Van Bommel, 2002). This model stipulate that high-quality firms underprice their stock at the initial IPO to raise additional funds in the future through seasoned equity offerings (SEOs) when market prices are established, and there has been an opportunity for information revelation, enabling more favorable terms (Jain & Kini, 1994). Consequently, the signaling model of underpricing forecasts that IPO firms, engaging in underpricing, should exhibit superior operating performance in comparison to those that do not (Jain & Kini, 1994).

In explaining the excessive underpricing of the Dot-com era, Ljungqvist & Wilhelm (2003) argue that managers of issuing firms, to a large degree, consented to the apparent underpricing. They articulate that the reasons for the increased underpricing were fewer IPOs containing secondary shares, reduced CEO ownership, an increased frequency and size of *friends and family* share allocations combined with an increased ownership fragmentation. Loughran & Ritter (2002), however, credited this consent, holding constant the level of managerial ownership and other characteristics, to the increased emphasis placed on analyst coverage at the time. As issuers placed more importance on hiring a lead underwriter with a highly ranked analyst to cover the firms, they became less concerned about avoiding underwriters with a reputation for excessive underpricing. On the contrary, Loughran & Ritter (2004) report that firms, to an increased extent, employed underwriters with a history of underpricing, which in exchange provided analyst coverage and side payments to the CEO. As Brau & Fawcett (2006) postulate, the high-tech firms of the Dot-com era were more concerned about lousy market and pricing issues, than control and dilution of its issued shares.

4.6 VENTURE CAPITAL

Venture Capital funds (VC) represent a crucial internal factor and contributor in the early stages of a startup (Davila et al., 2003). The fundamental investing operation of formal VC firms has thus been extensively elaborated in academic literature (Huntsman & Hoban, 1980; Tyebjee & Bruno, 1984; Sahlman, 1990). Typically, VC firms structure and execute investment contracts with the investee companies, monitor the performance of the investees, and, eventually, liquidate their investment through the means of an IPO or trade sale (Valliere & Peterson, 2004). VC funds are relevant to explain differences among startup companies (Hellmann & Puri, 2000). As startups are subject to high information asymmetry (Petersen & Rajan, 1995) and a high degree of uncertainty reflected in the liabilities of smallness and newness (Hannan & Freeman, 1993), the access to traditional financing sources is typically limited. In contrast, VC funds have the capabilities to deal with these factors and provide funding for companies that might otherwise have a hard time attracting traditional financing sources through the capital markets or debt financing alternatives (Gompers & Lerner, 2001). The VC firm accept the higher risks and uncertainties associated with the performance of these startups as it entails potentially high-growth and high returns investment opportunities (Valliere & Peterson, 2004).

During the Dot-com era, VC became an increasingly preferred source of funds for new firms. Whereas the traditional bank lending to small firms had remained more or less constant since 1977, VC investments in 2001, had increased by almost 100 times since 1977 levels (Ueda, 2004). It became the primary source of seed money for the Internet sector (Janszen, 2008). In the beginning, IT-startups were nothing more than regular companies, being one part of the spectrum of tech industries and software-enterprises, in which VC funds invested their money. However, similar to the market for IPOs during the Dot-com bubble, peaking in 1999, the pre-IPO markets of VC funds experienced significant increases in business volumes (Valliere & Peterson, 2004). As the tech IPO market in particular exhibited significant first day returns, VC funds became, to an increased extent, drawn to the frequency and consistently high performance of these companies, thus shifting their investment focus accordingly (Loughran & Ritter, 2002). According to the US National Venture Capital Association (NVCA), there were 288 VC funds with $31.1bn investment capital in 1998. By 2000, this number had increased to 635 funds with $107.7bn, as VC firms aggressively obtained additional funds from their respective investors.

By the end of 2001, the number of VC funds had declined to a mere 94, with just $5.7bn in investment capital (NVCA, 2002). Sohl & Rosenberg (2003) argue that this notable downturn in VC activity derived from multiple factors. Firstly, the notion that it was a surge in new VC funds and new funds managers within the tech industry, adding a layer of inexperience in a market filled with uncertainty. Investors were slow to react to favorable conditions, and then, once investment started, the same investors were slow to react to the deteriorating conditions, creating an overshoot of investments (Lerner, 2002). Secondly, the entire timeline

from startup to exit was abbreviated with the hot IPO market driving VCs and entrepreneurs to build *designer* companies fashioned for a fast exit, rather than the creation of a solid company. Lastly, Sohl & Rosenberg (2003) note how the inherent high failure rates in high growth VC funds was neglected by both novice and experienced investors with the mantra of *invest what you can afford to lose* being replaced by dreams of unprecedented capital gain multiples. When the Dot-com bubble eventually burst, the falling stock prices induced VCs to desperately sell their stakes in companies. When they were not able to successfully do this, VCs turned to shut down companies, causing fear and job loss across the economy and aggravating the crisis (Lerner, 2002)

Overall, VC backed firms are associated with high levels of uncertainty (Ueda, 2004). For instance, by reviewing 110 investments made by three VC firms between 1960 and 1975, Huntsman & Hoban (1980) find that 17 percent of the sample generated a complete loss (-100 percent) for the investors and only one-quarter of the sample exceeded the average return of the portfolio. Hall & Hofer (1993) attribute this uncertainty of VC performance to the screening and assessment of business proposals prior to investments, finding that VCs used less than six minutes to derive to the conclusion of investment or not. Further, they found that the key criteria of the VCs were the fit with the lending guidelines of the VC firm, the long-term growth prospects and profitability of the industry. Conversely, they report that a mere 1.3 percent of the respondents considered the proposed business as imperative for the screening protocols and that no proposals were, at any stage, rejected based on this criterion. Furthermore, Gompers & Lerner (2004) argue that as the average lifetime of a VC-fund is typically a modest ten years, these funds may have incentives to push the IPO process, even if the firm is not ready, to ensure cash for new investments. Consequently, VC fund managers adopt an aggressive valuation stance that results in inferior deals (Amit et al., 1990).

Nevertheless, according to Jain & Kini (1995), VC backed IPOs exhibit higher post-issue performance compared to non-VC backed companies. Barry et al. (1990) and Rosenstein et al. (1993) suggest higher post-issue performance may derive from the recognition of VCs as experts in the capital markets, hence sending positive signals to investors. Further, academic literature suggests that VCs stipulate other services to private firms that increases the probability of success (Berglof, 1994; Casamatta, 2003; Ueda, 2004). One such service is according to Mudambi & Treichel (2005) the access to extensive networking ties. The VC network ties facilitate superior firm performance by easing the identification of new customers, providing refinancing opportunities, new management opportunities and broaden the potential beneficial merger candidates (Florida & Kenney, 1988; Hsu, 2006; Hochberg et al., 2007). VC is further recognized to be the most tailored financing alternative for the growth of high-tech entrepreneurial firms (Gompers & Lerner, 2001) and has a positive effect on firm growth (Bertoni et al., 2011; Puri & Zarutskie, 2012). Moreover, VCs are better at screening entrepreneurial firms that have high-growth potential, than other capital market operators (Sahlman, 1990).

The VC backing of high-tech firms further provisions managerial skills and competencies (Hellmann & Puri, 2002), and the monitoring activity of the managerial conducts and results (Lerner, 1995). Additionally, empirical evidence find a strong positive correlation between VC funding and innovation (Hellmann & Puri, 2000; Kortum & Lerner, 2001).

However, Kenney & Zysman (2019) asserts that VC-backing may induce potential dangers. They argue that the VC industry lacks discipline, attempting to disrupt businesses and gain market share without any clear path of profitability. Benjamin & Margulis (1996) postulate that, as VC firms are involved with multiple investments within a year, they concern less about the risks involved in each investment. Mason & Harrison (2002) argue, that due to adverse selection problems, VC funds fail to accurately assess the competency and the offer price required to onboard the entrepreneurs, meaning VC-backed firms will be more prone to fail as less capable entrepreneurs may run it. Moreover, Schwienbacher (2008) finds that high concentration of asset intangibility, such as proprietary technology, reduce the efficiency and willingness of VC funds to exit through trade sales, as the transfer of technology is costly and difficult. Thus, the more significant innovation and intangible asset composition, the higher the likelihood of VCs exiting through an IPO. The VC funds are more concerned with "hitting a home run" than to maintain a "good batting average" (Quindlen, 2000). Therefore, the return profile of VC funds are typically negatively skewed, but with a long positive tail, reflecting a large proportion of loss-making investments but, additionally, a small number of very successful investments (Mason & Harrison, 2002).

4.7 INTEREST RATES

Being one of the most fundamental macroeconomic factors for stock returns and economic growth, interest rates have been widely discussed within the financial environment (Alam & Uddin, 2009). Especially the question of whether movements in money may be utilized to predict movements in output or income has been an enduring topic in macroeconomics (Stock & Watson, 1989). For instance, Zhou (1996) studied the relationship between interest rates and stock prices, concluding that interest rates have an essential impact on stock returns, particularly on long horizons. This study supported the argument of both Fama & Schwert (1977) and Christie (1982), suggesting interest rates may be an important explanatory variable as it is possible for an increase in interest rates to have a positive effect on stock volatility. The results by Zhou (1996) further indicated that the high volatility of the stock market is related to the high volatility of long-term bond yields, which could be accounted for by changing forecasts of discount rates. Building on this, Zordan (2005) argues that stock prices and interest rates are inversely correlated, and explanatory for economic cycles over a period stretching back to the 1880s.

During the Dot-com bubble, The Fed lowered interest rates from 5.5 percent to 4.75 percent, while claiming that it was not looking at the stock market, which considering the inflated asset prices of tech companies, may have seemed questionable at the time (Hunter et al., 2005). It is possible to argue that if tighter, more hawkish, monetary policies had been implemented to dampen the enthusiasm during the Dot-com era, this might have reduced corporate lending and decreased the recessionary pressure brought to bear by low interest rates. Thus, it is possible that the burst of the bubble would have been less severe, limiting the inflationary consequences of the excessive equity price levels (Hunter et al., 2005). However, the Dot-com bubble was predominantly contained within the technology sector, and raising interest rates could have had negative consequences on housing and business investments in other sectors, hurting the overall economy (Kohn, 2006). Thus, the mitigation of capital misallocation in one sector would have created capital misallocations in other sectors, making that the assessment of net gain from policy alterations difficult. Nonetheless, even without this tightening, it existed too few resources available for all formulated and funded plans during the boom to succeed. As Callahan & Garrison (2003) argue, this wedge between savings and investment would have manifested itself in the absence of other resources such as shortage of capable personnel, office space, housing for workers and other factors of production. The rising prices of these factors would have eventually brought the boom to an end, regardless of the Fed tightening credit or not.

The effect of Yield spreads on the economy

In the period preceding the Dot-com bubble, more specifically the time interval 1994-1999, the yield spread between the long-term Treasury note and the short-term Treasury bill reached a significant low 0.57 percent (Nayak, 2010). Wright (2006) has highlighted how this spread may be used as a leading indicator for a coming recession, as it measures the difference between current short-term interest rates and the average of expected future short-term interest rates over a relatively long horizon. Consequently, the term spread is a measure of the attitude of monetary policy, implying that the higher the term spread, the more restrictive current monetary policy, and thus, the more likely is a recession over the subsequent quarters. If investors suspect that a recession is near, the response of the yield curve will depend on their assessment of the magnitude and duration of the effect of the recession on short-term interest rates (Dueker, 1997). Campbell (1987) further suggests that the term structure of interest rates spreads contains useful information for forecasting stock returns. Historically, long-term interest rates dipping below prevailing short-term interest rates, a phenomenon known as an inverted yield curve, has preceded major recessions of the past (Dueker, 1997). Thus, a considerable body of literature argues that the yield curve may be utilized to forecast recessions.

For instance, Estrella & Hardouvelis (1991) and Estrella & Mishkin (1996) found that the spread between the yields on the ten-year Treasury note and the three month Treasury bill is a useful predictor of both cumulative economic growth, up to four years in the future, and marginal economic growth rates, up to seven quarters in

the future. Thus, it significantly outperforms other financial and macroeconomic indicators in predicting recessions. In another examination of yield spread predictability, Plosser & Rouwenhorst (1994) utilize various maturities of long-term bonds and the three-month Treasury bill rates for a variety of countries, concluding that the term spread has significant in-sample predictive power for future cumulative changes in industrial production. Due to the predictability associated with yield spreads, it has induced the creations of various recession and growth predictor models. One of these models, the recession model of Estrella & Trubin (2006), utilizes the spread between the three-month T-Bill and ten year T-note to estimate the probability of a recession occurring within twelve months from the viewpoint of information available.[1]

However, although the yield spread has been a useful leading indicator of economic activity in the past, the observation of periods in the 1990s were not nearly as informative as it has previously been (Dotsey, 1998). Over time, economists have no stellar record of predicting downturns, which may be the result of the possible explanation that recessions are simply unpredictable (Rudebusch & Williams, 2009). According to Dotsey (1998), it is impossible to state if the diminished predictability of the yield spreads is a function of some underlying change in the economy, if it is transitory, or simply the result of examining small sample periods that are characterized by little output variability.

4.8 CORPORATE DEBT

Concerning financing of companies, Kim et al. (2008) argue that debt represents a less attractive alternative for high-tech firms than for low-tech firms. Carpenter & Petersen (2002) argue that it exist several reasons why the widespread use of debt finance may be unsuitable for high-tech firms and why the shadow cost of debt finance may increase rapidly with higher leverage. For instance, they argue that the very nature of the debt contract is not well suited for the potential high upside of tech investments. As creditors are more concerned with the returns of firms in good states of nature, the lenders are only concerned with the lower tail of the distribution of returns (Stiglitz, 1985). Considering how tech companies often have less stable cash-flows, it increases the difficulty of servicing the interest and principal payments of the leverage. Furthermore, as the majority of the asset concentration for these firms is intangible, Kim et al. (2008) argue that the cost of financial distress is much higher as these are not easily liquidated. Additionally, as tech firms rarely have earnings during the first years, they tend to benefit less from the tax-shield accompanying debt. As a result, technology companies are more inclined towards the financing from VCs and the capital market (Audretsch & Lehman, 2003).

[1] The model, in it entirity can be found in appendix 1.

Nevertheless, the literature asserts that higher leverage in the capital structure of firms creates several benefits. Jensen (1986) argues that increased leverage creates value for shareholders as it imposes strong managerial incentives and limits the amount of excess cash-flow available for potential malinvestments. Grossman & Hart (1982) further advocate that leverage can prompt management to align their interests with shareholders, in a way not possible by traditional incentivized remuneration & compensation structures. Additionally, Lowenstein (1985) postulates that increased leverage facilitates tax shield benefits. These tax shield effects does, according to Jensen (1989), far outweigh the corresponding costs of financial distress associated with high leverage. However, increased leverage does inherently give rise to several threats as identified in financial literature (Opler & Titman, 1993). Lowenstein (1985) admits that, although leverage facilitate tax shield benefits, it exists concerns of financial distress and whether the leveraged firms are viable in periods of negative economic developments.

Further, Nielsen (2010) highlights how high leverage within finance actors such as hedge funds, PE funds and LBO firms, may facilitate significant ramifications for the overall market as evident in the 2008 Housing Crisis where it induced a *too big to fail* rationale, leading to a severe problem of moral hazard within the financial sector. According to Acharya et al. (2009), when leveraged financial institutions experience substantial losses, it inevitably lead to a lower spending on capital goods and exacerbated asset price deflation, thus triggering overall economic contraction. According to Bernanke & Gertler (2000), high degree of leverage incentivizes profit maximization in good times but in the event of an economy-wide recession or sharp increase in interest rates in bad times, it could become a vicious force. This relationship between financial structure and post-crisis output contractions is well established. Stone (2002) argues that output contractions are associated with high levels of corporate debt over-appreciation. Mulder et al. (2001) suggest that corporate indicators of leveraged financing and short-term debt encapsulate predictability to major output contractions. Additionally, Davis & Stone (2004) find a clear relationship between levels of corporate leverage and more substantial GDP declines. According to Bordo et al. (2001), studying output contractions from the past 120 years, the probability of financial crises has increased due to higher capital mobility, whereas the intensity has deteriorated as a result of financial safety nets.

Covenants

In recent times a trend where leveraged loans include less covenants has become apparent (Acharya et al., 2007). These covenant-lite loans offer fewer restrictions on the borrower, and fewer protections for the lender. Further, these Covenant-Lite loans does not possess any of the three standard forms of maintenance covenants such as overall leverage, interest coverage and cash flow coverage. Thus, as Covenant-lite only result in default when the borrower is unable to repay the debt, and not when traditional covenants are violated, it is effectively different from other forms of covenants loans (Acharya et al., 2007). Kaplan (2007) argues that ignoring

catastrophic events, these covenant-lite loans will result in fewer defaults, compared to traditional loans, but it may result in reduced incentives for the lender to monitor the borrower, thus preventing him from identifying early warnings of a possible default. Bharath et al. (2007) further provides evidence that, although covenant-lite loans result in a decreased likelihood of default, the recovery rates in case of default are likely to be much lower. Consequently, due to increased levels of debt, combined with fewer covenants, it exists concerns regarding the implications of a large-scale default (Acharya et al., 2007).

Overheated economy

Literature suggests that the stock markets provide services that bolster economic growth (Levine & Zervos, 1999a). According to Greenwood & Smith (1997), large stock markets can reduce the cost of mobilizing savings, thus facilitate investment in the most productive technologies. Bencivenga et al. (1996) further suggest that the ability to trade equity easily; the stock market liquidity, is essential for economic growth. Correspondingly, Levine & Zervos (1998; 1999a) show that stock market development is positively and robustly associated with long-run economic growth. However, when the economic growth reaches an unsustainable level, it facilitates the creation of an overheated economy. One potential indicator of an overheated economy is the level of employment within a country. As Callahan & Garrison (2003) argue, both theory and history suggest that an unemployment rate below five percent should be considered unsustainable, meaning it should be considered as a clear symptom of an overheated economy. As shortage of available factors of production leads to an increase in inflation, it inherently gives rise to hawkish monetary policies designed to rein in inflation and reducing investment activities.

V: DEVELOPMENT OF CONCEPTUAL FRAMEWORK

In the aftermath of the Dot-com bubble, the issue of how to best identify speculative asset bubbles remains uncertain. This uncertainty derives from the conceptual difficulty of fully understanding the seemingly irrational market characteristics visible in the period leading up to the burst of a bubble. As it is doubtful that any single factor is capable of providing categorical evidence of the existence of a bubble, this paper will introduce a multifactor approach for predicting financial market anomalies. As a financial bubble is a highly complex and intricate phenomenon, it is established that this analysis will benefit from covering multiple factors, thus capturing how individual factors may interact and consequently result in significant market corrections.

Following the above rationale, this thesis proposes a conceptually practical framework based on three distinctive, though related pillars. The three pillars are established with the basis in the financial literature highlighted in the literature review and are considered to act as umbrellas, encapsulating, and harmonizing, the key variables within each pillar. The first pillar, concerning *Asset Valuations & Investor Behavior,* captures the general speculative nature of investors combined with the irrational behavior exhibited during the Dot-com bubble. The second pillar, *Capital Market Mechanisms*, covers the overall state of affairs in regards to the attractiveness of the capital market. The third and final pillar, *Monetary Policy & Corporate Lending*, concerns the developments within the US monetary policy. The analysis will be structured via multiple propositions regarding each identified factor. Based on the ability to acknowledge or decline these propositions, the framework will thus evaluate to what extent each factor is present within the contemporary financial landscape.

PILLAR I: ASSET VALUATIONS & INVESTOR BEHAVIOR

The first pillar in our framework concerns to what extent behavioral shortcomings are currently visible in the US economy. With the emergence of academics such as Kahneman, Tversky and Thaler, behavioral finance has become a respected branch of modern economics, describing how investor behavior and cognitive biases heavily influence the choices that are made in the marketplace. Considering how it is established that these shortcomings were central in the creation, persistence and eventual burst of the Dot-com bubble, the first pillar, covering asset valuations and investor behavior is considered a key theme in the creation of a potential new bubble. With the basis in the academic literature, multiple specific factors within these areas have been identified. The framework will now review each factor, and, with the objective of verifying the presence of these, present multiple propositions.

Neglecting of Financial Metrics

The first identified factor within the area of asset valuations and investor behavior is the neglecting of financial metrics. A large body of empirical research suggests that, due to wholesale changes in the economy, traditional financial statements have become less relevant when assessing shareholder value. As the Dot-com bubble was characterized by investors neglecting the fundamental valuation metrics in the pricing of financial assets, so-called fundamental value irrelevance (Shiller, 2000), the examination of the distributional properties of actual prices and fundamental values, is considered a viable method of identifying behavioral shortcomings. The framework has therefore developed two propositions regarding the neglecting of financial metrics. Considering how, during the Dot-com era, even firms with an absence of recorded earnings experienced significant increases in stock price (Morris & Alam, 2012), it is deemed necessary to investigate to what extent this is happening in the contemporary financial landscape. We therefore arrive at the first proposition of the framework:

Proposition 1: *Is there a noteworthy divergence between financial metrics and market value visible in the overall US equity market today?*

Considering how the Dot-com bubble was primarily contained within the tech sector (Kohn, 2006), applying a wide lens when establishing the likelihood of a new tech-bubble, may result in ambiguous interpretations. Conversely, by placing a specific emphasis on the technology sector, it will induce the ability to draw valid inferences concerning the neglecting of financial metrics in relation to a new tech-bubble. The second proposition of the framework is thus formalized accordingly:

Proposition 2: *Is there evidence that, just as during the Dot-com bubble, this divergence between financial metrics and market value is particularly present within the technology sector?*

Intangible asset valuation

The second identified factor is the valuation of intangible assets. As previously highlighted, companies within the technology industry are often defined by having a large portion of intangible assets (Brynjolfsson et al., 2002). Naturally, as the valuation of these intangible assets is prone to subjective estimations, it becomes increasingly difficult to assess the intrinsic values of technology stocks (Cravens & Guilding, 1999). This subjective element of intangible asset valuation may result in the influence of cognitive biases and thus a decrease in the accurateness of the valuation. Hence, if the trend where intangible assets are priced far above their actual value-potential, as visible during the Dot-com era, is identified today, this could be an indication of cognitive shortcomings again being evident in the marketplace. The third proposition of the framework, regarding the valuation of intangible assets, is thus presented:

Proposition 3: *Is the investor fascination for companies primarily comprised of intangible assets, unjustifiable in relation to their ability to generate profits?*

Investor behavior

The final factor of the first pillar is the behavior exhibited by investors. Following how the significant deviation from economic efficiency and share prices in the technology sector, could not be explained by fundamentals, a reoccurring theory is that it existed repeated patterns of irrationality, inconsistency, and incompetence in the decisions and choices by investors at the time (Wheale & Amin, 2003). Although irrational investor behavior has been widely referred to as a contributor to the Dot-com bubble, this section will apply an alternative method of identifying irrational investors in the marketplace. By attempting to identify the existence of rational investors, which at the expense of less rational investors, achieved arbitrage, the presence of irrationality would thus be confirmed.

Whereas behavioral shortcomings are the overall theme of this pillar, investigating to what extent rational investors may be contributing to a new bubble is considered to be of particular interest to this section. This is with the basis in how, rather than eradicating mispricing in bubbles it is proposed that rational speculators actually may drive a bubble at the expense of less rational investors (Griffin et al., 2011). The fourth proposition is thus presented:

Proposition 4: *Have rational investors exploited the mispricing in the technology sector, and having realized we are at the verge of a burst, now reduced their investments?*

PILLAR II: CAPITAL MARKET MECHANISMS

The second pillar in our framework concerns the market in which capital is exchanged between those who have the capital and the actors who seek the capital. The structure in which this market operates is highlighted as a critical determinant in whether a bubble may be created and is thus an essential part of this framework. As the capital market was defined by a *growth at all costs* mentality during the Dot-com bubble, the identification of such a mindset today, may be an indication that the capital market has temporarily failed in its role as an efficient allocator of capital. With the basis in academic literature, two of the most common, and heavily debated, parts of the capital market will be investigated in order to evaluate whether such a mantra again is present. The framework will now review each factor, and, with the objective of verifying the presence of these, present multiple propositions.

Initial Public Offering mania

The first factor of this pillar, and arguably the most prominent characteristic of the capital market during the Dot-com bubble is IPO activity. As an IPO represents a critical transition point in the development of a firm, it is considered a pivotal moment in terms of capital market interaction. Bearing in mind the main theme of this pillar is the *growth at all costs* mentality, the IPO is considered an ideal event to commence the attempt to identify this mentality in the contemporary capital market.

In view of academic research having highlighted how it appeared there was a deteriorating quality of the firms deciding to go public during the Dot-com era, as represented by poor business plans and limited foreseeable earnings, applying a similar lens to current IPOs is established necessary. Correspondingly, if the contempt for profitability and performance once again is visible, it may indicate a shift in investor sentiment towards the same *growth at all cost* mantra. Thus, the fifth proposition of the framework is presented:

Proposition 5: *Is the same disregard for profitability and financial performance, which was visible during the Dot-com bubble, again present in the contemporary IPO-environment?*

Aggressive Venture Capital

The second factor concerning the capital market identified in academic literature is what takes place before a company goes to the public market through an IPO. During the Dot-com period, Venture Capital funds became drawn to the performance of the IPO market and a substantial increase in VC business volumes became evident (Valliere & Peterson, 2004).

However, as highlighted in the literature review, this increased VC activity brought with it general concerns regarding how Venture Capital funds may inflate prices, disregard profitability, and pose a threat to the soundness of the US Capital Markets, both private and public (Gompers & Lerner, 2004). As it is the objective of the pillar to evaluate whether the capital market has temporary failed in its role as an efficient allocator of capital, the possible effects of the VC industry is recognized as imperative. The framework therefore presents the sixth proposition, evaluating the current VC industry:

Proposition 6: *Is the Venture Capital activity seen today contributing to dangerous developments within the technology sector, thus being harmful to the US Economy?*

PILLAR III: MONETARY POLICY & CORPORATE LENDING

The third pillar in our framework concerns what many believe to be the cornerstone of the US economy, the monetary markets. With extensive literature highlighting the effects of monetary policy on the health of the overall economy, it is established that the monetary markets are of great significance for the development of a new potential bubble. Considering how it is established that the actions of the Federal Reserve, in regards to the Dot-com bubble, were questionable at best, it is established that an investigation in the current developments within US monetary policy will result in a robust indication to the health of the US economy. With the basis on the academic literature on the topic of monetary policy and corporate lending, two specific factors have been identified. The framework will now review each factor, and, with the objective of confirming the presence of these, present several propositions.

Monetary Policy

The first identified factor within the third pillar is the effect of monetary policy on the developments within the US economy. Monetary policies are considered among the most effective means for the US Federal Reserve to govern the economy as the long-term interest rate represents a significant explanatory variable for stock market developments (Fama & Schwert, 1977). Consequently, if interest rates encapsulate predictability concerning economic cycles, it should entail valid inferences concerning the establishment of a new bubble. Following how the literature has credited the yield spread as a leading indicator of coming recessions, it is with the basis in this spread the analysis will investigate whether the US monetary policy may lay the foundation for an economy more prone to a downturn. The framework therefore presents the seventh proposition, scrutinizing the US monetary policy:

Proposition 7: *Are the US interest rates today revealing investor sentiment suggesting a new bubble?*

Corporate Lending

The second factor identified in this pillar, and the seventh overall, comes as a consequence of the low interest experienced in recent times. Increases in corporate debt is a theme extensively covered within the academic literature, and multiple prominent figures, including former Chair of the Federal Reserve Ben Bernanke, has expressed his concerns on the topic. As there is found a relationship between high levels of corporate debt and more substantial GDP declines (Davis & Stone, 2004), the factor of corporate lending is considered essential when investigating whether the US monetary policy has resulted in the economy becoming more prone to a market downturn. The framework thus presents the eight proposition, concerning the consequences of cheap capital:

Proposition 8: *Has the access to cheap capital resulted in US companies issuing dangerous levels of debt?*

Whereas the level of US corporate debt may give some indication of the willingness of firms to exploit the cheap capital offered by the monetary market, it does not indicate the level of risk embedded in said debt. It may therefore fail to accurately reflect how, in the case of a market downturn, it will affect the overall economy. Considering how Acharya et al. (2009) highlight how the emergence of more risky loans have led to concerns regarding the implications of large-scale default, it is deemed necessary to further investigate the risk involved in corporate loans issued today. The framework therefore presents the ninth, and final, proposition:

Proposition 9: *Is there a visible reduction in the quality of loans issued in the US today?*

SUMMARY OF THE FRAMEWORK

The thesis has now presented the framework covering the three main pillars, all considered to encapsulate a distinct area within the creation, persistence and eventual burst of a bubble. Furthermore, nine propositions regarding the state of the US economy have been conceptualized, with the basis in seven distinct factors, each covering a main feature deemed relevant in the creation of a bubble. This framework, and its propositions, will be utilized when trying to answer the problem statement that we may be on the verge of a new bubble, like the one taking place nearly twenty years ago. This will be done in a structured manner, reviewing each of the nine propositions and conducting relevant analyses necessary to acknowledge or dispute each proposition correctly. Considering how some of the factors identified may not be exclusively attributed to the Dot-com bubble, but rather concerns the economy as a whole, each analysis will differ in terms of area of focus. Some factors, deemed highly related to the market mechanisms during the tech bubble, will have a primary objective of comparing the current market environment with that of the late 1990s. Other factors, arguably more associated with the economy as a whole will be investigated in relation to the most prominent academic literature and empirical observations.

It is stressed that it is not the intent of this framework to deem each factor as individually significant, but rather to evaluate how the interdependency among the factors may lay a foundation for the creation of a new bubble. Thus, the framework will not attribute a set number of propositions which need to be acknowledged for a bubble to be considered likely. Instead, a thorough and complete evaluation, where all factors and propositions are considered in relation to each other, will discuss the likelihood of a new bubble like the one in 2000. Finally, a visual illustration of the presented framework is demonstrated below.

CONCEPTUAL FRAMEWORK

Asset Valuations & Investor Behavior

1. Neglecting of financial metrics
2. Intangible asset valuation
3. Investor behavior

Capital Market Mechanisms

4. Initial Public Offering mania
5. Agressive Venture Capital

Monetary Policy & Corporate Lending

6. Monetary policy
7. Corporate lending

1. Is there a noteworthy divergence between financial metrics and market value visible in the overall US equity market today?

2. Is there evidence that, just as during the Dot-com bubble, this divergence between financial metrics and market value it is particularly present within the technology sector?

3. Is the investor fascination for companies primarily comprised of intangible assets, unjustifiable in relation to their ability to generate profits?

4. Have rational investors exploited the mispricing in the technology sector, and having realized we are at the verge of a burst, now reduced their investments?

5. Is the same disregard for profitability and financial performance, which was visible during the Dot-com bubble, again present in the contemporary IPO-environment?

6. Is the Venture Capital activity seen today contributing to dangerous developments within the technology sector, thus being harmful to the US Economy?

7. Are the US interest rates today revealing investor sentiment suggesting a new bubble?

8. Has the access to cheap capital resulted in US companies issuing dangerous levels of debt?

9. Is there a visible reduction in the quality of loans issued in the US today?

VI: DATA SAMPLE

In order to ensure a structured and transparent presentation of the data gathering process, this chapter will be structured in terms of each factor highlighted in our framework. This structure will contribute to a better overview and understanding of the data gathering process, while also result in consistency throughout the analysis. In cases where identical pieces of data are utilized across multiple factors, the data gathering process will be elaborated in detail only in the first instance. A more compact version will be included in the event of later instances. Each factor, with their respective data gathering processes, will now be elaborated.

6.1 NEGLECTING OF FINANCIAL METRICS

The data foundation for this part of the analysis is primarily gathered from The Bloomberg Terminal. The paper will rely on the S&P 500 (SPX), in combination with a selection of S&P 500 sector indices with emphasis on the technology sector, and the NASDAQ Composite Index (CCMP). The S&P 500 index, in itself, provides a benchmark for the state of the overall US equity market, consisting of 10 subsectors, which includes some of the biggest companies by market cap in the world. Conversely, for the sake of the analysis, in conjunction with the formalized problem statement, the data will be based on the S&P 500 sector indices that fall within the Global Industry Classification Standard (GICS) of Information Technology (MSCI, 2019). Furthermore, the additional industry sectors utilized are Financials (SPF), Energy (SPN). Communication Services (S5TELS), Industrials (S5INDU), and Consumer Staples (S5CONS). The NASDAQ Composite Index (CCMP) is made up of more than 3,300 common equities, and is, due to its heavy weight towards information technology companies, considered a good proxy for the US technology industry.

When calculating the P/E ratio for the S&P 500 and NASDAQ Composite Index, the Bloomberg function (RR900) is utilized. The RR900 is calculated as Last Price (PR005, PX_LAST) divided by Trailing 12M EPS before XO items (RR819, TRAIL_12M_EPS_BEF_XO_ITEM). When calculating the CAPE ratio for the S&P 500 index, the financial data is retrieved from Bloomberg, and the calculations are done on a monthly basis spanning the period from 1919 to 2019. When calculating the P/S ratio for the S&P 500 and NASDAQ Composite Index, the Bloomberg function (RR904) is utilized. This is calculated as Total Market Value (IN089, INDX_MARKET_CAP) divided by the sum of Trailing Sales contributions from holdings. Contributions are computed as the value of trailing 12M Sales per Share (RR800 divided by BS081) of the security, multiplied by the number of shares held.

6.2 INTANGIBLE ASSET VALUATION

Data on the asset composition of the NASDAQ Composite Index is collected through The Bloomberg Terminal. Tangible book value per share is gathered utilizing the "tangible assets" function in Bloomberg (TANG_BOOK_VAL_PER_SH), which is calculated as Tangible Common Equity (RR179, TANGIBLE_COMMON_EQUITY) divided by Shares Outstanding (BS081, BS_SH_OUT). Total Book value is calculated using Bloomberg (DY283), which is calculated as Net Fixed Assets (BS032) + Disclosed Intangibles (BS138) + Net Purchase Amounts. This calculation is done for the NASDAQ Composite Index as a whole. Due to an error in data regarding Tangible book value for the years 2003 and 2005, the analysis has extrapolated the values as the average of the preceding and succeeding years.

When investigating the long-term performance of tech companies going public, data from Bloomberg is utilized. Through the (IPO) command, it is possible to segment Initial Public Offerings by multiple criteria. The analysis has initially segmented IPOs by location, namely North America. Furthermore, the Technology and Software industries are selected. Finally, only the twenty largest IPOs, by offering amount, is selected.[2] This selection is made to limit the number of IPOs to cover only large and relevant companies. The analysis has then gathered data on all IPOs, corresponding to the above search criteria, each year from 2010 to 2018. It is worth noticing that as there are some technical issues with Bloomberg, no IPOs from 2013 are included in the data sample. These issues constitute that amongst others, Twitter Inc. is excluded. When comparing to other sectors, the same methodology is utilized, except the SIC codes, which are *Industrials*, *Energy*, *Basic Materials* and *Utilities*.[3] The criteria for the year is the execution date of the IPO. Some IPOs had announcement dates and execution dates in different years, so here the latter has been utilized. The 2018 Basic EPS value (IS_IPS) is then calculated for all the selected companies, allowing for comparison and analysis.

6.3 INVESTOR BEHAVIOR

When investigating to what extent Hedge Fund managers are reducing their positions in technology companies, the analysis will be based on 13F corporate filings. Initially, the analysis attempted collecting data from the CDA database, maintained by Thomson Financial, containing all 13F filings with the United States Securities and Exchange Commission (SEC). This database is accessible through Wharton Research Data Services, offered by the Wharton University of Pennsylvania. After correspondence with representatives from Wharton, it became clear that CBS only has a limited partnership with Wharton, offering access to specific databases. As the 13F database was not among these, the analysis relies on data collected directly from the SEC. This is done through the Electronic Gathering, Analysis, and Retrieval system (EDGAR). Beginning in 1978, all

[2] The complete list of the selected companies within «technology» can be found in appendix 2.
[3] The complete list of the selected companies within «other sectors» can be found in appendix 3.

financial institutions with more than $100m in assets under discretionary management are obliged to disclose their holdings in US stocks to the SEC on a quarterly basis. This is done through a form 13F. This is true for all positions greater than 10,000 shares or $200,000, in which the investment manager exercise sole or shared investment discretion.

Following legislation by the SEC, companies are required to submit the report on a quarterly basis, and no more than 45 days after the end of the quarter. Data is thus available in quarterly intervals. In order to capture a sufficient time period, while at the same time maintaining data at a manageable level, data from every second quarter will be utilized in the analysis. The quarters which are extracted are 1Q2017, 3Q2017, 1Q2018, 3Q2018 and 1Q2019. It is believed this is sufficient data to capture any potential change in exposure among the largest Hedge Funds within the US. The Hedge Funds are selected with a basis in the 2018 rating of US Hedge Funds done by Pensions & Investments, a respected provider of research, news and analysis to the executives who manage the flow of the institutional investment market. The Hedge Funds in question are listed below.

List of US Hedge Funds					
	Name of Hedge Fund	AUM $bn	Founded	CEO	HQ
1	**Elliott Management**	$ 34,00	1977	Paul Singer	New York
2	**Davidson Kempner Capital Management**	$ 30,90	1983	Thomas L. Kempner	New York
3	**Baupost Group**	$ 30,00	1982	Seth klarman	Boston
4	**Farallon Capital Management**	$ 29,90	1986	Andrew J.M. Spokes	San Francisco
5	**Viking Global Investors**	$ 27,00	1999	Ole Andreas Halvorsen	Greenwich
6	**Canyon Capital Advisors**	$ 23,00	1990	Joshua Friedman	Los Angeles
7	**York Capital Management**	$ 20,50	1991	Jamie Dinan	New York
8	**Third Point Management**	$ 17,50	1995	Daniel Loeb	New York
9	**King Street Capital Management**	$ 20,00	1995	Brian Higgins	New York
10	**Angelo Gordon & Co**	$ 32,00	1988	Micheal Gordon	New York

Table 1: List of Hedge Funds utilized in the analysis

The individual positions for each of the Hedge funds are examined and segmented by sector. As the main objective of the analysis is to establish the funds' exposure to the technology sector, it is crucial to define what is included in this sector. Here, the industry sectors from Bloomberg are utilized. Both the entire Communications (Code 10) and Technology (Code 18) sectors are included. In addition, the sub-sector Retail Discretionary within Consumer Discretionary (Code 11) is included as this incorporates E-commerce.[4] The applied sectors with relevant sub-sectors can be viewed below. As the analysis is solely interested in whether a hedge fund is exposed towards the tech sector, it will not investigate the other sectors of the S&P.

[4] The complete list of Level 1 and Level 2 sectors from Bloomberg can be found in the appendix 4.

Level 1		Level 2	
CODE	**Macro Sector**	**CODE**	**First Level Microsector**
10	**Communications**	1010	Media Content
		1011	Telecom
11	**Consumer Discretionary**	1117	Retail Discretionary
18	**Technology**	1810	Design, Mfg & Distribution
		1811	Hardware
		1812	Semiconductors
		1813	Software
		1814	Technology Services

Table 2: List of sector codes extracted from Bloomberg

Furthermore, the 13F filings also include long positions in ETFs and other equity funds. The analysis has, therefore, included the funds that are explicitly focused on the technology sector. These are funds such as the Invesco PowerShares QQQ Trust, which follows the NASDAQ -100 index. Funds which track the entire S&P 500 are disregarded, as it is impossible to determine the weight of tech companies within each fund. It is worth mentioning that, as the main objective of Hedge Funds is to beat the market, these type of funds are relatively rare. This disregard is therefore not considered to be a noteworthy weakness of the analysis.

Utilizing the EDGAR database, we examine all 13F forms submitted by the respective hedge funds, which provides position-level disclosure of all relevant US holdings. Given the unstructured nature of the data provided through EDGAR, and in order to isolate the Hedge Fund activity, only firms that are exclusively managing a Hedge Fund are included. A similar methodology has been utilized by Brunnermeier & Nagel (2004), although they included more than 50 hedge funds in their analysis. Due to the manual nature in terms of data gathering from the EDGAR database, we have limited our sample to the ten largest hedge funds. It is acknowledged how this may reduce the validity of the results; however, the sample is considered sufficient for the purpose of establishing a general enquiry to the hedge fund exposures.

Below is a more detailed view of the first 15 positions of Elliot Management, one of the ten selected Hedge Funds. Notice how the companies classified as technology oriented, according to our criteria, have been selected as Tech sector. The value of the position, as well as the number of stocks owned, is highlighted.

1Q 2019				
NAME OF ISSUER	Value ($1000)		# Stocks	Tech Sector
ACADIA HEALTHCARE COMPANY IN	$	83.558,00	3,250,000	-
ADVANCED MICRO DEVICES INC	$	6.076,00	2,500,000	x
AKAMAI TECHNOLOGIES INC	$	145.582,00	2,383,468	x
ALTABA INC	$	1.284.539,00	22,170,156	x
APPLE INC	$	78.870,00	500,00	x
ARCONIC INC	$	875.070,00	51,902,133	-
ATHENAHEALTH INC	$	76.519,00	580,00	x
B RILEY FINL INC	$	32.752,00	2,306,450	-
CITRIX SYS INC	$	624.084,00	6,091,000	x
CITRIX SYS INC	$	51.230,00	500,00	x
COMMUNITY HEALTH SYS INC NEW	$	12.960,00	4,500,000	-
COMMVAULT SYSTEMS INC	$	124.089,00	2,100,000	-
CORMEDIX INC	$	5.375,00	4,166,868	-
DELL TECHNOLOGIES INC	$	323.846,00	6,626,674	x
DEVON ENERGY CORP NEW	$	376.418,00	16,700,000	-

Table 3: Example of our Hedge Fund portfolio structure

6.4 INITIAL PUBLIC OFFERING MANIA

To investigate the developments in the US IPO industry, the paper relies on data on Initial Public Offerings from Thomson Reuters (SDC) and Dealogic database. This data has been extracted through Initial Public Offerings: *Updated Statistics*, by Ritter (2019). Ritter has collected data on IPO's in the United States, from 1980 to 2018, and this data set will be used as a foundation for this part of the analysis. The dataset includes observations including first-day returns, median age, Last Twelve Months (LTM) sales, company sales, LTM EPS and frequency. To ensure that the data is not disproportionally affected by extremely small firms, a restriction on the sample is formalized with an offer price of at least $5. Furthermore, the dataset does not include ADRs, natural resource limited partnerships and trusts, SPACs (Special Purpose Acquisition Company), unit offers, REITs (Real Estate Investment Trust), banks and S&Ls, and stocks not listed on NYSE or NASDAQ. This selection results in a large dataset providing information regarding a total number of 8.497 IPOs for the entire period between 1980 and 2018. The primary focus of this paper is to investigate the operational companies which went public in our time period, thus excluding trusts and S&Ls is considered a necessary step when structuring the data. The data is then organized in multiple methods, dependent on the key figures of interest in the individual parts of the analysis. The nature of the different data extracted will now be elaborated.

Mean first day returns

Mean first day returns are simply calculated as the closing price the day of the Initial Public Offering, over the opening price. It is important to note that throughout the analysis the practice will be using an equal-weighted approach when calculating returns. The overall results of these calculations can be seen below.

		Mean First-day Returns	
Period	**Number of IPOs**	**Equal-Weighted**	**Proceeds-Weighted**
1980-1989	2.048	7,20%	6,10%
1990-1998	3.613	14,80%	13,30%
1999-2000	856	64,60%	51,70%
2001-2018	1.980	14,30%	13,40%
1980-2018	**8.497**	**17,90%**	**18,40%**

Table 4: Mean first-day return and number of IPOs (1980 – 2018

Mean first day returns categorized by sales

When calculating sales, which is denoted in millions, the last twelve months before the company is going public is used as basis. In order to compare sales across different periods, all nominal sales figures have been converted. This is represented by dollars of 2003 purchasing power. As an example, from 2003 to 2018, the Consumer Price Index (CPI) increased by 36.7%, constituting that $100m in 2003 is the equivalent of $136.7m in 2018. The result of these calculations can be seen below.

			1980 - 1989		1990 - 1998		1999 - 2000		2001 - 2017	
Sales			**Return**	**# IPOs**	**Return**	**# IPOs**	**Return**	**# IPOs**	**Return**	**# IPOs**
$0	<	$10	10,3%	425	17,2%	741	68,9%	331	10,0%	429
$10m	<	$20m	8,6%	242	18,5%	393	81,4%	138	13,5%	85
$20m	<	$50m	7,8%	501	18,8%	789	75,5%	154	15,7%	228
$50m	<	$100m	6,3%	356	12,8%	590	62,2%	86	20,8%	293
$100m	<	$200m	5,1%	234	11,8%	454	35,8%	56	19,5%	259
$200m	<	∞	3,4%	290	8,7%	646	25,0%	91	11,9%	686
All			**7,20%**	**2.048**	**14,80%**	**3.613**	**64,60%**	**856**	**14,30%**	**1.980**

Table 5: Mean first-day returns and number of IPOs segmented by LTM sales (1980 – 2017)

Profitability among Technology Companies

Technology companies are defined as internet-related stocks plus other technology stocks including telecom, but excluding biotech.[5] Utilizing the abovementioned criteria, the total number of tech IPOs are established at 3.086 for the period between 1980 and 2018, of which 38 took place in 2018. When estimating the median age, this is the amount of years between the calendar year of the establishment of the company, and the calendar year of the Initial Public Offering. When estimating the percentage of tech companies which are profitable, the trailing LTM earnings are used. In cases where LTM earnings are unavailable, last fiscal year earnings are utilized. The results for the previous 4 years, including the overall period of the dataset, are visible below.

Year	# Tech IPOs	Median Age	% Profitable
2015	38	11	26%
2016	21	10	29%
2017	30	13	17%
2018	38	12	16%
1980-2018	**3,086**	**7**	**49%**

Table 6: Number of tech IPOs, median age and percentage profitable (1980 – 2018)

Share of Technology IPOs

When estimating the number of tech companies, the abovementioned industry classifications are used. This is also true in regards to the percentage of companies that were profitable. It is important to mention that companies that fall under the classification *Biotechnology* is not included in the section "Other". This is done to highlight the key differences between pure technology companies and companies occupied with other parts of the industry. A visual representation of the results are seen below.

	Number of IPOs		% Profitable		Median Sales	
Year	Tech	Other	Tech	Other	Tech	Other
2014	53	79	17%	57%	90,5	271
2015	38	38	26%	66%	130,9	171,3
2016	21	29	29%	59%	108,2	645,4
2017	30	45	17%	44%	181,5	421,1
2018	38	39	16%	51%	167,3	452,4
1980-2018	**3086**	**4626**	**49%**	**76%**	**37**	**111,3**

Table 7: IPOs and percentage profitable and median sales, segmented by industry (1980 – 2018)

[5] The complete list of SIC (Standard Industrial Classification) codes can be found in appendix 5.

EPS Technology Companies

When estimating the number of IPOs where the company going public had a negative EPS, the last twelve months prior to going public were used. Extraordinary expenses in relation to the offering is excluded from the earnings, resulting in a more nuanced picture of the financial situation of the companies. Tech companies are identified using the same industry classifications as mentioned earlier. This is also true for the mean first-day returns. A sample of the data set is visible below.

				Mean first day returns	
Year	**# IPOs**	**% Tech**	**% with EPS < 0**	**EPS < 0**	**EPS > 0**
2014	206	26%	71%	17,1%	11,4%
2015	118	32%	70%	19,1%	19,6%
2016	75	28%	67%	13,2%	17,4%
2017	107	28%	76%	12,3%	15,4%
2018	134	29%	81%	20,6%	10,3%
1980-2018	**8,497**	**36%**	**39%**	**25,6%**	**12,8%**

Table 8: Profitability of technology related IPOs (1980 – 2018)

6.5 AGGRESSIVE VENTURE CAPITAL

When investigating the developments within the US Venture Capital industry, data has been gathered from the Venture Monitor 4Q 2018 report, issued by Pitchbook and National Venture Capital Association (NVCA, 2018). This report covers trends and statistics in Venture Capital throughout the United States. Data collected includes total deal value, the number of deals closed, and sector data on the total invested amount. Here, Venture Capital funds are defined as pools of capital raised for the purpose of investing in the equity of startup companies. Any funds with the same primary intent as the one stated above are also included in the dataset. Funds identified as growth stage vehicles are classified as Private Equity funds and are not included in the Pitchbook and National Venture Capital Association report. Further, with regards to deals, any equity investment into startup companies from an outside source are included. This includes investments from individual angel investors, seed funds, Venture Capital funds, angel groups and corporate venture funds. Investments that are part of an accelerator program are not included. The data is structured as highlighted below.

US VC Activity by Year													
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Deal Value ($Bn)	29,23	36,01	36,94	27,17	31,27	44,75	41,51	47,54	71,03	82,97	77,23	82,95	130,93
# of Deals Closed	3.344	4.319	4.727	4.487	5.409	6.759	7.882	9.301	10.573	10.740	9.200	9.489	8.948
Angel/Seed	458	787	918	1.226	1.723	2.600	3.532	4.639	5.472	5.716	4.585	4.521	3.760
Early VC	1.750	2.117	2.260	1.830	2.101	2.426	2.584	2.780	3.067	3.061	2.849	3.119	3.156
Later VC	1.136	1.415	1.549	1.431	1.585	1.733	1.766	1.882	2.034	1.963	1.766	1.849	2.032
Angel/Seed	13,7%	18,2%	19,4%	27,3%	31,9%	38,5%	44,8%	49,9%	51,8%	53,2%	49,8%	47,6%	42,0%
Early VC	52,3%	49,0%	47,8%	40,8%	38,8%	35,9%	32,8%	29,9%	29,0%	28,5%	31,0%	32,9%	35,3%
Later VC	34,0%	32,8%	32,8%	31,9%	29,3%	25,6%	22,4%	20,2%	19,2%	18,3%	19,2%	19,5%	22,7%

Table 9: List of Venture Capital data (2006 – 2018)

When segmenting Venture Capital deal volume by sector, the technology sector is calculated to include *Software*, *Media* and *Information Technology Hardware*. The non-technology sectors include, *Pharma & Biotech*, *HC Services & Systems*, *HC Devices & Supplies*, *Energy*, *Goods & Recreation* and *Commercial Services.* Here, the percentage of tech investments is simply calculated as the total amount of investments in technology, divided with the total investment volume each year. The structure can be seen below.

US VC Activity segmented by sector													
Sector	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Software ($Bn)	7,29	9,52	10,11	7,29	8,43	15,33	13,73	16,03	28,64	29,39	29,39	30,32	46,82
Media ($Bn)	0,79	1,39	1,32	0,76	0,84	1,64	1,25	2,15	1,87	2,57	1,48	1,85	1,37
Information technology Hardware ($Bn)	5,45	4,81	3,64	2,48	3,11	2,87	2,51	2,51	2,09	2,55	1,87	2,57	2,28
Total Technology ($Bn)	13,53	15,73	15,07	10,52	12,39	19,84	17,49	20,69	32,59	34,51	32,74	34,74	50,47
Other ($Bn)	15,69	20,28	21,87	16,65	18,89	24,91	24,02	26,86	38,44	48,47	44,49	48,21	80,46
Total ($Bn)	29,23	36,01	36,94	27,17	31,27	44,75	41,51	47,54	71,03	82,97	77,23	82,95	130,93
Invested in Technology (%)	46,3%	43,7%	40,8%	38,7%	39,6%	44,3%	42,1%	43,5%	45,9%	41,6%	42,4%	41,9%	38,5%

Table 10: List of Venture Capital data segmented by sector (2006 – 2018)

When investigating the share of companies going public which are Venture Capital backed, the analysis relies on data provided by Ritter (2019). Here, growth capital IPOs are also classified as Venture Capital backed, however, as with the data on Venture Capital activity, funds identified as growth stage vehicles are classified as Private Equity and are not included.

6.6 MONETARY POLICY

When investigating the information concerning investor sentiment found in interest rates, the Federal Reserve interest rates, including three month (CB3 GOVT), ten years (CT10), and the Federal Funds Target Rate – Upper Bound (FDTR), are all collected from the Bloomberg terminal. The data is sampled on a monthly basis, with each observation located on the final trading day of each month. The data contains monthly interest rates from 1975 to 2019, resulting in a total of 528 observations. The time period is selected as this gives a sufficient overview of interest rates in recent financial times.

When comparing with US recessions, the periods of financial recessions are defined in accordance with economic research by the Federal Reserve Bank of St. Louis. Here a model is created which assigns dates to US recessions based on a model of the way recessions differ from expansions. The dates are calculated entirely mechanical and solely from historical GDP. Whenever this indicator exceeds 67%, the US economy is determined to be in a recession. When this indicator falls below 33%, the nation is deemed to be out of the recession. When investigating the US Yield Spread, data is gathered from the Bloomberg terminal. The data utilized is the 3 month US Treasury Yield (USGG3M; INDEX and the 10 year US Treasury Yield (USGG10YR; INDEX). When comparing yield curves from different periods in the US economy, data for these yield curves are all collected from the resource center of the U.S. Department of the Treasury, an official

database of the United States Government. The yields utilized for comparison are three months (USGG3M), one year (USGG12M), two years (USGG2YR), three years (USGG3YR), five years, (USGG5YR), seven years (USGG7YR), and ten years (USGG10YR), with base in the dates 01/01/2001, 31/12/2006, 01/08/2013 and 27/03/2019. A complete list of both rates and yields is visible below in table 11.

Name	Duration	Bloomberg Code
Fed Funds Target Rate - Upper Bound	Overnight	(FDRT)
Treasury Bill	3 Months	(CB3 GOVT)
Government Note	10 Years	(CT10 GOVT)
US Treasury Yield	3 Months	(USGG3M)
US Treasury Yield	1 Year	(USGG12M)
US Treasury Yield	2 Years	(USGG2YR)
US Treasury Yield	3 Years	(USGG3YR)
US Treasury Yield	5 Years	(USGG5YR)
US Treasury Yield	7 Years	(USGG7YR)
US Treasury Yield	10 Years	(USGG10YR)

Table 11: List of US Interest rates and yields utilized in the analysis

Investigating the effect of increased interest rates on the US economy, the US unemployment rate is gathered from The Bloomberg Terminal, using the US Unemployment Rate Total in Labor Force Seasonally Adjusted (USURTOT:IND). Here, the Fed Fund Target Rate – Upper Bound (FDTR) is used for comparison.

6.7 CORPORATE LENDING

Information and statistics on the Leveraged Loan industry, and more specifically the share of *Covenant-lite* loans, the Leveraged Loan volume, and US Recovery rates are all collected from the International Monetary Fund (IMF, 2018). This data is originally collected from Standard & Poor's Leveraged Commentary and Data site (LCD), however as the analysis was unable to receive access to this database, the relevant data has been extracted from IMF. When assessing the increase in US Corporate debt, the US. Corporate debt outstanding as percentage of GDP is simply calculated using the US Corporate Debt Outstanding, gathered from FRED economic research by the Federal Reserve of St. Louis' database, divided by the US GDP in nominal dollars YoY (GDP CURY) collected from Bloomberg. This ratio has been calculated from 1980 to 2018, capturing the developments in US corporate leverage the last 40 years.

When calculating Stock Market Capitalization to GDP of the United States, the stock market capitalization is calculated as the total value of the US stock market, according to the Bloomberg United States Exchange Market capitalization USD (WCAUUS). The GDP is calculated in nominal dollars, using the (GDP CURY) function in Bloomberg. The ratio is thus calculated as the prior divided with the latter. This is done for the time-period 1975 to 2018.

VII: ANALYSIS

The analysis will engage with the concrete analytical computations concerning the factors previously highlighted. For this purpose, the analysis will be divided into multiple sub-sections, corresponding to the selections made in the framework. Here, the propositions and the aforementioned data-sets will be elaborated. Building on academic literature on the Dot-com period, this part of the thesis will utilize the pillars as a foundation when analyzing the financial landscape of today. First, it will present a brief introduction to each pillar. Second, with the basis in both quantitative data and qualitative information, the analysis will seek to evaluate the propositions put forth in the framework. It is important to note that the data utilized and theory applied, may vary dependent on the nature of the factor in question. Throughout the analysis, the thesis acknowledges the assumptions and limitations as stated in the respective limitations section.

Identified Factors in Framework		
Pillar I	**Asset Valuations & Investor Behavior**	1. Neglecting of Financial Metrics 2. Intangible Asset Valuation 3. Investor behavior
Pillar II	**Capital Market Mechanisms**	4. Initial Public Offering mania 5. Agressive Venture Capital
Pillar III	**Monetary Policy & Corporate Lending**	6. Monetary Policy 7. Corporate Lending

Table 12: Overview of Framework

7.1 PILLAR I: ASSET VALUATIONS & INVESTOR BEHAVIOR

As formalized in the framework, the first pillar is concerned with the potential behavior shortcomings which may influence the choices that are made in the marketplace. Building on the broad body of academic literature related to the topic of behavioral finance, and how the human mind reacts to new pieces of information, three distinct factors within this pillar have been identified. Furthermore, a total of four propositions have been presented, and the analysis will now in a transparent and structured manner review each proposition with the objective of verifying the presence of the abovementioned factors.

7.1.1 Neglecting of Financial Metrics

The first proposition of the framework is based on the consequences of the wholesale changes in the economy, as the traditional financial statements have become less relevant in the valuation of shareholder value. Following how the Dot-com bubble was characterized by investors neglecting the fundamental valuation metrics in the pricing of financial assets, the analysis will now investigate to what extent this is evident today, and thus answer the first proposition put forth by the framework.

Proposition 1: *Is there a noteworthy divergence between financial metrics and market value visible in the overall US equity market today?*

Investors, when faced with uncertainty, often rely on financial metrics to establish a reference point for the investments they consider. Under the assumption that the market value of stocks encapsulates all available information, this should provide a valid inference concerning the price state of the investment. However, as Penman (2002) argued regarding the Dot-com period, such financial metrics may fail to account for the apparent growth, typical for companies in the *new economy* paradigm. This shortcoming became evident, when investors accepted stellar implied growth rates, far above what could be reasonably expected, in order to justify the astronomical valuations for tech companies at the time. We are therefore interested in whether the valuation of tech companies today, requires the acceptance of the same unreasonable growth rates. Following how the best indicator of investor rationality, hereunder cognitive biases, is to look at the stock market, the analysis will utilize two of the most recognized, and commonly applied, stock market valuation metrics, namely the Price-to-Earnings ratio (P/E) and the Price-to-Sales ratio (P/S). According to Elton et al. (2014), inconsistent irrational market movements are often the best proxy for irrational investors. When the market moves inconsistently devoid of any economic reasoning, it indicates investors are investing or divesting inconsistently and incompetently.

As highlighted by Teeter & Sandberg (2017), the P/E ratio has become a benchmark when addressing valuation questions regarding firm performance and is thus deemed an appropriate factor to utilize. As with the P/E ratio, the P/S ratio is a key analysis and valuation tool for analysts and investors. The P/S ratio is interesting in

regards to technology companies, due to the nature of the industry in which these companies operate. The ratio is particularly applicable for companies in the *new economy* paradigm, primarily due to how the P/E ratio requires the existence of actual earnings, something few tech companies experience (Berkman et al., 2000). The analysis will now examine both the P/E ratio and the P/S ratio, with the emphasis on potential developments of the two variables. Below is an overview of the respective ratios, calculated for the S&P 500 Index, spanning the period from 1995 to 2019.

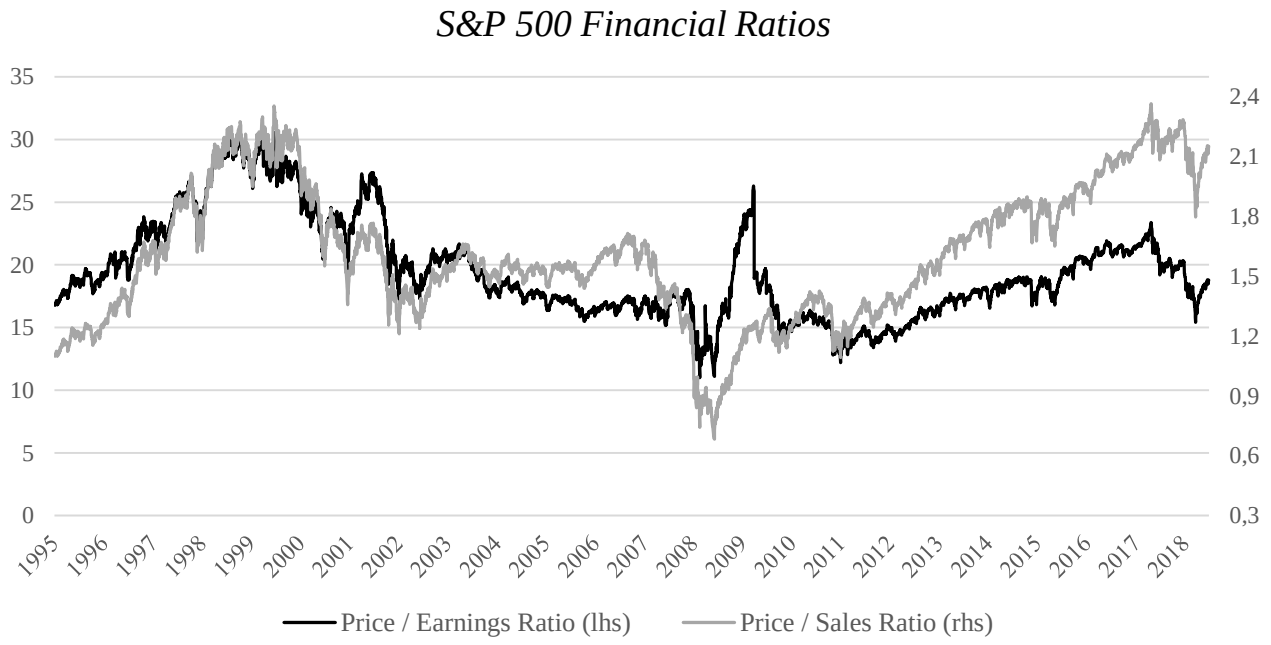

Figure 1: Development of P/E and P/S for the S& P500 (1995 – 2018)

As seen in figure 1, several trends regarding the two ratios are evident in the period from 1995 to 2019. First and foremost, an apparent increase in both the P/E and P/S ratios are visible in the years leading up to the Dot-com bubble. This increase makes sense considering the high implied growth rates associated with the *new Economy* companies at the time. Furthermore, the 2008 Housing Crisis is observable, marked by a steep increase in the P/E ratio, primarily caused by the large financial institutions writing down bad debt associated with mortgage-backed securities. Additionally, this effect was exaggerated by a general collapse in earnings across the economy. It is noteworthy how although the P/E increased dramatically, the P/S ratio actually decreased in the short period leading up to the Housing Crisis, which could be explained by write-downs affecting earnings, not sales. Following the aftermath of the Housing Crisis, a steady increase in both ratios are evident. This development continued until 2018, where the P/S ratio hit 2.36, a value higher than the peak in 2000. The P/E ratio has not experienced the same increase, although a positive trend is evident after the 2008 Housing Crisis. Finally, both ratios experienced a rapid decrease, primarily as the result of the stock market plummet of the final two quarters of 2018. It is hereby evident that both ratios have experienced a positive trend. However, only the P/S ratio is reaching levels last seen during the Dot-com bubble.

One significant weakness of both the traditional P/E and P/S ratio is their tendency to inadequately capture cyclical firms that typically go through boom and bust cycles. This inadequacy may offer increased difficulties when investigating companies in the *new economy*, as they tend to operate in relatively dynamic industries, experiencing greater instability than well-established industrial companies. Also, the occurrence of one-time accounting events, such as investments in PPE, highlights the demand for a more cyclical- and accounting neutral ratio. In order to compensate for these effects, the analysis will now utilize the *Cyclically Adjusted Price-to-Earnings Ratio*, better known as CAPE. This will result in a more nuanced picture of the company and its financial situation, as it takes both company-specific cyclical movements and market-wide trends, into account (Campbell & Shiller, 1998). The CAPE ratio has been selected at the expense of the cyclically adjusted P/S equivalent, due to its proven track record in predicting significant market corrections.[6] The analysis will now inspect the CAPE ratio, calculated using data from the S&P 500 Index for the period 1980 to 2019.

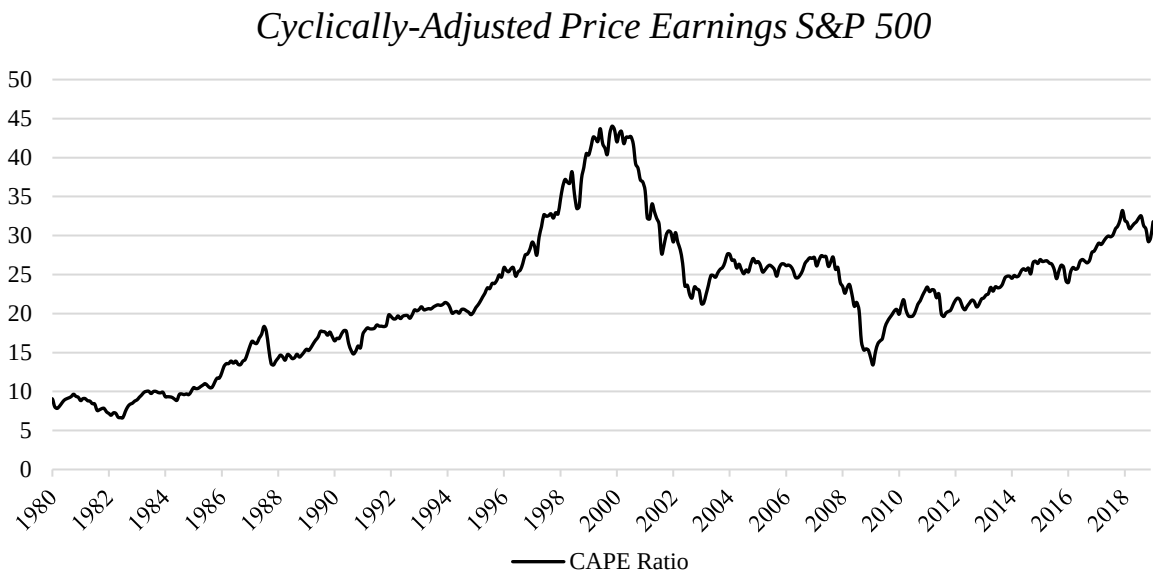

Figure 2: Development of the CAPE ratio for the S&P 500 (1980 – 2019)

As visible in figure 2, the CAPE ratio reached a period high during the Dot-com bubble, peaking at a level close to 45. The CAPE ratio exhibits no significant increase during the 2008 Housing Crisis, primarily due to the relatively rapid nature of the development of the bubble. Whereas the Dot-com era spanned the better half of the 1990s, the Housing Crisis experienced rapid inflation and subsequent burst. As the CAPE ratio measures the 10-year average of earnings, the short time frame of the Housing Crisis results in it not having the same impact on the CAPE ratio, despite being far more severe to the US economy.[7] As visible in the above figure, the CAPE ratio is approaching levels last seen during the Dot-com era, with a clear positive trend beginning in May 2008. However, as the 10-year average of the CAPE ratio still contains the outlier data of the Housing

[6] The CAPE ratio successfully predicted both the Dot-com bubble and the Housing Crisis.
[7] The total losses of the 2008 Housing Crisis is estimated to be in excess of $12 trillion (Yahoo Finance, 2012)

Crisis, this may still affect the current ratio, resulting in it not correctly reflecting the state of the current US economy. Furthermore, as our initial data sample includes two severe market corrections, both occurring within a relatively short time frame, it may not portray the current US equity market in a long-term perspective. To increase the quality of the analysis, the CAPE ratio has thus been calculated from 1900 to 2018.

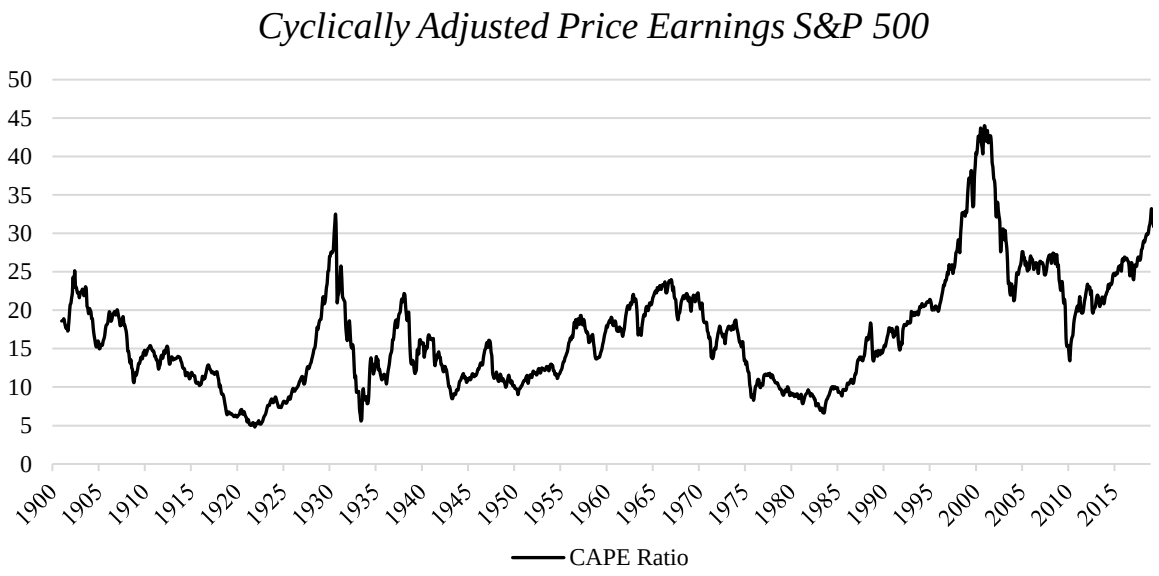

Figure 3: Development of the CAPE ratio for the S&P 500 (1900 – 2019)

In figure 3, the introduction of the significantly longer timeframe highlights how the current CAPE ratio is not only elevated when compared to the previous 40 years but in fact at a level only experienced two previous moments in modern time. Only during the period leading up to the Great Depression of 1929 and the Dot-com bubble of 2000, did the CAPE ratio stand at higher levels than it does today. These results may indicate that investor sentiment has shifted away from fundamentals, in the case of earnings and current performance and that this decline in earnings value-relevance, resemblance the findings of Lev & Zarowin (1999) concerning tech firms of the Dot-com era. Hence, there is a visible neglecting of financial metrics present in the overall US equity market today. Recalling how Elton et al. (2014) postulated that inconsistent irrational market movements are often the best proxy for irrational investors, the seemingly irrational movements in the above data is considered an indication of cognitive biases influencing the choices that are made in the marketplace. With respect to this, and considering the exuberated assumptions of growth prospects within the technology sector in the period, the question remains whether this declined value-relevance of fundamentals is especially apparent within the contemporary tech sector when compared to the larger US equity market. Hence, recalling the second formalized proposition of the framework:

Proposition 2*: Is there evidence that, just as during the Dot-com bubble, this divergence between financial metrics and market value is particularly present within the technology sector?*

In order to investigate whether the technology sector is particularly subject to cognitive biases, as represented by exuberated assumptions of growth, the S&P 500 and NASDAQ Composite Index (NASDAQ) will be utilized in a comparative analysis. These two indices have been chosen as they are considered to adequately reflect the overall economy and technology industry. Further, if this tendency of declined value-relevance is particularly present within the technology sector, there should be a visible divergence between both the P/E and P/S ratios for the S&P 500 and the NASDAQ. Here, the developments of the last ten years are of special interest, as the aim of the analysis is to evaluate whether the trend of irrationally optimistic beliefs, present during the Dot-com era, once again characterizes US equity market valuations.

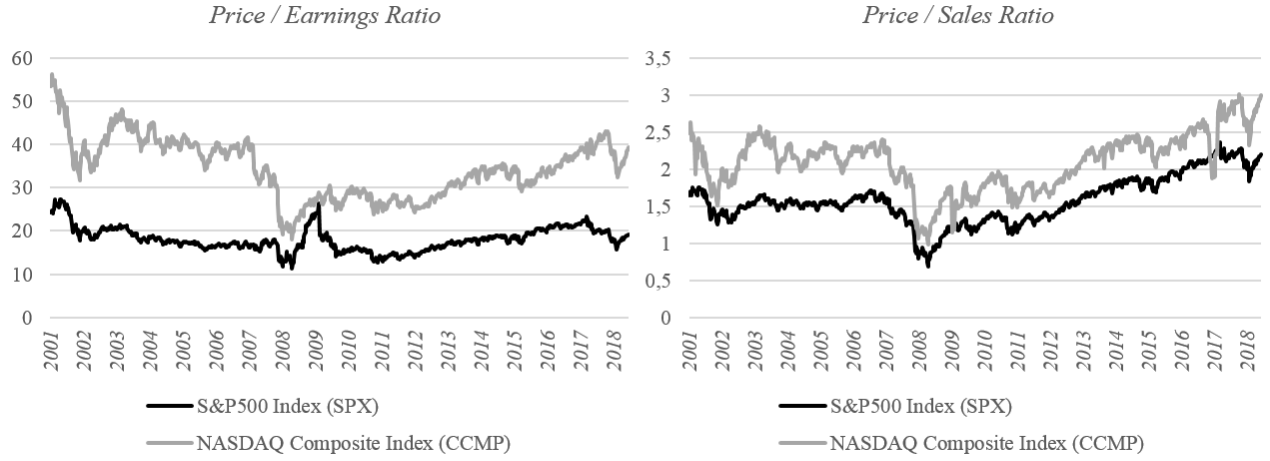

Figure 4: Comparison of P/E and P/S for S&P 500 and CCMP (2001 – 2018)

Visible in figure 4, the P/E ratio of the S&P 500 has remained relatively stable, although showing signs of a moderate increase since the aftermath of the 2008 Housing Crisis. The P/E for the NASDAQ, however, has experienced a rapid increase, more than doubling in the period between 2008 and 2018. In contrast, the P/S ratio for the S&P 500 closely resembles that of the NASDAQ, with both indices experiencing the same positive trend. Consequently, two remarks could be established with the basis in the above observations. First, the close resemblance of the P/S ratios indicates how there is little difference in terms of how investors value technology stocks concerning the ability of companies to generate sales. Second, as there is a clear divergence in terms of P/E ratios, with the NASDAQ exhibiting significant higher values, this may indicate that sales generated by tech companies, represented by the P/S ratio, are not correspondingly converted into realized earnings. Hence, it would appear that investors place a greater emphasis on potential earnings growth when evaluating technology companies, compared to the overall equity market. This might be an indication of how investors are displaying more optimistic, and perhaps irrational, beliefs regarding future earnings growth, and that this tendency is particularly visible within the technology sector. Our results thus highlight how the neglecting of financial metrics appear to be particularly evident within the technology sector of the economy. This can further be interpreted as the choices made in this marketplace is more influenced by behavioral shortcomings, when compared to the overall economy.

7.1.2 Intangible Asset Valuation

A possible explanation for the elevated financial ratios visible within the technology sector is how companies within this sector tend to be defined by having a large portion of intangible assets relative to their market value (Brynjolfsson et al., 2002). Considering how intangible assets are defined by high uncertainty, dispersion of opinions regarding the value of these is likely to occur. Following how this subjective valuation is prone to cognitive shortcomings and irrational assumptions, in addition to the literature highlighting this as a decisive factor during the Dot-com bubble, it is imperative to analyze to what extent investors are able to correctly and objectively value these intangible assets in the marketplace today. The analysis will therefore now scrutinize the valuation of intangible assets, and thus answer the third proposition put forth by the framework.

Proposition 3: *Is the investor fascination for companies primarily comprised of intangible assets, unjustifiable in relation to their ability to generate profits?*

The first step in this analysis will be to investigate whether companies today are actually comprised of a higher degree of intangible assets. For this, the analysis will utilize data comprising the NASDAQ Composite Index. The NASDAQ has been chosen due to how the analysis is especially interested in the asset composition in the companies located within the technology sector. Here, the book value of tangible assets has been selected instead of the market value, as this allows for the better isolation of the proportion of intangible assets. This will further result in a broad overview of the current asset composition of the companies comprising the NASDAQ. The emphasis will be on the asset composition development, thus attempting to establish the relevance of the first part of the above proposition**.**

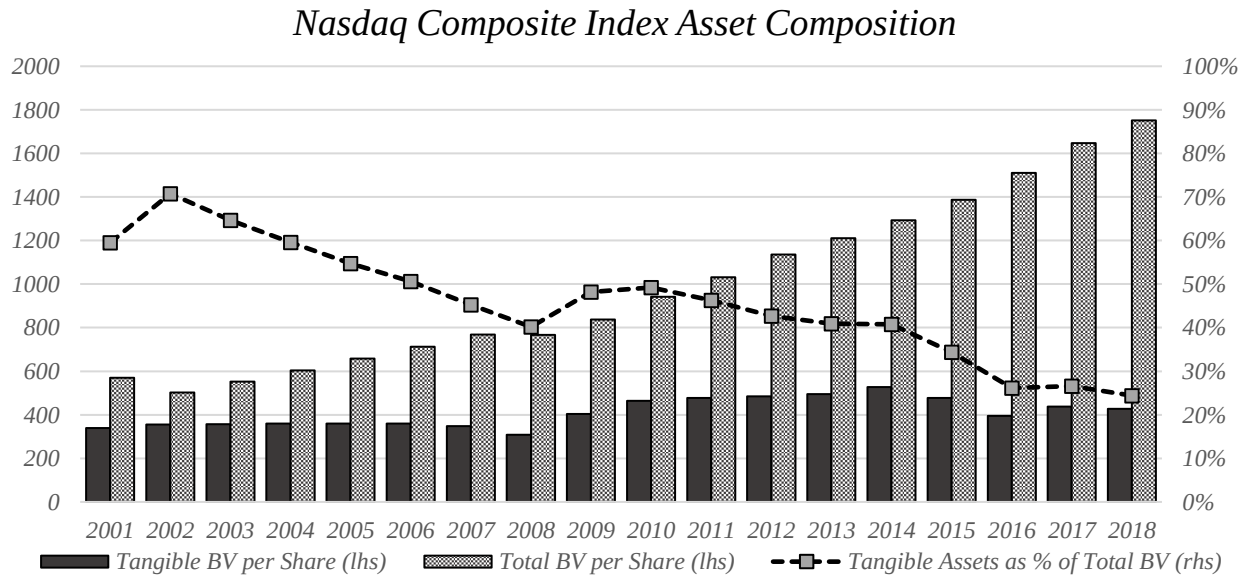

Figure 5: Asset Composition for NASDAQ Composite Index (2001 – 2018)

Based on the findings in Figure 5, some initial remarks could be established. It is found that tangible assets, as share of total book value, has steadily decreased over the previous 20 years. As of 2018, less than 25% of the book value on the NASDAQ index is considered tangible. Furthermore, there are indications that, as the book value of tangible assets has remained relatively flat, the majority of the increase of total book value for the companies constituting the NASDAQ, has potentially come from an increase in intangible assets and goodwill. Whereas the tangible book value has only increased by approximately 26% since 2001, the total book value has increased by more than 207% over the same period.

However, it is acknowledged that this fading of the tangible part of book value, is not just the result of a growth in intangible assets such as patents, proprietary technology and brand value. Consolidation and acquisitions are also significant drivers, due to their effect on the growth of acquisition-related goodwill. This goodwill could represent actual value, but it might as well just be an indication of how acquirers, just as stock investors, overestimate the value of the technology companies they buy. Hence, we move on to the second part of the proposition, namely whether the apparent investor fascination for these technology companies is justified in relation to their ability to generate profits.

Many of the above intangible assets are valued under the assumption that they will one day result in higher profits, thus increase the value of the company they are owned by. The question of whether these intangible assets actually result in earnings is therefore a natural one to ask. In order to investigate this notion, the analysis will now examine the 20 largest tech IPOs each year since 2010.[8] Common for these companies is their focus on growth, their high share of intangible assets, and that the majority were not profitable the year they went public. The rationale here is that estimating how many of them have been able to convert the intangible assets into actual dollars and cents will give a reliable indication on the accurateness of the proposition put forth by the framework. Below, the analysis has calculated what share of companies, by the year they went public, that experienced positive EPS in 2018. The x-axis here represents the year which the companies went public.

[8] The complete list of selected companies can be found in the appendix 2.

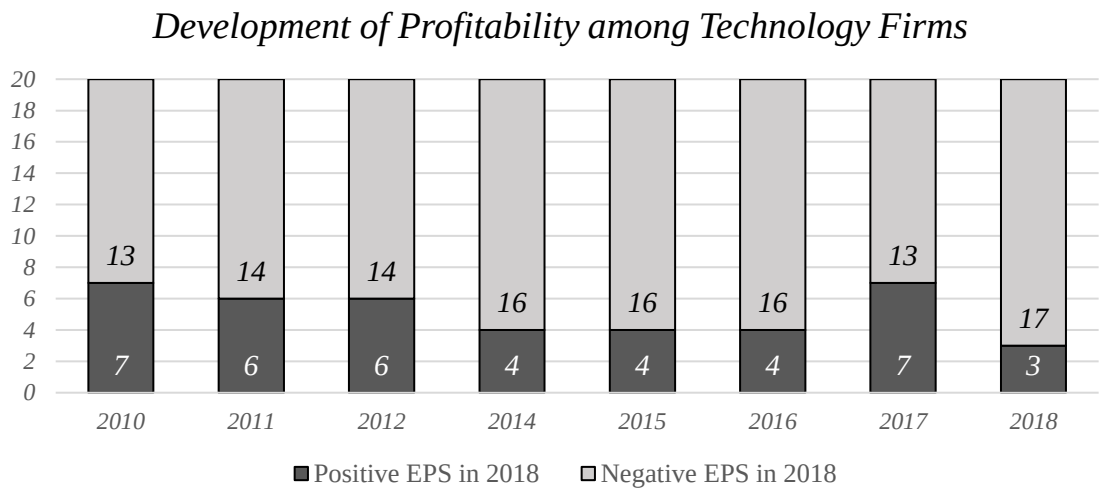

Figure 6: Profitability among technology companies by year of IPO (2010 – 2018)

In figure 6 it is evident that of the 20 largest technology companies that went public in 2010 (far left), only seven reported positive EPS in 2018 - almost ten years after their IPO. For the firms that went public in 2011, this number is even lower, with only 6 out of the 20 technology companies reporting positive EPS in 2018. This information reveals key insight about the long-term ability of tech companies to become profitable. Given how these companies receive stellar valuations, with the average Market Cap of the 20 companies going public in 2018 being $4.96bn, one should assume that the highly valued intangible assets would manifest themselves in the bottom line of the company, and be visible as a steady increase in the number of companies reporting positive EPS.[9]

However, as we have found evidence for, this does not appear to be the case. Although there may be several reasons why companies are not performing well in regards to EPS, it should raise some concerns that only seven of the 20 tech companies which went public eight years ago are profitable today. This trend is further highlighted when compared to other sectors in the US economy. Below, the same illustration, this time covering blue-collar sectors is observable.[10]

[9] The largest company going public in 2018 was Dropbox Inc, with a market cap of $10.406bn, while the complete list can be found in appendix 2 & 3.
[10] The list of sectors include *Industrials, Energy, Basic Materials and Utilities.*

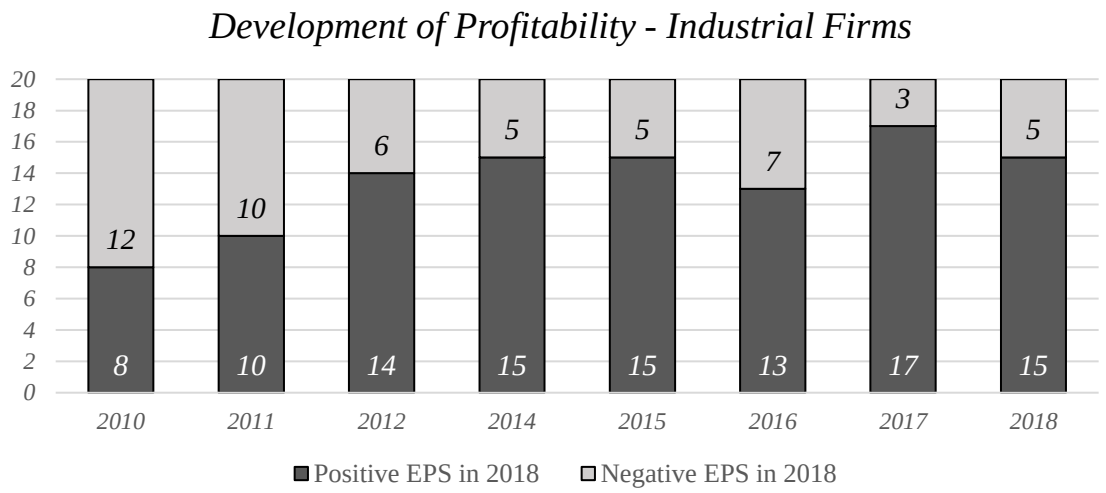

Figure 7: Profitability among brick and mortar companies by year of IPO (2010 – 2018)

In figure 7, it is evident that a vast majority of the *blue-collar* companies going public are experiencing positive earnings, including 15 of the 20 largest to do so in 2018.[11] There is a slight negative trend visible, following how as the years go on, fewer are profitable. However, when comparing to technology stocks, there is a clear positive difference. This dissimilarity between the two areas investigated, may be argued as an indication that investors within the technology sector are influenced by cognitive shortcomings when valuing these intangible assets. Bearing in mind how only seven out of the 20 companies going public in 2010 have been able to convert their intangible assets to actual value, the assumption of this conversion takes place may be perceived as irrational. Considering these findings, the fact that investors continue attributing astronomical valuations to these unprofitable technology companies, indicate that investors are not able to correctly and objectively value these intangible assets and that the subsequent fascination for said companies may be unjustifiable.

7.1.3 Investor Behavior

Following the findings in the above sections, several notions regarding the presence of cognitive biases have been established. First, investors are seemingly ignoring how tech firms are not able to convert sales to actual earnings. Second, the lack of knowledge regarding the value generating capabilities of intangible assets results in investors vastly overestimating the long-term effectivity of promoting this intangible capital. Building on this, the framework will now investigate to what extent irrational investors are defining the contemporary marketplace

[11] The entire list of companies can be found in the appendix 3.

In order to investigate the role of investor behavior in the creation of bubbles, the analysis will employ an alternative method. By attempting to identify rational investors, which at the expense of irrational traders, achieves arbitrage, the presence of irrationality will be confirmed. We therefore arrive at the fourth proposition of the framework;

Proposition 4: *Have rational investors exploited the mispricing in the technology sector, and having realized we are at the verge of a burst, now reduced their investments?*

For the purpose of answering the above proposition, we apply the methodology of Brunnermeier & Nagel (2004) concerning hedge fund positions preceding the Dot-com bubble burst. Regarding the question of whether rational investors are exploiting the apparent mispricing in the technology sector, it is vital to first establish who can be considered rational investors. As hedge fund managers are among the most sophisticated investors, and arguably closer to the idea of "rational arbitrageurs" than any other, these will, for the sake of this analysis, be regarded as rational investors.

We will now investigate the positions of the largest US-based Hedge Funds, and examine whether these funds have invested a large share of their portfolio in technology stocks. We will only investigate funds which are solely involved with hedge fund operations, following how the stock positions collected are not divided between different branches of institutional investors.[12] Furthermore, it will be explored whether a sharp decrease in tech exposure is visible, highlighting how these rational investors may have exploited the mispricing, and, having realized we are at the verge of a tech burst, now reduced their investments.

It is now possible to establish the developments in portfolio exposure for each of the ten hedge funds, over the chosen period of five quarters. Here, the weight of tech stocks in their portfolio will be used as a proxy for their exposure to the technology sector. Having reviewed more than 5.000 individual positions, including cross-checking with the Global Industry Classification Standards (GICS) from Bloomberg, it is now possible to view the results of our analysis in the illustration below.

[12] e.g. Blackrock, Citadel and Goldman Sachs Asset Management, all have their respective Hedge Funds branches, but also substantial positions within Asset Management and Mutual Funds

Developments in Hedge Fund Exposure							
Name of Hedge Fund	% Of portfolio invested in technology						Change last period
	1Q17	3Q17	1Q18	3Q18	1Q19		
Elliott Management	53,0%	49,8%	51,2%	60,1%	36,7%		-23,3%
Davidson Kempner Capital Management	31,0%	25,9%	27,3%	36,1%	25,2%		-10,9%
Baupost Group	28,9%	33,9%	36,9%	43,5%	54,2%		10,6%
Farallon Capital Management	41,2%	48,1%	46,1%	37,7%	48,8%		11,1%
Viking Global Investors	44,5%	40,4%	36,4%	28,2%	45,5%		17,3%
Canyon Capital Advisors	39,9%	55,7%	44,6%	47,2%	12,1%		-35,2%
York Capital Management	38,6%	45,7%	43,2%	43,5%	24,4%		-19,1%
Third Point Management	19,5%	32,3%	29,8%	37,2%	15,7%		-21,5%
King Street Capital Management	4,7%	0,0%	18,9%	38,5%	39,5%		1,0%
Angelo Gordon & Co	43,4%	33,0%	36,3%	14,4%	14,2%		-0,2%

Table 13: Developments in Hedge Fund exposure towards technology sector

Following the above results in table 12, there are signs of multiple hedge funds significantly reducing their tech exposure during the last two quarters. Of the ten funds in our sample, five are considered to have reduced tech exposure. However, no systematic trend is identified, with two of the funds investigated having an unchanged exposure, and three having actually increased the share of technology companies in their portfolio. Baupost Group, for example, has consistently increased their tech exposure across all five semi-annual intervals, displaying a total increase from $2.2bn to $6.2bn for the entire sample period. The same can be said about King Street Capital Management, as it went from having zero exposure in 3Q17 to 39.5% in 1Q19. However, it is worth noticing that this fund has grown from $463m to $2.19bn in our sample period. The developments of tech exposure for the two respective portfolios can be seen below in figure 8.

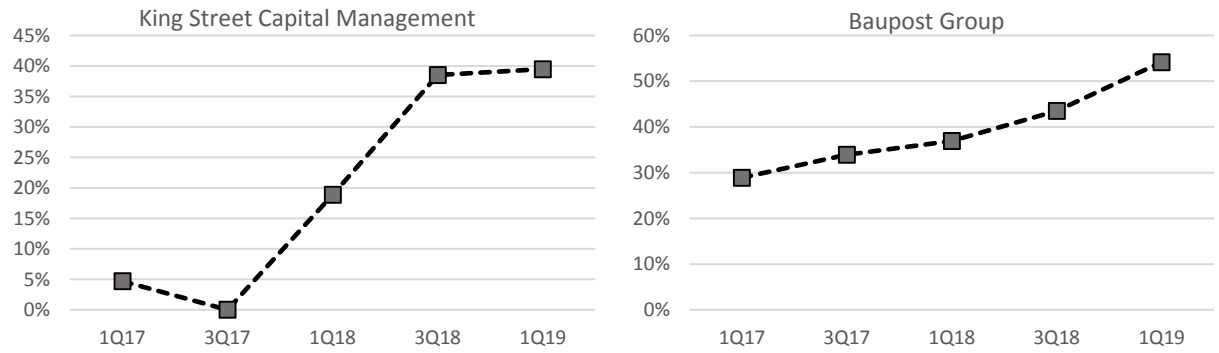

Figure 8: Selection of Hedge Fund exposure towards technology sector

Conversely, there are hedge funds where a substantial decrease in tech exposure is visible. Most notable is how Elliott Management, the second largest fund in our sample, decreased their total value invested in tech companies from $9.27bn in 3Q2018, to $4.94bn in 1Q2019. This constitutes a 45% reduction in only 6 months. Another example is how Third Point Management has reduced their exposure from 37.2% to 15.7% within the

same period. According to our data, this reduction includes a complete exit in tech giants Amazon, Facebook, Microsoft and Alibaba – positions totaling more than $2.3bn in value.[13]

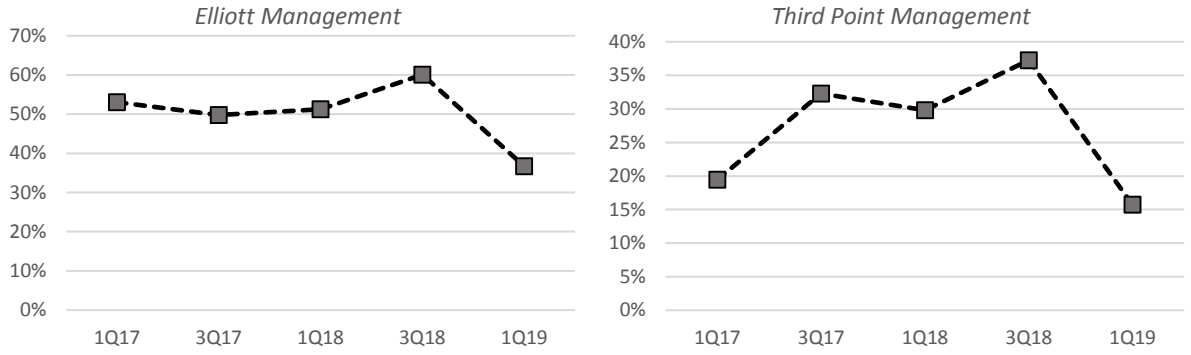

Figure 9: Selection of Hedge Fund exposure towards technology sector (2)

When calculating the development for the total sample it is evident that on average there has been an increase in tech exposure from 1Q2017 to 3Q2018 with seven out of 10 fund registering an increase over the period, and the average tech exposure increasing from 34.5% to 38.6%. Furthermore, in the subsequent semi-annual period, the average exposure has been reduced from 38.6% to 31.6%. The entire distribution can be seen in figure 10 below.

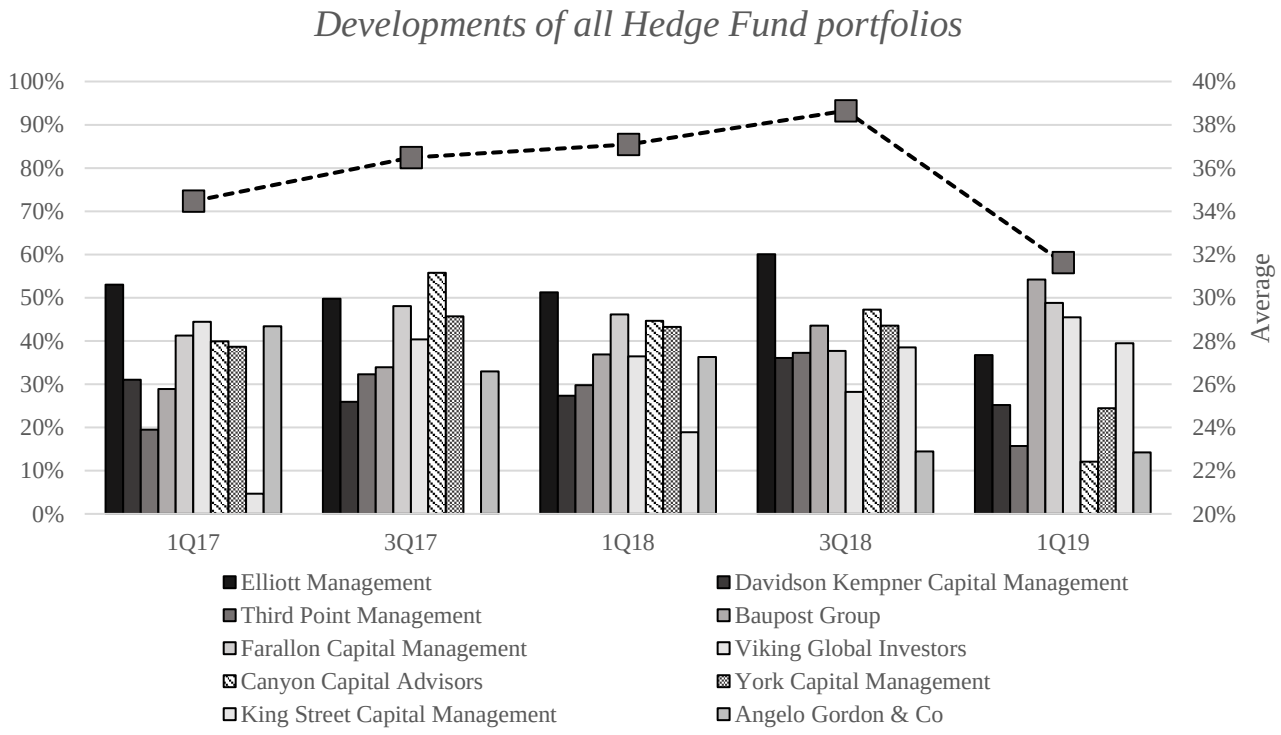

Figure 10: Total sample of hedge fund exposure towards technology sector

[13] This was later confirmed by Daniel Loeb, the CEO of Third Point, in a recent letter to investors, where he expressed concerns about market conditions and said he had trimmed the positions of the firm in technology stocks (Franck, 2018).

Regarding the above results, it is acknowledged that, as we have measured the individual positions as the market value of the stocks, the reduction in technology exposure may partly come as a result of the overall reduction in the market value of tech stocks following the market downturn in 4Q2018. Nevertheless, it is believed this effect has only marginally impacted the results. Firstly, hedge funds often operate with a long horizon, and subsequently re-balance their portfolio according to pre-defined sector weights, thus any decrease in relative value should be corrected by the hedge fund manager. Secondly, as the 4Q2018 downturn affected the entire market, this should not have had a significant effect on the percentage of technology stocks in the portfolios. Finally, although the trend of decreased tech exposure was not found to be systematic across our entire sample, the existence of funds that had completely exited large technology companies is believed to reinforce robustness of the results.

By attempting to identify the existence of rational investors, in this case hedge fund managers, which at the expense of less rational investors, achieved arbitrage, the analysis have made several discoveries. First, there is no conclusive systematic trend identified in the data sample. Although multiple funds have been found to significantly reduce their tech exposure, this is not the case for all funds, and some have conversely increased their exposure to technology companies. Second, there appears to be no relationship between the size of the fund and the reduction in tech exposure, disputing the notion that larger hedge funds may exhibit more rational behavior.

7.2 PILLAR II: CAPITAL MARKET MECHANISMS

Having investigated the possible cognitive shortcomings in relation to a new bubble, the second pillar in the framework concerns itself with the market in which capital is exchanged. With the basis in academic literature and empirical research on the topic, the analysis will now investigate the current US capital market. Here, the identification of a *growth at all costs* mentality has been advocated by the framework as an appropriate indicator that the capital market has temporarily failed in its role as an efficient allocator of capital. Following the overall methodology of the paper, the framework has presented several propositions, concerning two individual factors within this pillar. The analysis will now evaluate each proposition with the objective of verifying the presence of these.

7.2.1 Initial Public Offering mania

As previously mentioned, deteriorating quality of the firms going public, was a key characteristic during the period leading up to the burst of the Dot-com bubble. Following how an IPO represents a pivotal moment in terms of capital market interaction, the process is considered a suitable factor when investigating whether a *growth at all costs* mentality is again visible in the capital market. It is therefore highly interesting to investigate the state of the current US IPO market, with a special focus on performance and profitability. Correspondingly, if these metrics have once again weakened, it may indicate a new shift in investor sentiment and be an indication that the capital market has failed in its role as an efficient allocator of capital. We therefore arrive at the fifth proposition of the framework:

Proposition 5: *Is the same disregard for profitability and financial performance, which was visible during the Dot-com bubble, again present in the contemporary IPO-environment?*

In theory, the capital market should price a firm according to all relevant information available to the public, and the subsequent valuation should, therefore, be a fair representation of the true value of the firm. However, the Dot-com period was marked by a considerable number of speculative firms that, despite having poor business plans and little or no foreseeable earnings, still received astronomical valuations (Schwartz, 1998). This may be an indication that there was a severe fault in the capital market at the time, which in turn contributed to the unprecedented IPO activity. We are therefore interested in investigating the US capital market, with an emphasis on the current IPO activity. It is with the basis in this notion, four different features of the IPO activity will be investigated, considered as good proxies for pre-IPO operating performance. The four metrics are *First-day returns*, *frequency*, *Sales*, and *Profitability*.

First-day returns & frequency

The first-day returns, and frequency, for IPOs seen during the Dot-com period dwarves anything previously observed. From only 110 companies going public in 1990, there were a total of 677 IPOs in 1996 - the peak year in terms of IPO frequency during the Dot-com era. Although the total amount of companies going public saw a sharp increase beginning in the early 1990s, this was not immediately the case for the first-day returns. Here, the developments peaked in 1999, where the average first-day return was 71.20%, up from a moderate 21.90% in 1998.

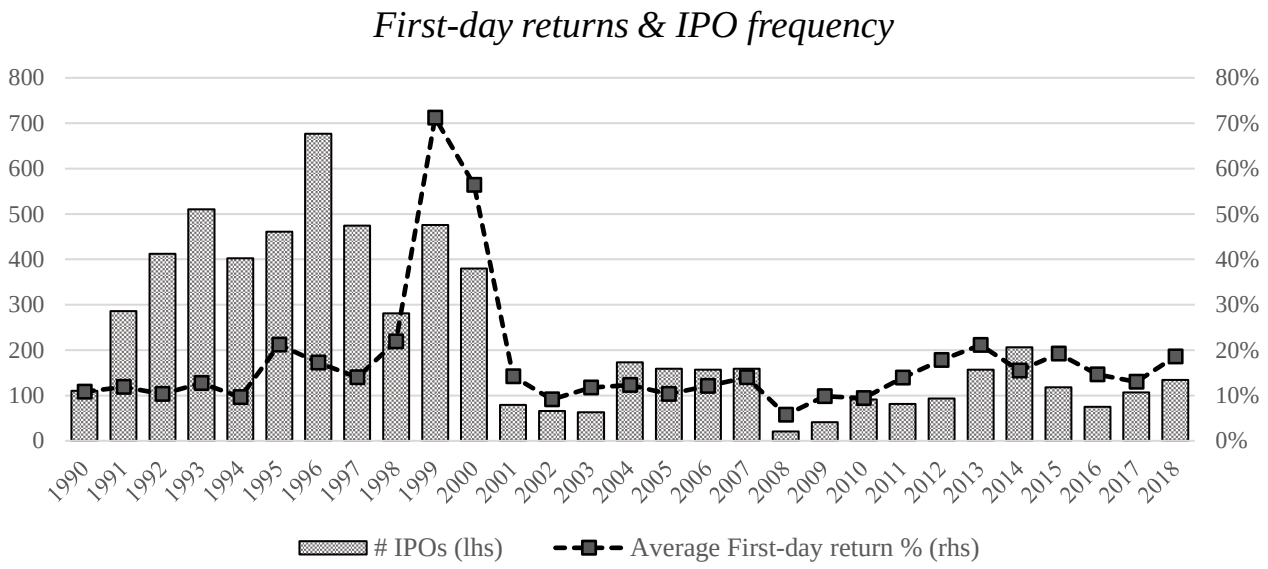

Figure 11: Number of IPOs and average first-first day returns (1990 – 2018)

As evident in figure 11, the average first-day returns observed in 2018 are far from those during the period leading up to the Dot-com bubble. This is also true in regards to frequency, as in 2018, only 134 companies decided to go public, averaging a first-day return of 18.60%. These numbers pale compared to the 71.20% average first-day return for the 476 companies that went public in 1999. Bearing in mind that the average first-day return for our entire data sample (1980 – 2018) is 17.90%, there is little evidence of abnormal IPO first-day returns taking place today. Conversely, by limiting the time frame to the period of 2001 to 2018, the first-day returns of 2018 were significantly higher than that of the average of 13.25%. However, this is not deemed to be evidence that the first-day returns are approaching the levels last seen during the Dot-com era. Firstly, it is essential to note that the 2001-2018 period includes the years 2008 and 2009, the worst years in terms of IPO activity for the past 40 years. Secondly, the 18.60% first-day return seen in 2018 is significantly lower than those of the Dot-com era.

Sales

Although few similarities between the contemporary IPO market and the Dot-com era were discovered in the previous section, stellar first-day returns and high IPO frequency were not the only key characteristics of the Dot.com era. As highlighted by Loughran & Ritter (2004), another important feature was the high stock performance of companies with little sales. In figure 13, this trend is visible, as the first-day returns of firms generating between $0 and $20m in LTM sales far outperformed those generating from $100m and upwards. Here, the observations covering the Dot-com era have been highlighted in grey.

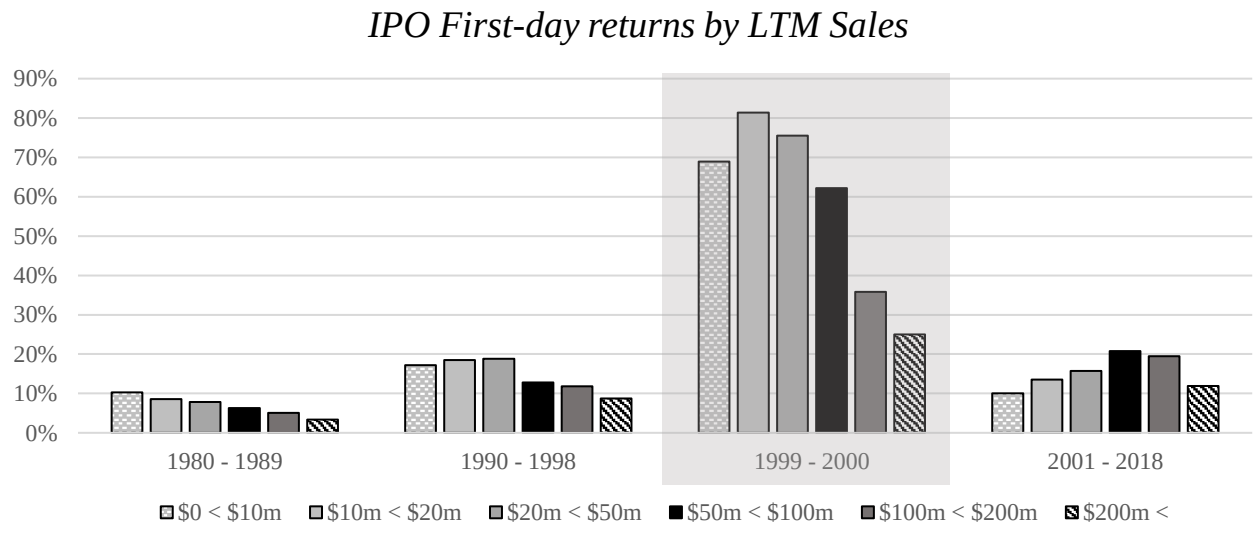

Figure 12: First day-returns segmented by LTM sales (1980 – 2018)

Albeit the significantly higher first-day returns for the period during the Dot-com bubble (grey), what is important to note in figure 12 is the distribution within each period. Here, it is evident that, although the market already had an appetite for companies with lesser sales before the bubble, this effect appears strongly exaggerated from 1999 to 2000. In regards to first-day returns, a company could expect almost three times higher first-day IPO returns if the company had modest sales between $0 and $10m, compared to significant sales of more than $200m. In the period following the crisis, it is clear that investors have at least somewhat shifted their preferences towards companies that have noteworthy sales, and the average first-day return of companies with less than $10m, is in this period a more reasonable 10%. In this epoch, a company could actually expect a higher first-day return if it had significant sales of more than $200m, compared to modest sales between $0 and $10m.

This shift in preferences is also true when investigating the number of companies choosing to go public. During the years 1999 to 2000, almost 40% of companies going public had less than $10m in sales the preceding year. However, in the period following the Dot-com bubble, the majority of companies going public experienced significant sales and the same number is now only 21%. The entire distribution is visible in figure 13 below.

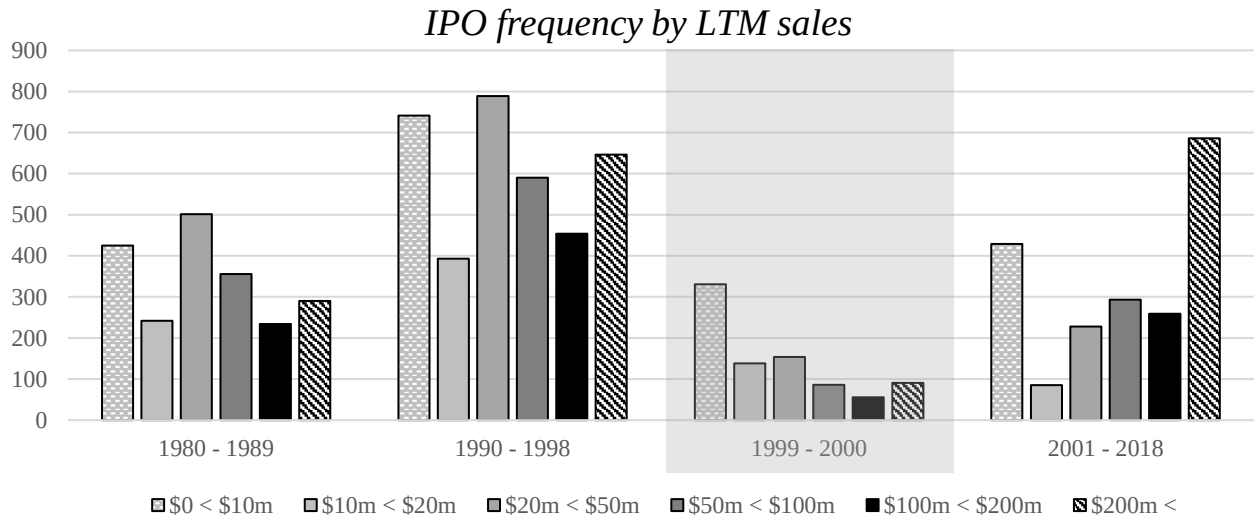

Figure 13: IPO frequency segmented by LTM sales (1980 – 2018)

Here, it becomes evident how there has been a visible shift in focus towards sales when comparing the period 1999-2000 with that of 2001-2018. Whereas during the Dot-com bubble, only 10.6% of the IPOs featured firms with more than $200m in sales, this constitutes 34.5% of the firms going public between 2001 and 2018. However, as the year-to-year developments are of especial interest for the analysis, the median sales have been estimated for each year spanning the entire sample period and the results can be seen below.

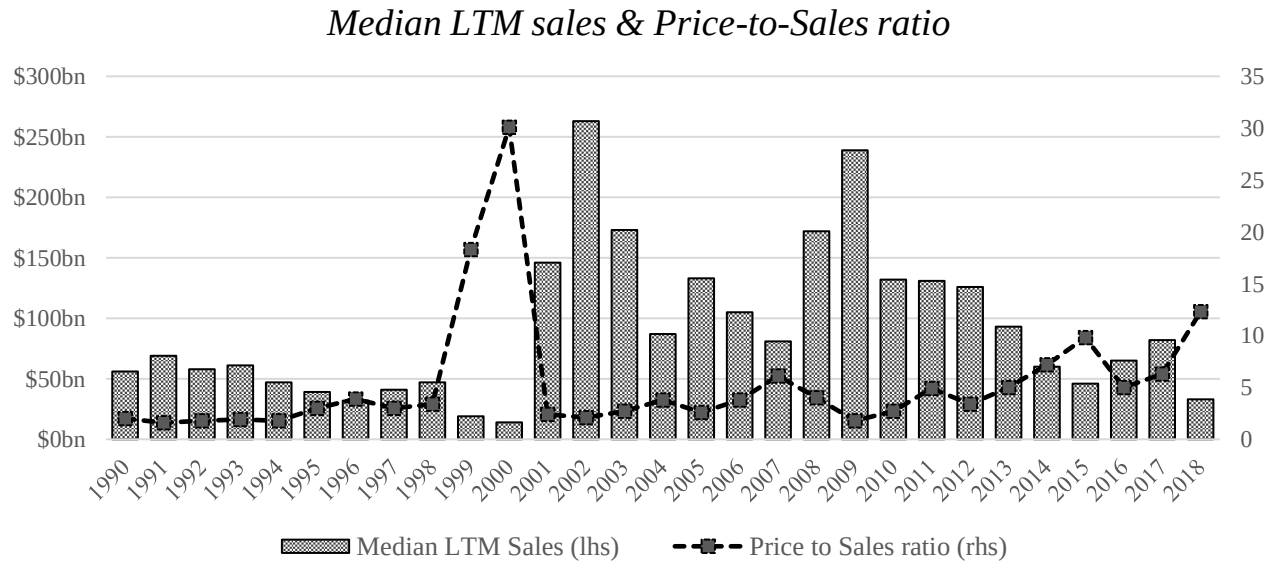

Figure 14: IPO LTM sales and P/S ratios (1980 – 2018)

Based on figure 14, a steady decrease in the median LTM sales is evident in the period leading up to the Dot-com bubble. Correspondingly, the P/S ratio has gradually increased in the same period. This trend continues until the year 2000, where the median LTM sales and P/S ratio reached $14m and 30.1 respectively. Following the burst of the bubble, the LTM sales increased rapidly, whereas the P/S ratio, in contrast, fell dramatically. An explanation for this observation may derive from how the irrational exuberance of the Dot-com era was replaced by a general suspicion and cautiousness, allowing only the most financially sound companies, with a proven history of sales generation, to go public. As visible, subsequent of the bubble burst, the median LTM sales for companies going public in 2002 was $263m, a number which has steadily decreased to a modest $33m as of 2018, the lowest median LTM sales recorded since the height of the Dot-com bubble. Thus, it is evident that the apparent high fraction of companies with significant sales going public in the period 2001 – 2018, as depicted in figure 14, did not provide a complete representation of the sales distribution. An explanation for this is how the average of the period was artificially inflated by the companies going public straight after the burst of the bubble. Considering how the median LTM sales have experienced a sharp decrease in previous years, combined with an increased P/S ratio, it appears investors place less emphasis on sales generation when valuing companies.

Profitability

As established in the previous section, there is a trend of declining sales for the companies choosing to go public. Further, it is highly interesting to investigate the current level of pre-IPO profitability among these same firms. As reported under the Dot-com bubble, the number of firms that went public without experiencing profitability rapidly increased, highlighting how the capital market at the time did not consider profitability a prerequisite for going public (Ritter & Welch, 2002). If we are able to identify a similar trend of decreased pre-IPO profitability, this may be an indication that the capital market sentiment has again shifted towards solely valuing technology companies based on future growth and thus a *growth at all costs* mindset.

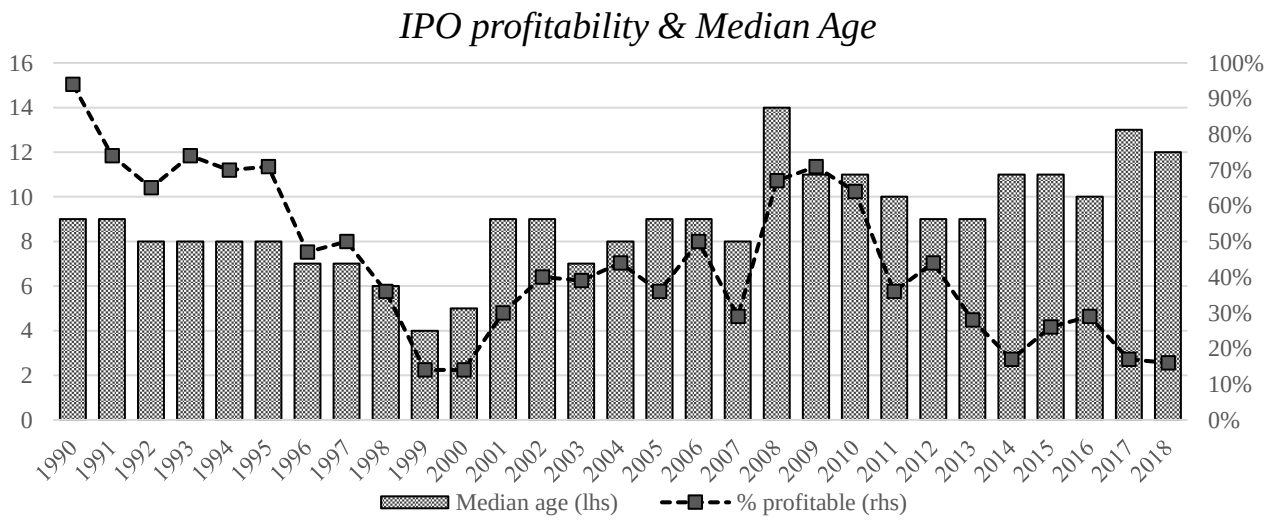

Figure 15: IPO Median age and percentage profitable (1990 – 2018)

Figure 15 depicts the developments in pre-IPO profitability going back to 1990, and a trend spanning from 1990 to 2000 is evident. Consistent with data presented by Gao et al. (2013) and Loughran & McDonald (2013), a large fraction of the companies in our sample have negative trailing EPS values. Whereas 94% of the technology companies which went public in 1990 where profitable, this number had declined to only 14% in 1999. This figure, combined with an all-time low median firm age of 4 years, highlights how earnings were secondary, and many firms were fashioned for a quick exit, rather than spending the time necessary to create a solid company.

In the years following 1999, the number of profitable companies going public gradually increased, thus it appeared to be a renewed focus on profits. This renewed focus can be illustrated by the fact that more than 70% of the companies which went public in 2009 were profitable. Once again it is important to note how only the most financially sound companies were allowed to go public the years following the Housing Crisis. However, as there is a positive trend visible in the years preceding the crisis, this is not considered a weakness in the data. Regardless of this trend, the share of profitable companies has once again gradually decreased, reaching levels previously seen during the height of the Dot-com era. In 2018, only 16% of the technology companies which went public experienced profits. Furthermore, the 12-year median age in 2018 was significantly higher than that of 1999.

In the view of our findings, it is highlighted how there is a deteriorating quality of the firms deciding to go public today. Bearing in mind the overall theme of the pillar, namely the g*rowth at all costs* investor sentiment, our results would suggest a contempt for profitability and performance is once again visible in the IPO activity. This could further be a sign that the capital market has failed in its role as an efficient allocator of capital, and that the developments share several characteristics of the period leading up to the Dot-com bubble.

7.2.2 Aggressive Venture Capital

The recent trend with declining profitability, combined with higher median age, may derive from the increased influence by Venture Capital funding. As previously mentioned, Venture Capital funds have the capabilities to deal with high degrees of uncertainty, and often provide funding for companies that might otherwise have a hard time attracting this through the conventional capital markets. Subsequently, the VC funds accept higher risks, investing in potential high-growth and high return opportunities. As highlighted in the academic literature, several concerns regarding the VC industry have been raised. Here, the VCs influence on the reduced quality of firms going public will be of special interest to this part of the analysis. As it appears the market sentiment in relation to IPOs is once again one that values *growth at all costs*, it is crucial to investigate the nature of the current VC activity within the US capital markets. We therefore arrive at the sixth proposition of the framework.

Proposition 6: *Is the Venture Capital activity seen today contributing to dangerous developments within the technology sector, thus being harmful to the US Economy?*

As established in the analysis of IPO activity, the vast majority of technology companies going public in 2018 did not experience pre-IPO profitability. We will now investigate to what extent the Venture Capital industry can be deemed partially responsible for this development. US Venture Capital investments reached $130.9bn in 2018, for the first time surpassing the $99.7bn observed in1999, in the peak year of VC during the Dot-com era. The amount invested during 1999 came after a sharp increase in the VC investments, increasing from only $7.6bn in 1995 to almost $100bn five years later.

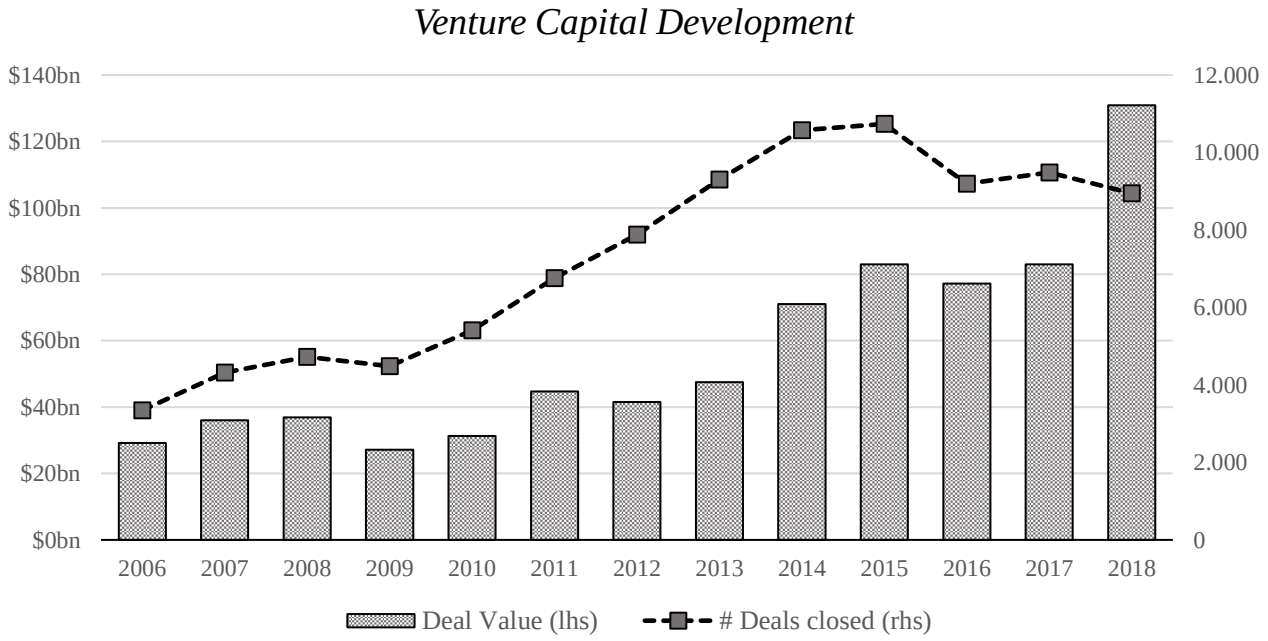

Figure 16: Developments within US Venture Capital activity

In figure 16, the recent development of the Venture Capital industry is highlighted. Since 2009, the VC industry has grown over 400% and is now at a historical all-time high. Although the total number of deals has slightly declined during the past couple of years, the individual deal value has increased, thus resulting in overall growth in the industry. These developments within VC volume closely resemble those of the late 1990s. This growth may result in startups and new companies having access to risk-loving venture capital funds, and in turn, just as during the Dot-com era, allowing managers to emphasize growth and generating revenues, instead of taking steps towards long-term profitability.

As established in the previous section on IPO activity, the current market sentiment is one that does not consider profitability to be a prerequisite for a successful initial public offering. Considering how VC managers likely realize this, and how an IPO is a common exit strategy for VC funds, this may create a dangerous shift of incentives for VC fund managers.

Another key aspect of VC firms is how they became drawn to the frequency and consistently high performance of technology companies during the Dot-com era, and thus shifting their investment focus accordingly (Loughran & Ritter, 2002). Whether this trend remains unchanged is, therefore, an important question to ask, and by segmenting VC investments by sector we hope to be able to answer it accordingly.

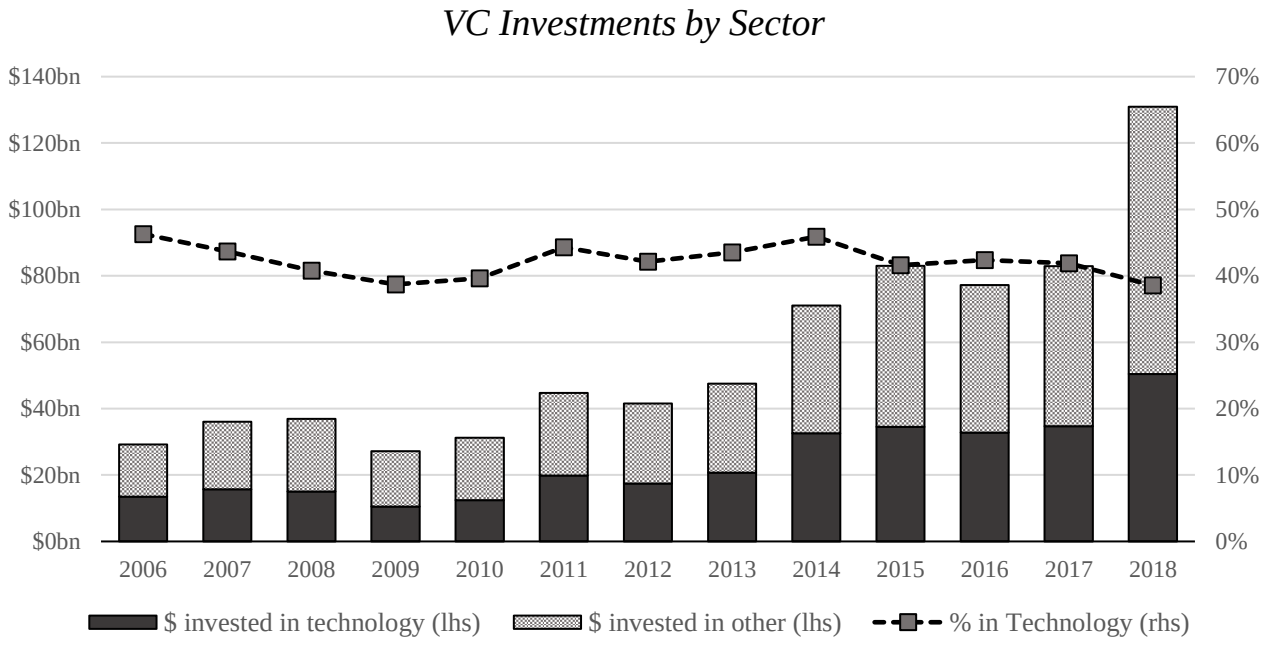

Figure 17: US Venture Capital activity segmented by industry

Based on figure 17, the share of VC investments in technology companies has remained relatively stable, at approximately 40% of total invested value. When considering that the Information Technology sector index of the S&P 500 currently constitutes 27% of the total S&P 500 index, this highlights how VC funds are still attracted to the frequency and consistent high performance of technology companies. In 2018, software investments are at a record high $50.47bn, constituting more than one third of total VC investments that year.[14]

Another important aspect of this factor is how much influence VC funds have on the current IPO activity. It is therefore established as necessary to investigate what share of IPOs which are backed by VC funds, thus uncovering the relevance of the formalized proposition. The analysis has therefore calculated the share of IPOs which were backed by VC funds, and the results can be viewed below.

[14] The total distribution of invested volume by sector is visible in appendix 6.

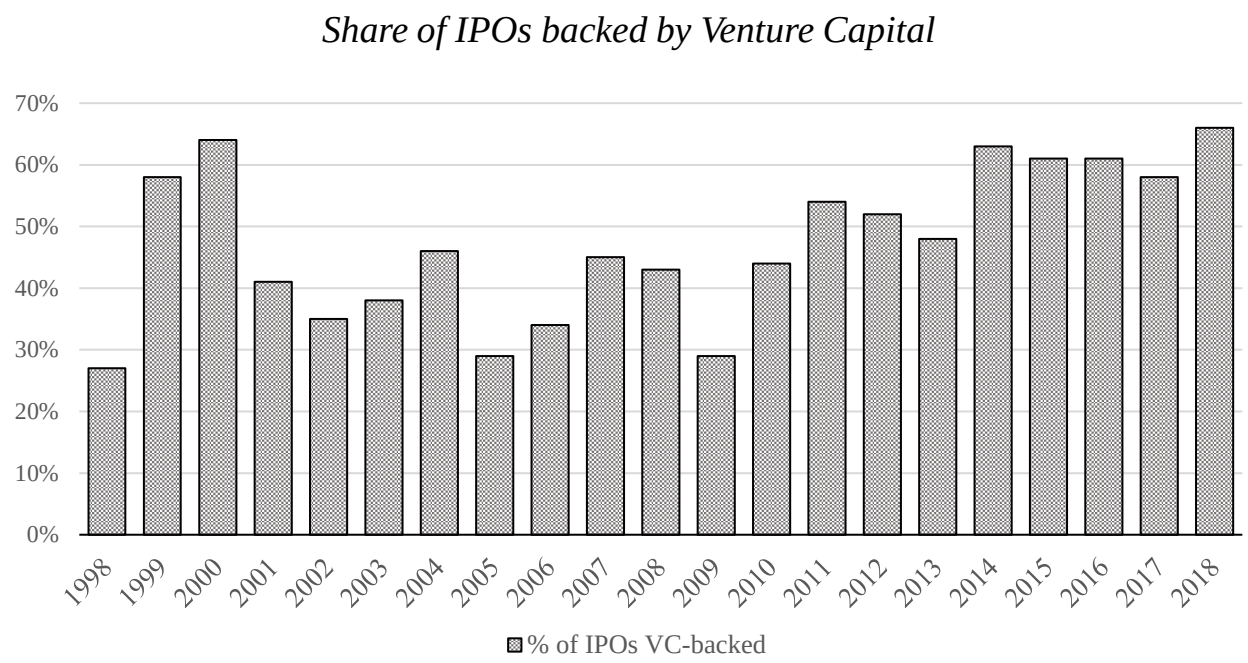

Figure 18: Share of IPOs which are VC-backed

In figure 18, there is a clear trend that the share of IPOs where the company is VC-backed has increased the previous ten years. In 2018, 66% of the companies going public were VC-backed, having now surpassed the peak of the Dot.com era, highlighting the increased influence of VC on the capital markets. Considering how VC funds are inherently building their business model on accepting higher risks, investing in potential high-growth and high return opportunities, it may be argued that they contribute how the traditional mantra of *invest what you can afford to lose* once again is being replaced by *growth at all costs*. Bearing in mind how the VC industry is significantly larger today than it was during the burst of the Dot-com bubble, it is reasonable to believe the effects of VC capital influence is even greater than during the Dot-com era, and it is possible to question the nature of its impact on the US economy.

7.3 PILLAR III: MONETARY POLICY & CORPORATE LENDING

Having investigated the two first pillars in our framework, the third pillar concerns the US monetary markets. Following a large body of literature on the topic of interest rates and the significance of monetary policy in the developments of the Dot-com bubble, it has been established that the actions of the Federal Reserve have been associated with laying the foundation in which enabled the creation, persistence, and eventual burst of the bubble. It is therefore believed that it an investigation of the current developments within US monetary policy, and subsequent corporate lending, will provide a solid overview of whether the developments within monetary policy have resulted in an economy more prone to a market downturn. Here, the framework has presented two factors, with corresponding propositions, which now will be investigated in detail.

7.3.1 Monetary Policy

With the recent hiking of the Fed Fund Target Rate, there are speculations on how this will affect the overall US economy. Many believe the rates are likely to continue increasing, climbing off their post-Great Recession record lows, yet the market is showing little signs of fear and anxiety for the potential consequences. In our framework, two propositions regarding the interest rates have been developed. In order to establish the proneness of the economy to a market downturn, the first proposition is based on the potential information contained within the interest rates and its yields, and how this may reveal insights on the market perception of a potential new recession. We therefore arrive at the seventh proposition of the framework;

Proposition 7: *Are the US interest rates today revealing investor sentiment suggesting a new bubble?*

The first part of the analysis will concern the investigation of to what extent there is a relationship between interest rates and market recessions. In order to do this, we have plotted the FED Fund Target Rate from 1975 to 2019. Furthermore, the previous six severe market corrections, as defined by the Federal Reserve of St. Louis, have been highlighted in grey.[15]

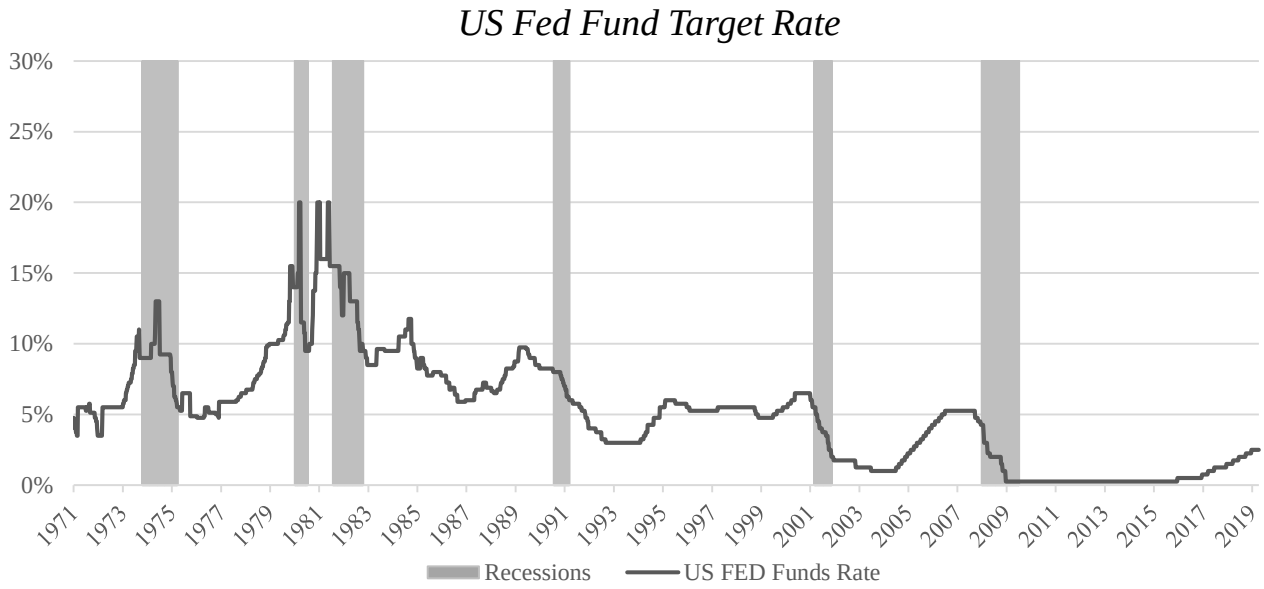

Figure 19: US Fed Funds Rate and US Recessions (1971 – 2019)

As seen in figure 19, a clear trend seems to be evident, as the previous six recessions came following a period of a sharp increase in interest rates. Without discussing causality, the above confirms our initial inkling concerning a potential relationship between the two investigated variables. However, as the FED Fund Target Rate is dictated by the Federal Reserve, and the not the market, it may not accurately reflect investor sentiment.

[15] The definition of US Recession, as by the *Federal Reserve of St. Louis,* can be found in the Data sample section.

As it is the objective of our analysis to investigate to what extent the US interest rates are revealing negative investor sentiment, it is crucial to examine the US yield curve.

We will, therefore, investigate the spread between US interest rates. We will analyze the 3 Month US Treasury Yield and the 10-year US Treasury Yield, with the spread calculated as the difference between the two. The two individual yields, in addition to the spread between them, can be visible below and these values are calculated from 1980 to 2019, capturing the five previous recessions, in addition to the current financial situation in the US economy.

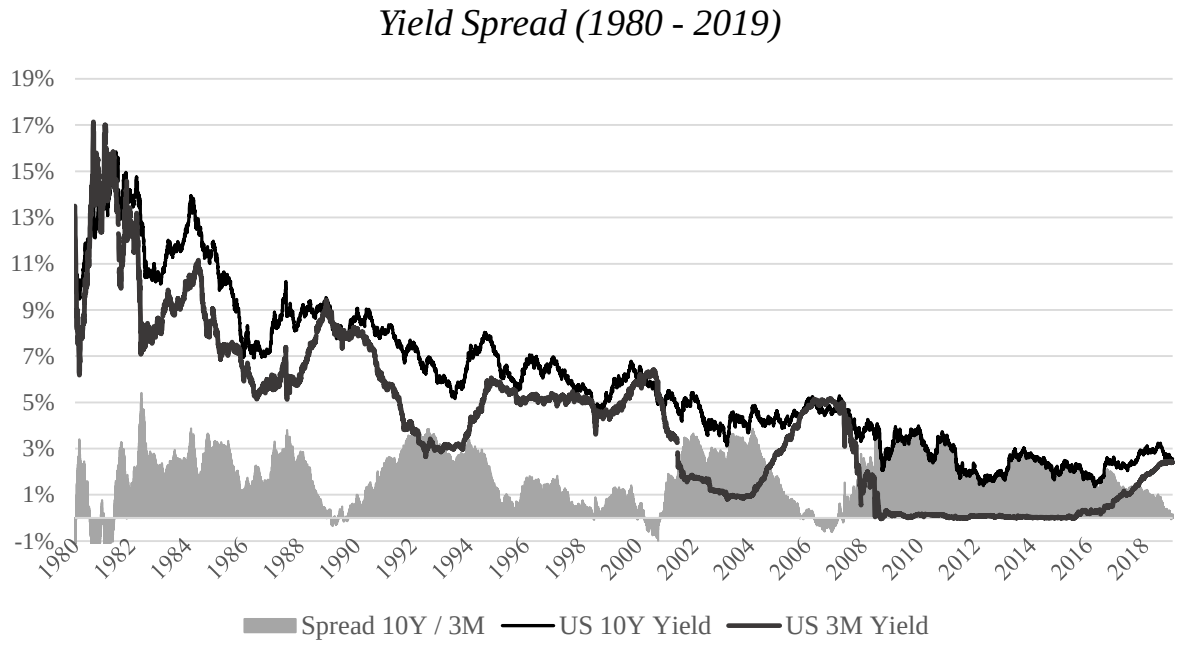

Figure 20: Yield spread between 10Y and 3M US treasuries (1980 – 2019)

In figure 20, it is visible to see how the yield spread (in grey) varies significantly across our sample. Here, it is evident how the yield curve has become inverted during five occasions since 1980, all corresponding to the abovementioned US recessions. Most notably, the yield spread fell more than two percent from 1999 to 2001, in the period leading up to the burst of the Dot-com bubble. Following close to 10 years of positive yield spreads, it is now apparent the yield curve has once again inverted. As visible in figure 21, this inversion came as a result of the increase in the Fed Fund Target Rate, combined with a steady 10-year yield.

The current inverted yield curve is illustrated below. In addition, the yield curves of the years preceding the Dot.com bubble and the Housing Crisis are included. Furthermore, the yield curve of 2013, considered a healthy year in the US economy, is included.[16] It is worth noticing that, in order to ensure a more accurate comparison, all yield curves have been indexed to begin at zero, thus the values are not representing the actual yield, but rather the developments of each yield curve.

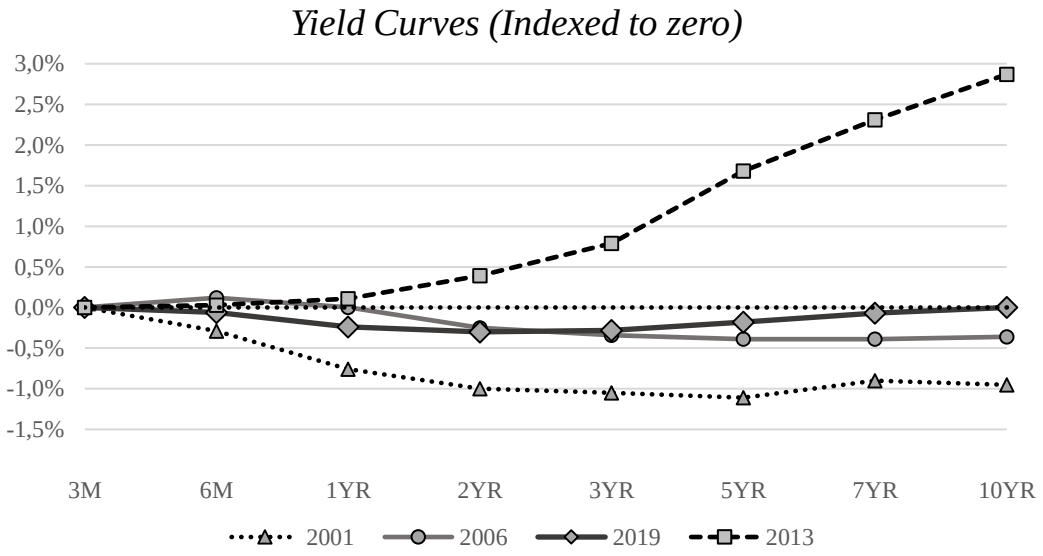

Figure 21: Indexed yield curves for different periods in the economy

In figure 21, it is evident how the yield curve of 2019 resembles those of both 2001 and 2006. The yield curves are all slightly inverted, indicating that the market sentiment is somewhat negative and expecting a period of lower growth. When compared to 2013, the difference becomes more evident. In 2013, the yield curve exhibits more traditional characteristics, in that investors demanded a higher premium for investing in longer maturities. Following our findings, in combination with the rationale put forward by Dueker (1997), the current yield curve may suggest a new recession is close. However, as the response of the yield curve depends on the assessment of the market of the magnitude and duration of the effect of the recession, and considering how the 2019 yield curve is significantly less inverted than the one in 2001, this may imply investor sentiment is not as negative as during the Dot-com bubble.

As we have now established the existence of an inverted yield curve, we will revisit our initial proposition, specifically how the US interest rates may reveal investor sentiment suggesting a new bubble. In order to further investigate this claim, and build on the knowledge acquired in the above section, we will now utilize a probability model put forth by Estrella & Trubin (2006).[17] This model is based on how the spread between the yields of the ten-year Treasury note and the three month Treasury bill is a useful predictor of both cumulative

[16] In 2013 the US stock market increased 26.5%, while the unemployment rate fell 1.2% (Bloomberg, 2019)
[17] The model by Estrella & Trubin (2006), in its entirety, can be found in the Data section of this paper.

economic growth and marginal economic growth rates. Utilizing this model, we will attempt to estimate the probability of a recession occurring within the next twelve months, according to investor sentiment. This is believed to further solidify the notion put forward by the framework and increase the overall quality of the analysis. Using the model, applying the current yield spread, the probability for a recession occurring within the next twelve months is estimated. This probability is then calculated, with monthly intervals, for the period 1990 to 2019, with the results visible below.

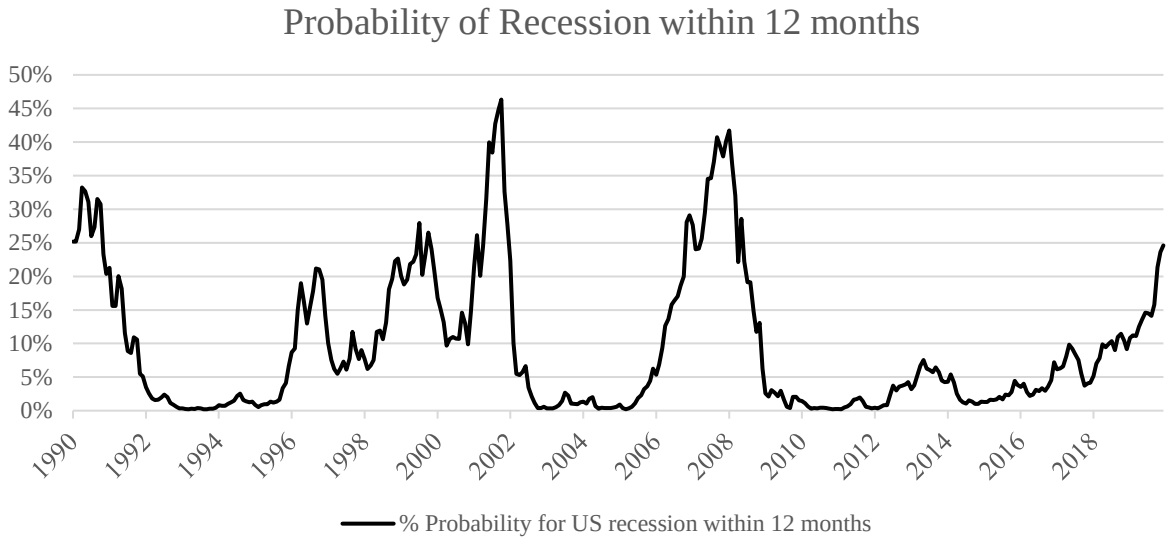

Figure 22: Probability of recession as calculated by analysis (1990 – 2019)

As evident in figure 22, we can see that the probability of a recession occurring within the next twelve months has experienced a significant increase during the last two years. From being only 3.74% as of December 2017, the probability is currently estimated to be 24.62%. The indicator peaked in January 2002, where it reached a level of 46.32%. However, the previous five times it has shown a probability of more than 23%, a recession has occurred within the next 24 months. These results, combined with the comparison of the different yield curves, reveal some negative investor sentiment contained within the current interest rates. However, this sentiment is not as negative as during the Dot-com bubble, and displays a significantly less inverted yield curve compared to the Dot-com period.

7.3.2 Corporate Lending

Perhaps the most important result of reduced interest rates is the accessibility to cheap capital, allowing companies to issue more debt in order to finance new projects and acquisitions. As highlighted in the previous section, the US interest rates have been record-low for several years, and it is thus reasonable to assume that this cheap capital has induced high levels of corporate lending. As there is found a relationship between high levels of corporate debt and more substantial GDP declines, the amount of corporate lending is an important factor to investigate when assessing the consequences of US monetary policy. We therefore arrive at the eight proposition of the framework

Proposition 8: *Has the access to cheap capital resulted in US companies issuing dangerous levels of debt?*

In order to establish the relative level of US corporate debt, the analysis will calculate the outstanding US Corporate debt as percentage of GDP. This is done, opposed to utilizing the total value of corporate debt, in order to account for the value creation taking place in the US economy. By applying this methodology, our data sample unveils that the current corporate debt is at an unprecedented high 46% of the total GDP. This is significantly higher than during both the Dot-com bubble and the Housing Crisis. The developments from 1985 to the current date, can be seen below, with the three most recent recessions highlighted.[18]

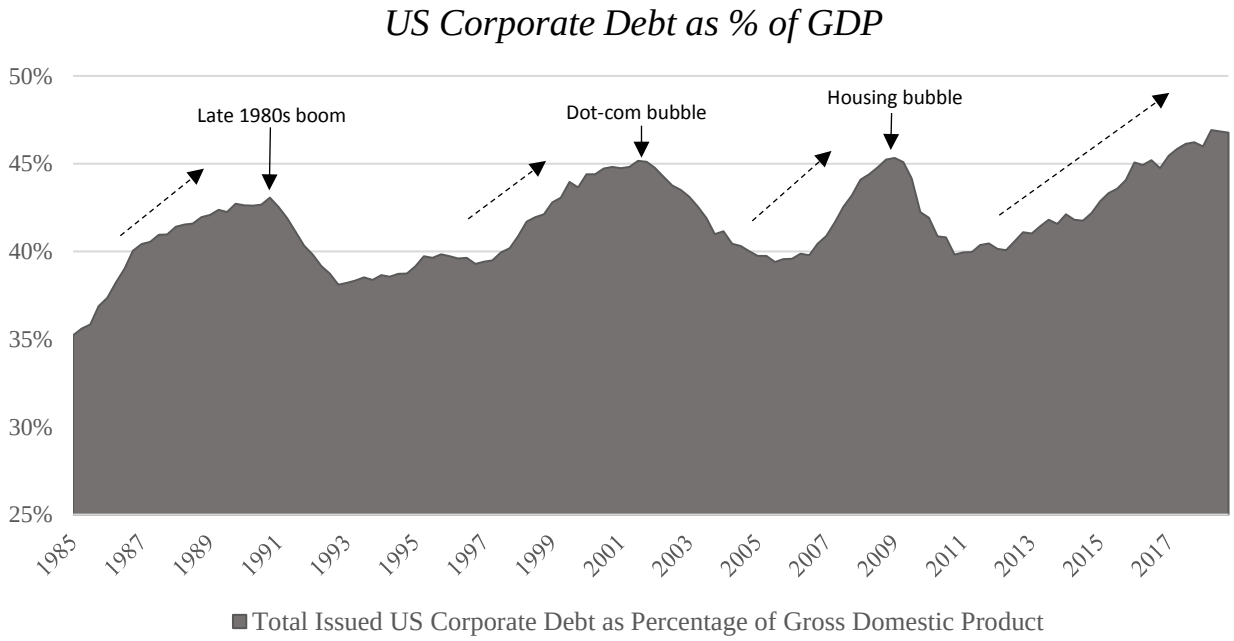

Figure 23: US Corporate debt as percentage of Gross Domestic Product (1985 – 2018)

As seen in figure 23, every large recession since 1985 occurred when US corporate debt approached levels close to 45% of GDP, highlighting how the levels of debt appear to be a good proxy for a coming recession. As of Q4 2018, the number is 46.77%, highlighting the high leverage among US corporations. This may be the result of how the Federal Reserve has kept artificially low rates over a longer period, making capital less expensive, and subsequently resulting in companies leveraging up. This cheap capital has again contributed to the vast growth in the US economy, and might partially explain why we are currently eight years into the second-longest bull market in history.[19] However, the eight successive years of rapid growth might be an indication that the dovish behavior exhibited by the Federal Reserve has resulted in an overheated economy and thus made it prone to a market downturn.

[18] As defined by the *Federal Reserve of St. Louis*.
[19] The current 96 month bull market period is only surpassed by the 113 month period during the 1990s.

In order to further investigate whether the US economy is in fact overheated, we will now calculate the stock market capitalization to GDP, which famous investor Warren Buffet has pointed out is "probably the best single measure of where valuations stand at any given moment".

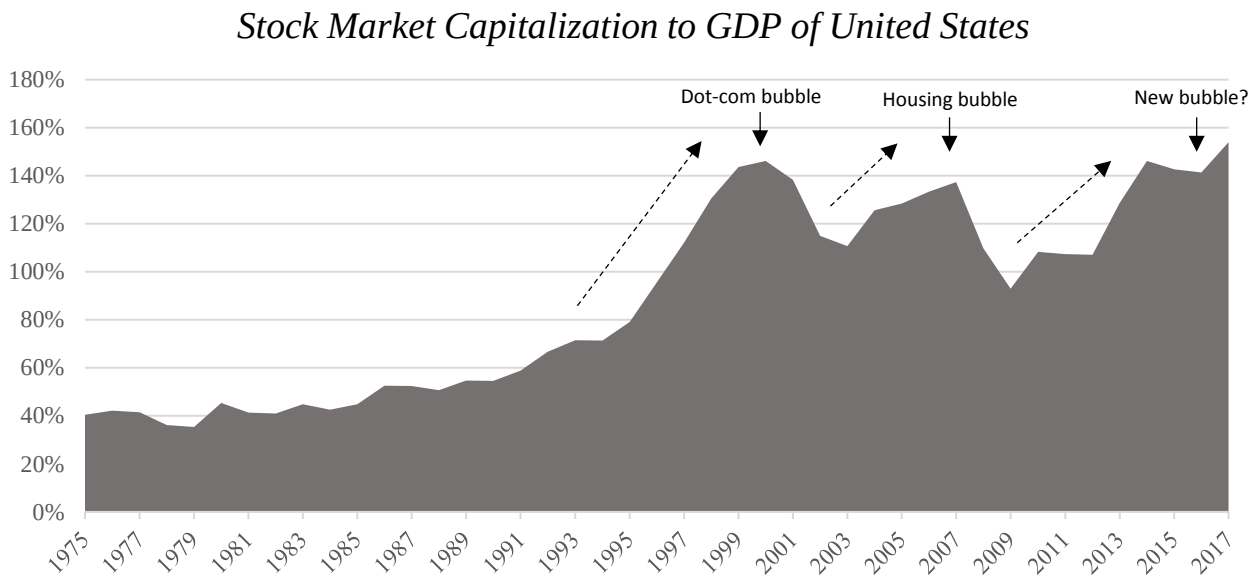

Figure 24: US stock market as percentage of Gross Domestic Product (1975 – 2017)

When investigating figure 24, it becomes evident that the current stock market capitalization is at a record high 154% to the total GDP. Considering how the consensus is that if the stock market is more than 115% of GDP the market is overvalued, the current market can be established as significantly overvalued.[20] This would imply that if one is to assume the ratio should eventually revert to the historical mean, the stock market should have an annual return of -2.2% for the next ten years. The lower interest rates facilities economic expansion for firms, increasing the stock market capitalization and economic output. Additionally, due to the increased economic expansion, it inevitably entails the reduction in the unemployment rate as factors of production must expand correspondingly to the new market equilibrium. As evident in the US labor market, the unemployment rate is standing at 3.6%, the lowest rate for the past 50 years.

We have now discovered how corporate debt is at an all-time high when comparing to GDP, and that this may have resulted in what can be described as an overheated economy. One important factor here is how the combination of record high corporate debt and the increase of interest rates may result in a US economy more prone to a market downturn. The reasoning is that when corporate debt increases, this may cause firms to be inherently more vulnerable to increased interest rates, thus resulting in a corporate sector more prone to financial distress. Although US Companies are holding a record $2.1 trillion in cash to service their debt, this

[20] If the stock market is below 50% of the GDP, it is too low. Between 75% and 90%, the market is about right. Above 115%, it is overvalued on a relative basis (Business Insider, 2017).

is primarily held by a handful of giants on top, which is further emphasized by how the top 1% control more than half of this cash pile. An example of this is how the cash-to-debt ratio of the speculative-grade companies, meaning more risky issuers, has reached a record low of 12% (S&P Global, 2017). This is well below the 14% leading up to the Housing Crisis and displays how for every $1 these companies have in cash – they have $8 in debt. Another alarming fact is how the debt-to-cash ratio is very high, while the debt-to-equity ratio is remarkably low. This insinuates that US corporations are not borrowing against cash and income, but rather against their equity, tightly resembling the lending activity of households in 2005 and 2006. As this excessive lending prior to the Housing Crisis resulted in a decrease in the quality of the loans issued, it is highly interesting to investigate to what extent similar tendencies are taking place for US corporations today. We therefore arrive at the ninth proposition of the framework;

Proposition 9: *Is there a visible reduction in the quality of loans issued in the US today?*

Another consequence of access to cheap capital is the growth of leveraged loans. This is when corporations with already considerable amounts of leverage, or a poor credit history, issues new debt. A recent trend among leveraged loans is the amount of new issues that are so-called *Covenant-lite*, meaning that they have generally fewer restrictions on the borrower and fewer protections for the lender. Covenants are traditionally built into loans in order to protect the lender, through financial maintenance tests that measure the borrower's ability to service the debt. Covenant-lite loans, on the other hand, are much more flexible with regards to the amount of collateral posted, income level, and payment terms of the borrower.

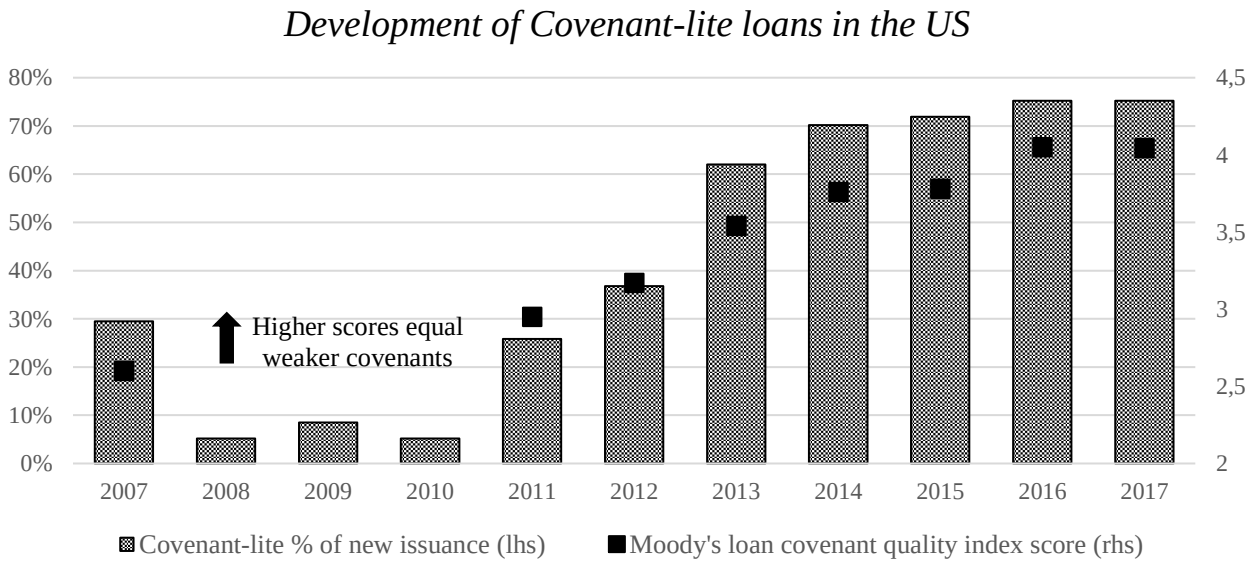

Figure 25: Development of new covenant-lite loans (2007 – 2017)

As visible in Figure 25, there is a clear increase in the share of newly issued loans which are considered covenant-lite. From less than 30% of new loans issued in 2011, more than 75% of the loans in 2017 were covenant-lite. Furthermore, the Moody's loan covenant quality index, which tracks the quality of covenants, as reached a level of more than 4, signaling decreased covenants in newly issued loans.[21] As it is thus established a clear increase in the share of covenant-lite loans, it is further necessary to investigate the potential consequences of this development.

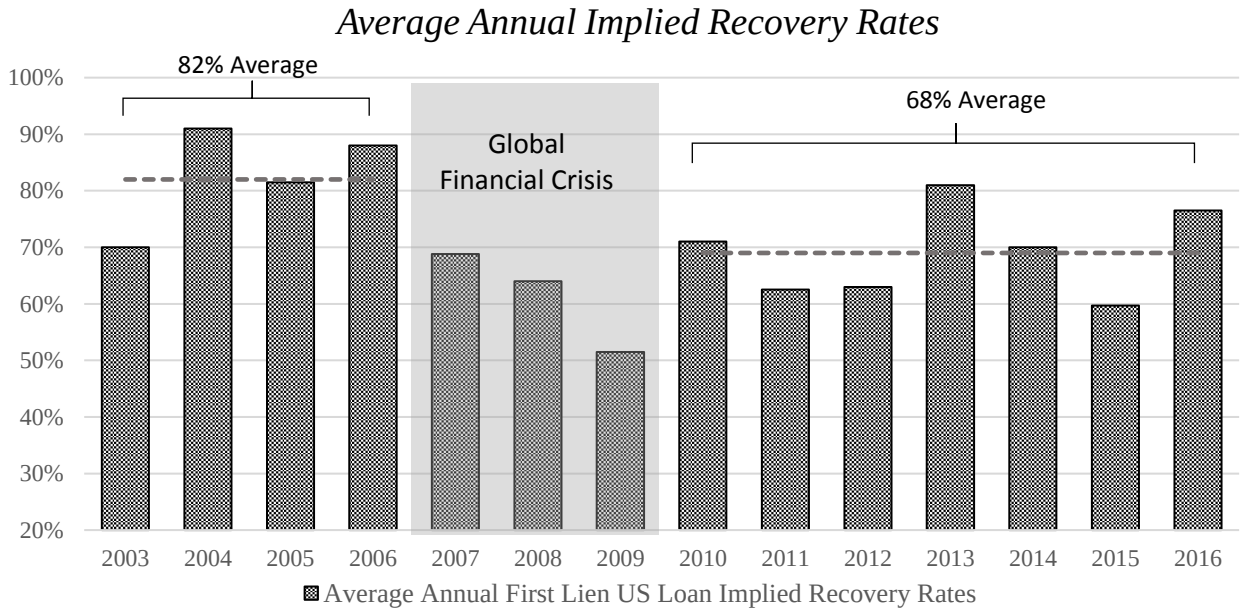

Figure 26: Implied recovery rates for First Lien loans (2003 – 2016)

In figure 26, the average implied recovery rates for First Lien US loans are illustrated by each year.[22] There is a clear trend in that following the financial crisis, the average implied recovery rate, based on loan prices one month after default, is significantly lower than during the pre-crisis era. This implies how the weakened covenant protection, following covenant-lite loans, may lead to potentially decreased recovery rates during the next downturn, and thus result in an aggravation of a potential new bubble. Considering how the US corporate debt is at an all-time high, this is established to be partially responsible for the overheated US equity market, as illustrated by the 154% market capitalization to GDP. Furthermore, the trend of excessive borrowing has caused the quality of new loans to decrease, manifested by the rise in covenant-lite loans. As it is established that the implied recovery rates for these loans are lower than those of strong covenants, this might indicate that the US monetary policy has indeed resulted in the economy being more prone to a market downturn.

[21] Moody's Loan Covenant Quality Index uses a five-point scale, in which 1.0 denotes the strongest covenant protections and 5.0, the weakest (Moody's Investors Service, 2018).
[22] The first lien is the first to be paid in the case of a default, and is generally considered to take on less risk than the second and third liens.

VIII: DISCUSSION

The objective of this thesis was to utilize the conceptualized framework for achieving a broad understanding of the current market situation and thus be able to present an educated opinion on the likelihood of a new bubble. Through the analysis and the subsequently presented results, the basis for answering the formalized problem statement in this thesis is found. As initially stated, numerous factors have been identified to affect bubble creation. Considering the problem statement, this thesis is grounded on the rationale of factors that we believe would have the most significant impact on the technology sector. Based on the analysis, we have obtained mixed results with regards to the relevance of each factor. Individually, the factors may not have a significant impact, however, in conjunction, they may prove to lay the foundation for the creation, persistence and eventual burst of a new bubble. This section will therefore first discuss our findings of each factor, and then debate the interplay between the factors, with an emphasis on how the factors, in combination, may imply a new bubble.

8.1 ASSET VALUATIONS & INVESTOR BEHAVIOR

Through the first pillar of the framework, the paper has investigated to what extent behavioral shortcomings are currently visible in the US economy. This has been done with the basis in three distinct factors, all identified to capture a distinct area of interest within the pillar. The factors investigated are *Neglecting of Financial Metrics, Intangible Asset Valuation* and *Investor Behavior*. Bearing in mind the four propositions in the first pillar of the framework, the objective of this section is thus to condense and discuss the findings presented in section 7.1 of the analysis.

8.1.1 Neglecting of Financial Metrics

Based on the investigation of financial ratios, concerning the creation of a potential new bubble, several valid inferences can be drawn. Firstly, as the P/E ratio for the overall market is found to trail significantly below Dot-com bubble levels, our initial results concerning the current economy does not imply that investors are neglecting financial metrics when valuing companies. Following these results, it would appear current investors have more rational assumptions regarding future growth, placing more emphasis on the existence of actual earnings, and subsequently, may be considered to exhibit more rational behavior than during the Dot-com era. However, in contradiction to the above findings, the CAPE ratio is found to be historically high, which could point towards investors placing less emphasis on the long-term ability of firms to generate earnings. The reason for this discrepancy in findings derives from how the CAPE ratio takes both company-specific cyclical movements and market-wide trends into account and therefore provides a better reflection of the financial situation of a company (Campbell & Shiller, 1998). The analysis has therefore deemed the results of the CAPE ratio as more significant than the P/E, which is further reinforced by Siegel (2016).

We believe a possible explanation for the high CAPE, and subsequent apparent neglecting of financial fundamentals could be investor overconfidence. This overconfidence among investors would, in this case, be believing that unprofitable companies in their portfolio, despite exhibiting poor performance over a long period, will one day turn into Microsofts. Another explanation is the presence of Disposition Effect, which according to Shefrin & Statman (1985), and building on the hypothesis of prospect theory, is how investors display a disposition to sell winners and ride losers when standard theory would suggest otherwise. This refusal of selling losers may help sustain the stock price of poorly performing companies, thus resulting in the elevated financial ratios visible in our data. With the basis in the above findings, it appears that the presence of cognitive biases in the marketplace has resulted in investors neglecting financial matrics and exhibiting unrealistic assumptions regarding growth. **We therefore recognize the first proposition of the framework**, and believe there in fact is a noteworthy divergence between financial metrics and market value visible in the overall US equity market today.

Further, our results show a close resemblance in terms of the development of P/S ratios between the overall US economy and the technology sector. This resemblance reveals how there is little difference in how investors price the ability of companies to generate sales across the two indices. Investors are willing to pay approximately the same amount for each dollar in company sales, regardless of industry. Our results show a close resemblance in terms of the P/S ratios, but show a clear divergence in P/E ratio, with the technology sector significantly higher. This divergence could be evidence of how investors currently value technology stocks, as opposed to the rest of the economy as if their sales have already been converted into earnings. This appraisal takes place, although little evidence of such conversion is found. One example is how the ridesharing company Uber recently received a $75bn valuation, which, considering their $11.3bn in revenue in 2018, appeared reasonable. However, considering they have not been able to convert this into earnings, and actually reported a net loss of $1.8bn the same year, the valuation seems as if it is done with the basis in the revenues alone, ignoring the lack of earnings, and thus appearing much more irrational. Uber, with their significant losses, is thus entering the public market with a valuation greater than long-term profitable companies Ford, Avis and Viacom combined.[23] Considering how Uber is far from the only technology company with these characteristics, with LYFT, Netflix and Snap Inc., all sharing similar narratives, the neglecting of financial metrics do appear to be especially present within the technology sector. **We therefore recognize the second proposition of the framework** and believe that, just as during the Dot-com bubble, cognitive shortcomings, as evident by the neglecting of fundamental metrics, is particularly present within the technology sector.

[23] Uber went public May 10th, falling more than 7.6% during its first day of trading, resulting in a loss of more than $600 million and representing the most substantial first-day dollar loss ever recorded for a US IPO.

8.1.2 Intangible Asset Valuation

Based on the steady decrease in the tangible asset concentration discovered in the analysis, it was necessary to question whether these intangible assets are one day converted to negotiable forms of value. Although several academics, including Bouteiller (2000), Smith & Parr (2000) and Lev (2001) have stated how the industrial and economic exploitations of these intangible assets may give claims to future benefits, our findings on the long-term performance of IPOs does not support this notion. Considering how only seven of the 20 tech firms going public in 2010 are currently reporting profitability, this could be considered evidence that companies are not fully able to convert these intangible assets to meaningful economic value. Thus, our findings may be considered in conflict with Campbell & Shiller (1998), and their argument that intangible assets enable the creation of a future effective high-tech organization, where these assets could be transformed to value creation output at a later stage. It is suggested that one consequence may be how companies that otherwise would fail due to non-viable business-models are allowed by the market to continue as investors keep valuing the potential of the intangible assets, regardless of current performance. This seemingly irrational fascination for technology companies, despite the continued low performance, mimic how Cooper et al. (2005) found that firms adding a "Dot.com" to their name in 1998 and 1999 experienced a substantial increase in stock value. Just as today, the operations and performance of a company are seemingly irrelevant, as long as it is labeled as Tech and is headquartered in Silicon Valley.

Furthermore, this disregard for the lack ability of companies to convert intangible assets to actual earnings may result in companies having extended maneuverability. Thus, managers may not experience the same scrutiny from shareholders concerning the profitability associated with each investment and become more careless in their investment decision. In addition to this carelessness, many of the intangible assets held by technology companies may actually not be possible to convert to actual value. A real-life example of such a company is the Swedish music platform, Spotify. Although the company has a high degree of intangible assets, including a large user-base and high brand recognition, it is not able to convert this into profits. On the contrary, the company has reported substantial losses for consecutive years. The reason for this could be how their business-model and user-base does not provide any network effects, and subsequent no extra value for the customer. The fact that one user is active on the music platform does not immediately result in an increased experience for another user. Arguably, the recent implementation of *Social playlists* and *Friends* on their platform may be evidence that shareholders are finally urging for profitability. However, this has been done with little success, and all they are left with is a poor business plan, inflated valuation, and no accurate projections of long-term profitability. Thus, it appears the only rational justification for investing in these companies is if an investor thinks he can resell it in the future to a less informed trader or a "greater fool", preferably at a higher price (Flood & Hodrick, 1990; Kindleberger & Aliber, 2011).

It is, however, possible to argue that many technology companies fully deserve their considerable valuations. As asserted by Mowery & Rosenberg (1979), it is thinkable that the market is yet to fully accept new inventions beyond their present competencies. This would imply that tech firms, such Spotify, find themselves in an environment where the market is still unable to fully utilize the technological potentials of their services, helping to explain why they are not able to convert their intangible assets into actual earnings. Further, it could help justify the previously discussed neglecting of financial metrics, highlighting how, when the market has learned to accept this new technology, the unrealistic assumptions regarding growth rates and future earnings, could actually become a reality, justifying the stellar valuations seen today. However, as the value of these intangible assets derives from their alignment with the strategic priorities of companies, which arguably is not present, it raises the question of whether this notion could be established as accurate. Furthermore, as the results of our analysis regarding EPS, showing that only seven of 20 technology companies going public in 2010 have been able to successfully convert their intangible assets to actual profits, the notion put forth by Mowery & Rosenberg (1979) is considered inaccurate in the contemporary financial landscape. Considering how technology companies are increasingly comprised of intangible assets, and, with our analysis highlighting how companies are not able to successfully convert these to actual value, it appears the subjective element of intangible asset valuation has resulted in the influence of cognitive biases. These shortcomings have again led to the decrease in the accurateness of the valuation of tech firms and it is therefore established that the investor fascination for companies primarily comprised on intangible assets is in fact unjustifiable. **We therefore recognize the third proposition of the framework.**

8.1.3 Investor Behavior

The primary theory explaining the neglecting of financial metrics in the tech sector is that it comes as a result of irrational investors. The analysis has applied an alternative method for identifying these irrational investors in the marketplace. By attempting to identify rational investors, which at the expense of less sophisticated traders, achieved arbitrage, the presence of irrationality would thus be confirmed. This could be explained by how, as hedge fund managers are considered among the most sophisticated investors, they may exhibit less irrational behavior, and therefore possess more accurate information regarding the future.

Based on our findings, it could be established that the investigated hedge funds have, on average, only gradually increased their exposure towards the tech sector for the previous four semi-annual periods. Our results are thus partially in line with the notion put forth by DeLong et al. (1990a), suggesting how speculators may initiate and contribute to price movements, based on the expectation that positive-feedback traders will later purchase the already overpriced securities at even higher prices. Subsequently, our findings moderately support Abreu & Brunnermeier (2002, 2003) on how arbitrageurs knowing that the market is overvalued, maximize their profits by riding the bubble. It was further hypothesized that investors, with the expectation of a market correction, would significantly decrease their tech exposure prior to worsened market conditions.

This notion stems from the argumentation of Brunnermeier & Nagel (2004), stating that hedge funds drastically reduced their positions in tech stocks prior to the price collapse of the Dot-com bubble, suggesting that managers knew that the prices of these stocks would soon deflate. Based on our findings, which include how only half of the hedge funds have decreased their tech exposure within the last six months, it could be questioned whether the investigated hedge fund managers, in fact, have identified irrational investors in the marketplace, and know that the prices of tech stocks will deflate within a short period of time. Although the analysis found the average technology exposure to decrease, no systematic trend was observed in our data. A possible explanation of why the analysis only found that five out of ten hedge funds have significantly reduced their holdings, may be the existence of the "synchronization problem", as defined by Abreu & Brunnermeier (2002). Here, it is argued that, although rational investors in the market have mutual knowledge that the prices are too high, this does not imply that arbitrageurs will jointly engage in eradicating the mispricing, primarily due to the difficult task of synchronizing such activates (Allen et al. 1993).

Conversely, another explanation for the five funds found to decrease their tech exposure may be the presence of herd behavior. As described by Scharfstein & Stein (1990), managers tend to simply mimic the investment decisions of other managers, ignoring substantive private information. As all hedge fund managers have access to the same 13F filings utilized in the analysis, the decrease in tech investments may be the result of funds imitating each other. This would also coincide with the argument of Dass et al. (2008) on how managers incline towards herding behavior as they are more concerned with the risk of being rated the worst fund, as opposed to being the top earner. Although this conclusion would disregard the notion that rational hedge fund managers are exploiting irrational investors, it would imply that it is the hedge fund managers who are exhibiting irrational behavior and thus support the notion that behavioral shortcoming are evident in the current marketplace.

Considering how there is no way of identifying whether the movements observed in the analysis are the results of rational investors riding the bubble, or a result of different cognitive biases, combined with the fact that no systematic trends were observed, no conclusive inferences can be drawn from this section of the analysis. Thus, **we do not acknowledge the fourth proposition of the framework**, concerning how rational investors exploited the mispricing in the technology sector, and realizing we are at the verge of a burst have now reduced their investments.

8.1.4 Summary of Pillar I

With the basis in the first pillar of the framework, the analysis has investigated the neglecting of financial metrics, intangible asset valuation and investor behavior. This investigation has been done applying an overall behavioral lens, attempting to identify whether distinctive behavioral shortcomings are currently defining US asset valuations. The analysis identified a noteworthy divergence between financial metrics and market value, and this may be the result of multiple aspects. Firstly, the overly optimistic assumptions regarding future growth and subsequent irrational overconfidence exhibited by investors today will result in inflated asset prices and elevated financial ratios. Considering how this divergence was found especially present in the technology sector, it coincides with our findings that this sector has a high intangible asset composition. Following how we found little evidence of companies being able to convert these intangible assets to actual value, this further strengthens the notion that the lofty valuations visible today are due to irrational investors placing too much emphasis on unrealistic assumptions. Additionally, there is found an irrational fascination for technology companies, who despite exhibiting continued poor performance experience significant increase in stock value. These developments, in combination with the subsequent elevated financial ratios, are considered to resemble those of the Dot-com era closely. The developments and subsequent investors irrationality was not conclusively confirmed by hedge funds exploiting the resulting mispricing, but several trends implying rational investors obtaining profits from the overpriced technology sector are found. When investigating the three factors in the first pillar of the framework in conjunction, it therefore becomes clear that the current US asset valuations, already considered highly overvalued, may very well be the result of the behavioral shortcomings found in the analysis.

8.2 CAPITAL MARKET MECHANISMS

Through the second pillar of the framework, the paper has investigated whether or not the capital market temporarily has failed in its role as an efficient allocator of equity capital. Further it has been examined to what extent the *growth at all costs* mentality could be said to define the current capital market. Bearing in mind the two propositions in the second pillar of the framework, the objective of this section is to summarize and discuss the findings presented in section 7.2 of the analysis.

8.2.1 Initial Public Offering mania

In the first part of the analysis, it was found that the first-day returns of the IPOs in 2018 averaged 18.6%. Considering how Ritter (2004) found the levels during the Dot-com bubble to be above 70% in 1999, the current levels display little resemblance to the Dot-com era. One explanation for the decrease in first-day returns may be the overall increase in the quality of the companies choosing to go public. This explanation has a basis in how Peristiani & Hong (2004) observed an inverted relationship between the first-day return and overall quality of the firm. Furthermore, lower first-day returns are generally associated with less valuation-

uncertainty and risk. Thus our findings would suggest that the current firms going public are less risky than the ones during the Dot-com era. Based on this observation alone, it would not appear that there is a general disregard for financial performance present in the current IPO environment.

However, according to signaling model theory, firms of high quality would actually engage in underpricing, thus signaling their superior quality to the market. When openly underpricing their IPO, the company signals that it is not in desperate need of cash, and is therefore considered a sounder long-term investment. As there is less evidence of this active underpricing, it may imply how the companies going public today are urgently in need of capital, and thus of lesser quality. This could be explained by the previously discussed high intangible asset concentration, combined with a non-viable business plan and high expenditures related to marketing, resulting in companies burning through cash at an unsustainable rate. Considering this would imply a reduction in firm performance, it would support the notion that there is a disregard for financial performance visible in the capital market.

Further, we find that the median LTM sales for technology companies going public have recently experienced a significant reduction. Considering how the current median LTM sales are less than one-third of what it was only six years ago, this may support the findings regarding first-day returns that suggest the quality of the firms going public has actually decreased. It is thus possible to argue that the primary focus of technology firms today is the growth of intangible assets, such as increasing user-bases and brand recognition. Following how we have previously established that these intangible assets do not necessarily result in future profits, this could further strengthen the argument that the companies going public today are of deteriorating quality. Building on this apparent decrease in the quality of companies, our initial assumption is reinforced by our results showing that only 16% of technology companies going public in 2018 were profitable.

Following how Bhabra & Pettway (2003), found a positive relationship between pre-IPO profitability, and post IPO returns, our results thus indicate a reduction in quality in regards to future performance for the companies going public today. This is further reinforced by Jain & Kini (1999), who found that pre-IPO operating performance is higher for surviving firms than for non-survivors. Considering how we found little ability among unprofitable companies to convert their intangible assets to actual earnings, the findings of both Jain & Kini (1999) and Bhabra & Pettway (2003), emphasize the potential hazards of the results discovered in this analysis.

Although no clear indication of disregard for profitability and financial performance was evident when investigating first-day returns or frequency of IPOs, several resemblances with the Dot-com era were indeed identified. First, the evident reduction in LTM sales highlights how the primary focus of technology firms

today is once again the growth of intangible assets, which, considering our findings on their apparent lack of ability to convert these, signals a clear decrease in the quality of firms going public today. This further emphasizes the existence of a *growth at all costs* mentality among the companies going public. Second, the significant reduction in profitability among IPOs emphasize the disregard for profitability found among investors. Finally, the reduced quality of companies going public, combined with the continued high valuations received, is considered clear evidence that the same disregard for profitability and financial performance, which was visible during the Dot-com bubble, is again present in the contemporary IPO-environment. **We therefore acknowledge the fifth proposition of the framework.**

8.2.2 Aggressive Venture Capital

Following our findings on the capital market, and more specifically the IPO activity, it was further investigated to what extent this may be partially a result of a harmful Venture Capital industry. Here it was found that the VC industry has experienced a substantial increase, growing more than 400% since 2009. Following the discoveries of Ueda (2004), namely that VC investments experienced a tremendous growth before the Dot-com bubble, it is possible to draw parallels between the current VC activity, and that of the period leading up to the Dot-com bubble. Building on this comparison, our evidence of how the VC industry heavily favors the tech sector, closely resembles that of the Dot-com era where Janszen (2008) found that VC funds were a primary source of funding for the tech sector.

As discussed in the previous section, the median age of tech IPOs was found to be much higher than that of the Dot-com era. Bearing in mind how VC funds are found to back the majority of technology companies going public, these results are in partial contradiction with the findings of Sohl & Rosenberg (2003), stating that the timeline from start-up to exit for VC backed firms often is abbreviated, building «designer» companies fashioned for a fast exit, rather than the creation of a solid company. Our findings on increased median age further differ from the findings of Gompers & Lerner (2004), who argue that VC funds may have incentives to push the IPO process, even if the firm is not ready, to ensure cash for new investments. Hence, it could be argued that the contemporary VC funds are to an increased extent more concerned with the screening and assessment of the companies they invest in and are therefore not contributing to the dangerous developments in the technology sector.

However, a potential danger with the increased median age is how the longer these tech companies receive backing from VC funds, the longer they can sustain their non-profitable operations. We argue that the longer this process goes on, this *growth at all costs* mentality becomes an increased part of the company culture. Thus, it may be significantly more challenging to adapt to life as a public company, and the increased scrutiny of stakeholders which follow. This may very well be an explanation to how we found that many technology

companies have difficulties becoming profitable, even numerous years after their IPO, and a clear indication that VC funds are harmful to the US economy.

Through the analysis, it was additionally revealed that VC funds are currently backing a record-high number of tech IPOs. Schwienbacher (2008) finds that companies with a high concentration of asset intangibility, a common characteristic for the tech sector, limit the willingness and efficiency of VC funds to exit through trade sales, due to the inherent difficulty of valuing and transferring these intangible assets. This could help explain why an increase in VC-backed IPOs is evident in our results. One interpretation is how VC funds have realized the difficulty of converting intangible assets to actual earnings, and thus an IPO represents the most likely mean of receiving a return on their investment. Furthermore, in the case of a new bubble, it is likely that VC funds will, similar to during the Dot-com bubble, be induced by falling stock prices, to sell their stakes in invested companies. When they are not able to successfully do so, the VC funds may shut down companies, causing fear and job loss, thus aggravating the crisis. Finally, following our findings, the warnings put forth by Kennedy & Zysman (2019), namely that the VC industry may lack discipline, attempting to disrupt businesses and gain market shares without any clear path to profitability, are considered highly appropriate. **We therefore acknowledge the sixth proposition of the framework** and believe the VC activity seen today is contributing to the dangerous developments within the technology sector, and can thus be considered harmful to the US Economy.

8.2.3 Summary of Pillar II

With the basis in the second pillar in the framework, the analysis has investigated both the IPO activity and the Venture Capital industry. This has been done with the objective of identifying whether there is a g*rowth at all costs* mentality evident in the current capital market. Here, the analysis has been able to draw multiple valid inferences based on our findings. Firstly, the sharp decrease in first-day returns is considered evidence that many technology companies going public are in urgent need of capital to fuel their cash burn rate. We explain this need for fresh capital by the increased influence of VC funds and the disregard for profitability they bring to many technology startups. This is further emphasized by the dramatic decrease in LTM sales found for tech IPOs. Bearing in mind the focus on growth employed by the VC funds, it is surprising to discover that this has not manifested itself as increased sales for the companies going public. Recalling the increase in intangible asset, it becomes clear that tech companies focus primarily on growth through increased intangible assets instead of revenues and profits, explaining the reduction in sales. Following the continued lofty valuations, exemplified by Ubers recent $75bn IPO valuation, combined with only 16% of companies going public being profitable, it is therefore established that similar to the Dot-com bubble there is an apparent disregard for profitability and financial performance among IPOs. Furthermore, this development is contributed by the VC capital, which allows startups to focus on growing their intangible assets, with total disregard to financial performance. Following these findings, it becomes clear that the US capital market is once again defined by a dangerous *growth at all costs* mentality and that it has temporarily failed as an efficient allocator of capital.

8.3 MONETARY POLICY & CORPORATE LENDING

Through the third and final pillar of the framework, the monetary markets and how it may play a part in a potential new bubble have been investigated. The analysis has assessed the two final factors identified in the framework, namely Monetary Policy and Corporate Lending, with a special emphasis on the three prepositions put forward. The objective of this section is therefore to condense and discuss the findings presented in section 7.3 of the analysis.

8.3.1 Monetary Policy

Following how we found an apparent relationship between the interest rates and recessions, our findings coincide with the arguments put forth by Stock & Watson (1989) on how interest rates, and the movements in money, can be used to predict movements in output or income. As the second objective of the analysis was to investigate to what extent the US interest rates revealed negative investor sentiment, we analyzed the current yield curves. Here, it was revealed that the yield spread was close to non-existent, and in fact, had turned negative in recent months. Following the rationale put forth by Dueker (1997), this could imply a recession is close, mainly due to how long-term interest rates dipping below prevailing short-term interest rates, has preceded major recessions of the past. This makes intuitive sense, as if an investor is willing to accept a lower return for a longer maturity, this indicates that he considers the opportunity cost of capital to be reduced, thus displaying negative expectations towards the future. When inspecting different yield curves, it is established that the current curve closely resembles that of the periods leading up to the two previous recessions. Following the negative investor sentiment revealed in the yield curve, a natural question would be why investors keep attributing unrealistic growth rates for technology companies, thus justifying the stellar valuations seen today. It appears somewhat counter-intuitive that the same investors, who expect reduced growth in the overall economy, somehow have entirely different beliefs regarding the growth of technology companies.

Regarding reduced frequency of IPOs, this may be explained by how the market is cautious regarding a new recession, and that we are currently experiencing a period of a "cold market" as defined by Ibbotson & Jaffe (1975). On the other hand, the fear of increased interest rates, and the possible recession it may induce could be the reason for why many technology companies filing for IPOs. It is possible that these companies, as they know the market is on a downward slope, may be desperate to go public before a recession hits. In order to further investigate the investor sentiment contained in the yield spreads, we have utilized the model conceptualized by Estrella & Trubin (2006). Our results display a moderate probability for a new recession, albeit far below that during the Dot-com era. The results are reinforced by Plosser & Rouwenhorst (1994), who using various maturities of long-term bonds and the three-month Treasury bill rates for a variety of countries, concluding that the term spread has significant in-sample predictive power for future cumulative changes in industrial production.

Despite the term structure being found to reveal investor sentiment implying worsened market outsights, our results are not as negative as the corresponding term structure of the Dot-com era. Further, the probability of a recession, as calculated by the model of Estrella & Trubin (2006), results in a value barely half of that during the Dot-com bubble. Furthermore, although the yield spread has been a useful leading indicator of economic activity in the past, Dotsey (1998) highlights how recent periods were not nearly as informative as it has previously been. Therefore, although our findings suggest there is negative investor sentiment present, they are not considered severe enough to be suggestive of a new bubble. **We therefore do not acknowledge the seventh proposition of the framework**, considering how the US interest rates are revealing investor sentiment suggesting a new bubble.

8.3.2 Corporate Lending

Although there are highlighted several positive consequences of low interest rates, the analysis has attempted to establish some of the potential apprehensions with the dovish monetary policy currently exhibited by the Federal Reserve. An initial concern has been the accessibility to cheap capital, allowing companies to issue substantial amounts of debt. This is confirmed in the analysis, highlighted by the record high corporate debt issued in the US today, and our initial concerns are further amplified by Bernanke & Gertler (2000) as they argue how high leverage, while possibly a positive in good times, might become a vicious force in bad times. This is due to how, as companies borrow more, although they can increase their activity level, they become inherently more exposed to increases in interest rates and the subsequent risk associated with higher leverage. Furthermore, the cheap access to capital may play a part in the emergence of unprofitable IPOs, as these firms can finance their loss-making operations with cheap debt. As the lower cost of debt effectively minimizes the overall cost of capital for firms, it may result in managers being more careless with investments, which in turn may result in an overall reduction of the quality of projects undertaken (Jensen, 1986). Alternatively, following Grossman & Hart (1982), high leverage can prompt management to align their interest with shareholders in a way not possible by traditional incentivized remuneration and compensation structures. However, the dangers of debt are considered to outweigh the benefits, with Lowenstein (1985) expressing concerns regarding the effects of severe financial distress, and thus the ability of highly leveraged firms to be viable in periods of negative economic developments.

Another aspect of issuing excessive amounts of debt is the risk of firms over-investing, eventually resulting in an overheated economy. In the analysis, it was found that the current stock market capitalization is 154% of the US GDP, significantly higher than that of the Late 80s boom, Dot-com bubble and Housing Crisis. This may be interpreted as evidence that the cheap capital following the dovish monetary policy has resulted in the stock market becoming overheated, highlighting the potential ramification of too much capital in the economy. Supporting this notion of an overheated economy, the current US employment rate is 3.9%, which, according to Callahan & Garrison (2003) should be considered unsustainable. They assert how both theory and history

argue that an unemployment rate below five percent should be considered a clear symptom of an overheated economy.

Although US companies are holding a record amount of cash to service this increased debt, this is established to be primarily held by a few giants on top. Furthermore, it appears that companies are to an increased extent borrowing against their equity value, rather than their cash and income, evident by an increased debt-to-cash ratio. As the effect of elevated interest rates will increase the amount of cash necessary to service said debt, it is likely that many of these companies are in danger of being unable to successfully oblige to their current creditor commitments given a higher cost of debt. Considering the unparalleled levels of corporate debt seen today, it is fair to assume that the effect of increased interest rates will therefore be of a correspondingly greater magnitude. We have therefore established the US corporate debt to be at an all-time high, with a particular emphasis on the reduced ability of highly leveraged firms to be viable in periods of negative economic developments. Further, it is recognized that the dovish monetary policy exhibited by the Fed has resulted in companies over-borrowing, which in turn has overheated the economy. Considering the potential consequences of companies not being able to service their debt, the overall increase in corporate leverage is considered highly troublesome, and **we therefore acknowledge the eight proposition of the framework**, concerning how the access to cheap capital has resulted in US corporations issuing dangerous levels of debt.

Moreover, it is apparent in our data that there is an emergence of Covenant-lite loans among new loans issued today. As highlighted in the analysis, these loans offer less protection for the borrower, resulting in reduced implied recovery rates given default. One reason for the emergence of these covenant-lite loans may be the cheap capital available in the monetary markets, resulting in corporations issuing more debt. This is evident by how the cash-to-debt ratio of speculative-grade companies has reached a record low of 12%. This is lower than during the period leading up to the Housing Crisis and displays how for every 1$ these companies have in cash; they have $8 in debt. As having a higher degree of leverage is often considered to result in being more prone to financial distress, this will increase the share of leveraged loans, including those with weaker covenants. Further, it was found that this increase in covenant-lite loans have resulted in the decrease in the first lien implied recovery rates, emphasized by how these rates have been reduced from an average of 82% in the pre-Housing Crisis period to only 68% in the period between 2010 and 2016. This is believed to be clear evidence of the covenant-lite loans being of lesser quality compared to traditional loans. Furthermore, the redistribution of these covenant-lite loans, as CLOs, are established to closely mimic those of the subprime mortgages during the Housing Crisis, something that should raise additional concerns. **We therefore acknowledge the ninth proposition of the framework**, and support the notion that there is a visible reduction in the quality of loans issued in the US today.

8.3.4 Summary of Pillar III

With increased leverage, decreased creditworthiness and a possible reduced quality of loans, the increase in interest rates may have severe consequences for the US economy. As companies are more leveraged, they are more exposed to interest rates, and subsequently less able to service their debt in the case of increased rates. Further, the decreased quality of loans, through covenant-lite, will result in borrowers recovering less and thus experience more significant losses. As the risk of these leveraged loans is high, a new practice where loans are bundled together has emerged within recent years. By compiling multiple loans, the risk is assumed reduced through the effect of diversification. These loans are subsequently divided into tranches, and the ones considered the least risky are sold on to risk-averse investors. As the credit ratings of these compiled loans are much higher than that of the underlying assets, in this case, leveraged loans, and the effect of diversification is virtually non-existent during a severe market downturn, this might result in investors taking on far more risk than they are aware of. Following the resemblances to the tranching and redistribution of subprime loans, this may have resulted in many naturally risk-averse investors, such as mutual- and pension funds holding practically worthless loans, and a rapid increase in interest rates may, therefore, have a significant impact on the average American. It is therefore concluded that the developments within the US monetary policy have resulted in the economy becoming more prone to a market downturn and that these developments should raise serious concerns regarding the overall health of the US economy.

IX: LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Analyses with the purpose of financial bubble detection often impose very little structure of the bubble process (Gürkaynak, 2008). Many of these analyses or empirical tests procedures inherently position itself against an unspecified alternative, which is inferred as signals of a bubble. The task of evaluating whether or not the implied properties of such signals are reasonable is conceptually difficult (Wu, 1997). The selection of factors for the analysis was based on the conjunction of academic literature and the own subject evaluation of the authors. Consequently, it is acknowledged that the thesis is subject to a degree of sample bias and that the outcome of results is bound by an inevitable subjectivism rather than objectivism as stipulated in the research philosophy. The inclusion of additional factors such as governmental regulation, the flow of funds in the capital market and consumer spending would naturally provide a more comprehensive foundation with respect to the analysis, but it is believed that the factors selected represent a solid base in which valid inferences can be established.

With regards to the data selection, it is further stressed that due to the limited availability of data, the utilization of secondary third-party data, such as the IPO activity analysis where data from Ritter (2019) is applied, may limit the robustness and reliability of the analysis. As the data selection for some of the individual analytical computations is based on a limited number of observations, any errors made in the data sampling and processing poses a threat to the internal and external validity of the findings presented in the thesis. Due to the nature of each specific analysis conducted, no consistent terminology for the definition of what the thesis considers as the technology industry is provided. However, in the cases where the analysis is grounded in previous research, the same methodology is applied, making the inferences comparable and thus arguably increases the reliability of the results.

Moreover, concerning the analysis, it exists a variety of alternative methodologies the thesis could have applied to derive to other conclusions. For instance, through multivariate regression, the testing of statistically significant variables in the determination of contributions to bubble occurrences could possibly be established. Alternatively, a survey study of trading preferences for an investor could induce valid inferences regarding behavioral finance aspects, which was an underlying factor of the Dot-com bubble. However, as the intention of this thesis is not to postulate a positive response to whether it exists a new bubble, but rather stipulate an educated opinion, the selected approach of this thesis is considered as valid. Further, this thesis has employed a series of qualitative interpretative methods that, although permitting a more open and nuanced analysis, make research replication particularly tricky and time-consuming

Aside from these limitations, the results of this study and the conceptualized framework representing a structural methodology for bubble creations, lead to a wide range of future research question; “What is the precise relationship between the different pillars of the framework during other asset bubbles?”, “How can investors rationally assess wide discrepancies of information, as evident in bubbles? “. By extending the framework, scholars and researchers could investigate to what degree it has applicability in the understanding of broader economic cycles of growth and recessions of different historical periods. Further, as behavioral aspects are central to the creation of bubbles, further research could, by altering the framework, investigate to what extent trading strategies could exploit behavioral mispricing. As this thesis solely investigated the existence of a new bubble, a suggestion for further research would be to examine what set of events might lead to the burst of the bubble. Further, as the technology industry is more intertwined with the rest of the economy, compared to the Dot-com era, the consequences of a bubble burst are considered highly interesting. It is likely that a technology bubble will have far greater impact on the rest of the economy, thus the consequences of a burst is both of further interest and applicability for financial policymakers.

X: CONCLUSION

The thesis has investigated to what extent market factors, present in the Dot-com bubble, could be established in the contemporary technology sector and whether the development of these factors would suggest a potential new bubble. Through the development of a framework, three distinct pillars were acknowledged, each encompassing a central theme within bubble creation. With the basis in these pillars, seven factors, all deemed to be decisive in the creation of a new bubble, were identified. In order to investigate to what extent the identified factors are present today, the framework formalized nine propositions, each designed to encapsulate the empirical essence of the individual factors. The thesis has, with the basis in the nine propositions, conducted multiple analyses, with the objective of either acknowledging or disputing each proposition and thus being able to present an educated opinion on the likelihood of a new technology bubble.

With the basis in the first pillar of the framework, the analysis investigated the neglecting of financial metrics, intangible asset valuation and investor behavior. The analysis identified a noteworthy divergence between financial metrics and market value, and this was explained by the existence of several behavioral shortcomings. Overly optimistic assumptions regarding future growth, as a result of irrational investors, is found to inflate asset prices and elevate financial ratios. Further, there is found an irrational fascination for technology companies, despite these companies exhibiting continued poor performance. This fascination is established to be particularly evident for companies with a high intangible asset concentration, despite little evidence was found of companies successfully converting these assets to measurable forms of value, further highlighting the high degree of irrationality in the marketplace. This presence of irrational investor was not conclusively confirmed by the identification of hedge funds exploiting mispricing. However, when investigating the three factors in the first pillar of the framework, behavioral shortcomings are currently plainly visible in the US economy. This is established with the base in how investor behavior and cognitive biases are confirmed to heavily influence the choices made in the marketplace, and help explain the irrational market movements observed throughout the analysis of the first pillar.

The second pillar, regarding the capital market mechanisms, found several resemblances between the current IPO activity and that of the Dot-com era. Investigating multiple features, all considered good proxies for pre-IPO performance, it was established that there is an overall reduction in the quality of technology firms currently going public. This reduced quality, combined with continued lofty valuations, is considered evidence that the same disregard for profitability and performance, visible during the Dot-com bubble, is again present in the contemporary tech IPO environment. Regarding how VC funds were found to back the majority of technology companies going public, identifying the influence in which these funds exerted on the sector was deemed necessary. Seen as it was found that these funds accept higher risks, lack discipline and ignore short-

term profitability, the Venture Capital industry was regarded as a substantial contributor to the reduced quality of companies within the technology sector, and thus recognized as harmful to the US economy. Building on these inferences, there is established to be a distinct *growth at all costs* mentality again visible in the US capital market, and it could therefore be argued that the capital market has temporarily failed in its role as an efficient allocator of equity capital.

Following the recent developments in US monetary policy, when investigating the third pillar considering monetary policy and corporate lending, it was found that the interest rates are currently revealing negative investor sentiment regarding future outlooks. However, due to the limited probability of a recession, as estimated from the term structure, this negative sentiment was not deemed substantial in order to suggest a new bubble. However, when investigating corporate lending, the findings of record-high corporate debt, combined with the identification of a reduced ability of highly leveraged firms to be viable in periods of negative economic developments, results in the conclusion that the access to cheap capital has resulted in US companies issuing dangerous levels of debt. A clear reduction in the quality of loans issued in the US today is established with the basis in the emergence of covenant-lite loans and the evidence of reduced implied recovery rates. With the basis in above findings, it is concluded that the US monetary policy, through historically low interest rates, has induced companies to leverage up, and thus resulting in an economy more prone to a market downturn.

When summarizing the findings of the analysis, seven out of nine of the propositions put forth by the framework have been acknowledged. This constitutes the validation of five of the seven factors deemed decisive in the creation of a new bubble. The thesis has subsequently, with the basis in the three distinct pillars, achieved a broad understanding of the current market situation and is thus able to present an educated opinion on the likelihood of a new technology bubble. This opinion is of one that is deeply troubled by the current developments, believing that there is a significant likelihood that we are currently in a technology bubble, and therefore calls for the utmost caution when considering the potential consequences of a new financial crisis.

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XII: APPENDICES

Appendix 1: The model created by Estrella & Trubin (2006)

This model consists of a probability equation of the form

$$Recession_{t+12} = F(\alpha + \beta * spread_t)$$

Where F is the cumulative normal distribution function

$$F(z) = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} \exp\left(\frac{-x^2}{2}\right) dx$$

Appendix 2: Companies within the «technology» selection.

Announced Date	Issuer Ticker	Issuer Name	Offer Size (M)	Basic EPS
04/27/2018	GSKY US	GreenSky Inc	1005,1	0,43
02/23/2018	DBX US	Dropbox Inc	869,4	-1,35
03/28/2018	DOCU US	DocuSign Inc	723,695	-3,16
03/23/2018	PVTL US	Pivotal Software Inc	638,25	-0,64
03/26/2018	CDAY US	Ceridian HCM Holding Inc	531,3	-0,556
10/19/2018	XM US	Qualtrics International Inc	430,769	0,02
09/21/2018	SWI US	SolarWinds Corp	375	2,599
04/16/2018	PS US	Pluralsight Inc	357,075	-4,137
09/14/2018	PLAN US	Anaplan Inc	303,025	-2,46
09/05/2018	ESTC US	Elastic NV	289,8	-1,65
06/29/2018	TENB US	Tenable Holdings Inc	288,305	-1,38
08/23/2018	EB US	Eventbrite Inc	264,5	-1,71
06/01/2018	DOMO US	Domo Inc	222,18	-9,43
02/16/2018	ZS US	Zscaler Inc	220,8	-0,63
09/06/2018	UPWK US	Upwork Inc	215,223	-0,38
08/29/2018	SVMK US	SVMK Inc	207	-1,43
03/26/2018	SMAR US	Smartsheet Inc	200,67	-0,65
12/19/2017	AGS US	PlayAGS Inc	188,6	-0,61
03/16/2018	ZUO US	Zuora Inc	177,1	-0,85
04/09/2018	CBLK US	Carbon Black Inc	174,8	-5,82
02/02/2017	SNAP US	Snap Inc	3910	-0,97
10/20/2017	SAIL US	SailPoint Technologies Holding	276	0,04
11/22/2016	PSDO US	Presidio Inc	262,721	1,46
03/31/2017	CLDR US	Cloudera Inc	258,75	-1,21
02/17/2017	MULE US	MuleSoft Inc	254,15	-0,75
09/01/2017	ROKU US	Roku Inc	252,255	-0,08
09/21/2017	MDB US	MongoDB Inc	220,8	-1,9
03/13/2017	OKTA US	Okta Inc	215,05	-1,17
09/29/2017	ALTR US	Altair Engineering Inc	179,4	0,2
09/15/2017	CARG US	Cargurus Inc	172,96	0,6
12/28/2016	APPD US	AppDynamics Inc	168	-4,85

10/18/2017	SEND US	SendGrid Inc	150,88	-0,74
03/20/2017	1638762D US	ConvergeOne Holdings Inc	150	-0,11
02/24/2017	AYX US	Alteryx Inc	144,9	0,46
10/19/2017	SFIX US	Stitch Fix Inc	138	0,59
10/02/2017	FSCT US	ForeScout Technologies Inc	133,584	-1,83
03/13/2017	YEXT US	Yext Inc	132,825	-0,76
04/10/2017	REAL CN	Real Matters Inc	117,472	-0,05
12/09/2016	GSHTU US	Verra Mobility Corp	400	-0,67
12/22/2015	NTNX US	Nutanix Inc	273,608	-1,81
04/05/2016	COTV US	Cotiviti Holdings Inc	245,78	1,5
05/26/2016	TWLO US	Twilio Inc	172,5	-1,26
09/30/2016	BL US	Blackline Inc	168,13	-0,52
09/08/2016	COUP US	Coupa Software Inc	153,18	-0,96
12/17/2015	SCWX US	SecureWorks Corp	112	-0,48
08/26/2016	APTI US	Apptio Inc	110,4	-0,64
06/28/2016	TLND US	Talend SA	108,675	-1,35
08/19/2016	EVBG US	Everbridge Inc	103,5	-1,63
05/06/2016	NH US	NantHealth Inc	96,6	-1,76
06/02/2016	PI US	Impinj Inc	77,28	-1,65
01/04/2016	TRHC US	Tabula Rasa HealthCare Inc	59,34	-2,48
09/09/2016	MRAM US	Everspin Technologies Inc	40	-1,08
07/20/2015	FDC US	First Data Corp	2817,23	1,08
12/30/2014	INOV US	Inovalon Holdings Inc	684,85	-0,27
06/09/2014	GDDY US	GoDaddy Inc	520	0,5
08/12/2015	PSTG US	Pure Storage Inc	488,75	-0,77
10/16/2015	MTCH US	Match Group Inc	460	1,73
03/04/2015	ETSY US	Etsy Inc	306,667	0,64
03/05/2015	PGND US	Press Ganey Holdings Inc	255,875	-0,75
05/05/2015	EVH US	Evolent Health Inc	224,825	-0,68
03/24/2014	BOX US	Box Inc	201,25	-0,95
04/17/2015	RMNIU US	Rimini Street Inc	172,5	-1,28
06/11/2015	RPD US	Rapid7 Inc	118,68	-1,2
05/11/2015	MB US	MINDBODY Inc	100,1	-0,33
03/20/2015	APIC US	Apigee Corp	86,955	-1,39
05/18/2015	APPF US	Appfolio Inc	85,56	0,59
10/09/2015	INST US	Instructure Inc	80,96	-1,27
10/16/2015	MIME US	Mimecast Ltd	77,5	-0,22
02/19/2015	1627120D US	eASIC Corp	75	-0,12
02/03/2015	MXPT US	MaxPoint Interactive Inc	74,75	-2,71
05/19/2015	XTLY US	Xactly Corp	64,7448	-0,55
05/20/2015	MOGO CN	Mogo Finance Technology Inc	40,9668	-0,74
01/02/2014	IMS US	IMS Health Holdings Inc	1495	1,26
08/15/2014	W US	Wayfair Inc	366,85	-5,63
09/26/2014	XELAU US	Exela Technologies Inc	350	-1,09
02/28/2014	GRUB US	GrubHub Inc	221,426	0,88
02/10/2014	CSLT US	Castlight Health Inc	204,24	-0,29
03/03/2014	OPWR US	OPOWER Inc	133,285	-0,87
11/10/2014	NEWR US	New Relic Inc	132,25	-0,83
10/22/2013	VRNS US	Varonis Systems Inc	121,44	-0,98
02/04/2014	RUBI US	Rubicon Project Inc/The	116,799	-1,23
02/12/2014	QTWO US	Q2 Holdings Inc	116,025	-0,83
04/10/2014	ZEN US	Zendesk Inc	115	-1,24

11/10/2014	HDP US	Hortonworks Inc	115	-3,08
03/10/2014	PAYC US	Paycom Software Inc	114,626	2,37
02/10/2014	AMBR US	Amber Road Inc	110,504	-0,49
09/09/2013	SEMI US	Globalwafers Singapore Pte Ltd	107,64	-3,28
05/02/2014	KXS CN	Kinaxis Inc	105,372	0,56
10/17/2014	WK US	Workiva Inc	100,8	-1,15
02/24/2014	EVDY US	Everyday Health Inc	100,1	-0,36
04/03/2014	TRUE US	TrueCar Inc	80,4717	-0,28
10/20/2014	CNXR US	Connecture Inc	53,08	-0,96
02/01/2012	FB US	Facebook Inc	16006,9	7,65
08/30/2012	WDAY US	Workday Inc	732,55	-1,93
04/06/2012	PANW US	Palo Alto Networks Inc	299,46	-1,61
01/12/2012	SPLK US	Splunk Inc	263,925	-1,89
03/30/2012	NOW US	ServiceNow Inc	241,155	-0,15
09/02/2011	GWRE US	Guidewire Software Inc	132,308	-0,25
08/01/2011	MTSI US	MACOM Technology Solutions Hol	131,1	-2,16
08/26/2011	1624250D US	Bazaarvoice Inc	130,883	-0,19
11/17/2011	YELP US	Yelp Inc	123,337	0,66
08/17/2012	1537336D US	Trulia LLC	117,3	-2,03
08/01/2011	VCRA US	Vocera Communications Inc	107,64	-0,32
08/24/2011	ELOQ US	Eloqua Inc	105,8	-5,4
11/17/2010	KYAK US	KAYAK Software Corp	104,65	0,45
06/08/2012	QLYS US	Qualys Inc	104,536	1,47
07/15/2011	DWRE US	Demandware LLC	101,2	-1,02
12/14/2011	PFPT US	Proofpoint Inc	93,9835	-1,99
01/13/2012	ADNC US	Audience Inc	89,5934	-3,25
05/14/2012	SSTK US	Shutterstock Inc	87,975	1,57
06/10/2011	PRSS US	CafePress Inc	85,5	-0,61
06/10/2011	EPAM US	EPAM Systems Inc	82,8	4,48
07/01/2011	ZNGA US	Zynga Inc	1000	0,02
02/11/2011	FSL US	Freescale Semiconductor Ltd	883,206	0,84
06/02/2011	GRPN US	Groupon Inc	805	-0,02
01/27/2011	LNKD US	LinkedIn Corp	405,72	-1,29
04/15/2011	RATE US	Bankrate Inc	344,917	-0,38
03/09/2011	FIO US	Fusion-io LLC	268,755	-0,4
03/11/2011	AWAY US	HomeAway Inc	248,4	0,14
02/11/2011	P US	Pandora Media LLC	240,544	-2,29
02/14/2011	ACTV US	Lanyon Solutions Inc	189,75	-0,73
08/06/2010	LEAF US	Leaf Group Ltd	173,995	-0,94
08/24/2011	JIVE US	Jive Software Inc	161,275	-0,18
08/25/2011	9895420D US	Angie's List Inc	131,461	-0,13
06/17/2011	IMPV US	Imperva Inc	103,5	0,68
07/16/2010	EPOC US	Epocrates LLC	98,624	-0,14
07/29/2011	IMI US	Intermolecular Inc	96,5	-0,07
12/23/2010	MKTG US	Responsys Inc	91,0506	0,16
04/18/2011	ZG US	Zillow Group Inc	79,626	-0,61
01/14/2011	WIFI US	Boingo Wireless Inc	77,895	-0,03
05/12/2011	CARB US	Carbonite Inc	71,875	0,24
06/24/2010	SMT US	SMART Technologies Inc	660,11	-4,99
04/06/2010	ARX US	Aeroflex Holding Corp	267,154	-1,23
04/29/2010	RP US	RealPage Inc	155,595	0,4
11/19/2009	QNST US	QuinStreet Inc	150	0,34

04/12/2010	IL US	Intralinks Holdings Inc	143	-0,53
01/05/2010	DVOXQ US	DynaVox Inc	140,625	-0,84
04/01/2010	QLIK US	Qlik Technologies Inc	128,8	-0,4
11/06/2009	MXL US	MaxLinear Inc	103,75	-0,38
03/31/2010	AOSL US	Alpha & Omega Semiconductor Lt	91,5477	0,6
03/26/2010	ENV US	Envestnet Inc	72,45	0,13
03/15/2010	BSFT US	BroadSoft Inc	67,5	0,03
03/26/2010	SQI US	SciQuest Inc	65,55	0,07
10/30/2009	TNAV US	Telenav Inc	64,4	-2
12/22/2009	RLOC US	Reachlocal Inc	62,2921	-2,11
12/23/2008	FFNTQ US	FriendFinder Networks Inc	50	-1,57

Appendix 3: Companies within the «technology» selection.

Announced Date	Issuer Ticker	Issuer Name	Offer Size (M)	Basic EPS
12/21/2017	ADT US	ADT Inc	1470	-0,81
12/27/2017	GTES US	Gates Industrial Corp PLC	841,225	0,86
08/17/2018	ZEK US	Zekelman Industries Inc	793,25	1034,73
03/20/2018	EAF US	GrafTech International Ltd	571,463	2,87
01/12/2018	WHD US	Cactus Inc	502,55	1,6
02/10/2017	FTSI US	FTS International Inc	403,65	2,48
08/27/2018	LTHM US	Livent Corp	391	0,99
07/09/2018	SIC US	Select Interior Concepts Inc	352,201	-0,1
05/07/2018	USX US	US Xpress Enterprises Inc	332,23	0,84
06/01/2018	AFGL US	AFG Holdings Inc	327,6	31,4
06/12/2018	BE US	Bloom Energy Corp	310,5	-4,54
09/12/2018	ACI CN	AltaGas Canada Inc	211,742	1,16
05/02/2017	NINE US	Nine Energy Service Inc	185,15	-2,17
06/29/2018	BRY US	Berry Petroleum Corp	182,609	0,85
05/04/2018	IPLP CN	IPL Plastics Inc	149,241	0,04
04/06/2018	ROAD US	Construction Partners Inc	143,4	1,08
12/15/2017	PL CN	Pinnacle Renewable Energy Inc	134,373	0,03
03/30/2018	LASR US	nLight Inc	110,4	0,38
04/06/2018	PRT US	PermRock Royalty Trust	106,25	1,28
08/09/2017	QES US	Quintana Energy Services Inc	96,321	-0,5
04/24/2017	KML CN	Kinder Morgan Canada Ltd	1294,87	9,25
02/28/2017	GDI US	Gardner Denver Holdings Inc	949,9	1,34
03/28/2017	AM US	Antero Midstream Corp	875,375	0,33
09/11/2017	BPMP US	BP Midstream Partners LP	860,299	2,53
06/01/2016	JELD US	JELD-WEN Holding Inc	661,25	1,38
04/17/2017	TPGE/U US	Magnolia Oil & Gas Corp	650	1,66
12/22/2016	SNDR US	Schneider National Inc	612,75	1,52
12/14/2016	FRAC US	Keane Group Inc	584,706	0,54
10/03/2017	AQUA US	Evoqua Water Technologies Corp	575,001	0,05

06/09/2017	PQG US	PQ Group Holdings Inc	507,5	0,44
12/19/2016	JAG US	Jagged Peak Energy Inc	473,985	0,78
02/08/2017	PUMP US	ProPetro Holding Corp	402,5	2,08
09/24/2014	HESM US	Hess Midstream Partners LP	390,931	1,27
02/15/2017	MPACU US	US Well Services Inc	325	-1,37
03/07/2017	HCC US	Warrior Met Coal Inc	316,667	13,19
05/30/2017	HCAC/U US	NRC Group Holdings Corp	256,65	-1,95
02/14/2017	LBRT US	Liberty Oilfield Services Inc	248,894	1,84
03/29/2017	NESRU US	National Energy Services Reuni	229,217	0,5
03/09/2017	NCSM US	NCS Multistage Holdings Inc	185,725	-4,25
09/27/2017	STLC CN	Stelco Holdings Inc	185,116	2,2
05/31/2016	VVV US	Valvoline Inc	759	0,84
09/14/2016	XOG US	Extraction Oil & Gas Inc	728,333	0,56
04/11/2016	RWC AU	Reliance Worldwide Corp Ltd	698,985	0,09
01/27/2016	SRAQU US	Centennial Resource Developmen	500	0,76
11/10/2016	WRD US	WildHorse Resource Development	446,957	0,88
08/21/2015	ADSW US	Advanced Disposal Services Inc	398,475	0,11
07/08/2016	FRTA US	Forterra Inc	331,56	-0,38
10/22/2015	NBLX US	Noble Midstream Partners LP	323,438	3,96
03/04/2016	ATKR US	Atkore International Group Inc	192	2,59
09/19/2016	SND US	Smart Sand Inc	148,005	0,46
09/25/2015	WAAS US	AquaVenture Holdings Ltd	134,55	-0,78
09/02/2016	TUSK US	Mammoth Energy Services Inc	116,25	5,27
01/19/2016	ROSEU US	Rosehill Resources Inc	81,853	3,25
06/17/2016	TPIC US	TPI Composites Inc	79,0625	0,15
11/23/2016	ARMT US	Ameri Metro Inc	60	-0,05
11/14/2016	ICHR US	Ichor Holdings Ltd	52,9002	2,34
12/01/2016	1469169D US	Biocrude Technologies USA Inc	46,7626	-0,02
06/02/2016	1432646D US	Biocrude Technologies Inc	46,7514	-0,1
08/12/2016	PRHR US	PetroShare Corp	27,78	-0,62
09/09/2016	POLA US	Polar Power Inc	19,32	-0,08
09/18/2015	H CN	Hydro One Ltd	1391,24	-0,11
02/24/2015	TGE US	Tallgrass Energy LP	1384,03	1,27
09/29/2014	CPPL US	Columbia Pipeline Partners LP	1238,16	0,73
06/27/2014	UNVR US	Univar Inc	885,5	1,22
05/07/2015	FIT US	Fitbit Inc	841,225	-0,76
02/12/2015	EQGP US	EQGP Holdings LP	714,15	0,98
05/07/2015	GLBL US	TerraForm Global Inc	675	-0,47
12/18/2014	SUM US	Summit Materials Inc	459,9	0,3
03/19/2015	BSM US	Black Stone Minerals LP	427,5	1,35
03/10/2015	CAFD US	8Point3 Energy Partners LP	420	0,41

01/03/2014	FTAI US	Fortress Transportation & Infr	377,66	0,07
04/03/2015	MCRN US	Milacron Holdings Corp	294,026	0,6
11/17/2015	FUDA US	Fuda Group USA Corp	292,5	0,28
02/17/2015	PESC US	Philadelphia Energy Solutions	272,727	1,06
06/25/2015	RUN US	Sunrun Inc	250,6	0,24
06/26/2015	MPSX US	Multi Packaging Solutions Inte	246,675	0,03
09/30/2014	PTXP US	PennTex Midstream Partners LP	237,89	0,23
05/22/2015	GNRT US	Gener8 Maritime Inc	236,351	-2,03
06/01/2015	TMR CN	TMAC Resources Inc	123,576	-0,33
05/22/2015	ALRM US	Alarm.com Holdings Inc	112,7	0,45
04/14/2014	PSK CN	PrairieSky Royalty Ltd	1527,6	0,26
02/06/2014	9966611D US	Antero Midstream Partners LP	1150	2,37
08/20/2014	AXTA US	Axalta Coating Systems Ltd	1121,25	0,87
04/11/2014	PE US	Parsley Energy Inc	1063,75	1,36
06/18/2014	SHLX US	Shell Midstream Partners LP	1058	1,5
12/16/2013	RICE US	EQT RE Merger Sub Inc	1050	-1,84
04/04/2014	MRD US	Range Resources-Louisiana Inc	935,18	0,49
05/02/2014	MR US	Montage Resources Corp	818,1	0,94
09/04/2013	EPE US	EP Energy Corp	704	-4,05
11/06/2014	RMP US	Rice Midstream Partners LP	474,375	1,66
05/20/2014	NEP US	NextEra Energy Partners LP	467,188	3,05
11/12/2013	RSPP US	RSP Permian Inc	448,5	1,5
08/25/2014	CNXM US	CNX Midstream Partners LP	442,75	1,9
03/28/2014	DM US	Dominion Energy Midstream Part	422,625	1,44
08/22/2014	FMSA US	Fairmount Santrol Holdings Inc	400	0,24
04/03/2014	PBFX US	PBF Logistics LP	363,688	1,73
02/02/2012	FELP US	Foresight Energy LP	350	-0,42
08/26/2014	VSLR US	Vivint Solar Inc	329,6	-0,13
04/29/2014	WLKP US	Westlake Chemical Partners LP	310,5	1,53
05/08/2014	JPEP US	AMID Merger LP	275	-0,94
06/25/2012	LNCOQ US	LinnCo LLC	1269,74	-9,14
01/05/2012	SDR US	SandRidge Mississippian Trust	627,9	0,2
11/14/2011	PBF US	PBF Energy Inc	612,95	1,11
06/21/2011	PDH US	PetroLogistics LP	595	1,25
05/26/2011	RXN US	Rexnord Corp	490,262	0,51
01/12/2012	MRC US	MRC Global Inc	477,273	0,55
03/23/2012	BERY US	Berry Global Group Inc	470,589	3,77
07/02/2012	MPLX US	MPLX LP	437,69	2,29
09/01/2011	FET US	Forum Energy Technologies Inc	435,78	-3,44
11/14/2011	MPOYQ US	Midstates Petroleum Co Inc	358,8	1,91
02/13/2012	EQM US	EQM Midstream Partners LP	301,875	2,43
12/13/2011	NTI US	Northern Tier Energy LP	261,625	3,58
02/14/2012	FANG US	Diamondback Energy Inc	251,562	8,09

04/20/2012	SXEEQ US	Southcross Energy Partners LP	207	-8,34
07/18/2011	SLCA US	US Silica Holdings Inc	200	-2,63
08/12/2011	MTDR US	Matador Resources Co	178,596	2,41
12/29/2011	EDG US	Edgen Group Inc	165	-1,21
07/25/2011	PRLB US	Proto Labs Inc	79,12	2,84
07/11/2011	GSEHQ US	GSE Holding Inc	72,45	-4,2
07/18/2011	REGI US	Renewable Energy Group Inc	72	7,96
11/23/2010	KMI US	Kinder Morgan Inc/DE		0,66
03/31/2011	PDSA NO	Pacific Drilling SA		-83,81
01/14/2011	KOS US	Kosmos Energy Ltd		-0,23
05/25/2011	PER US	SandRidge Permian Trust		0,48
04/27/2011	GEI CN	Gibson Energy Inc		0,81
03/30/2011	CJESQ US	C&J Energy Services Ltd/Old		-8,48
12/20/2010	UAN US	CVR Partners LP		-0,44
01/04/2011	ANDX US	Andeavor Logistics LP		2,57
08/24/2011	CMLP US	Crestwood Midstream Partners L		0,22
03/31/2011	OILT US	Enterprise Terminaling Service		1,22
12/13/2010	LPRIQ US	Lone Pine Resources Inc		-3,23
04/11/2011	KIORQ US	KiOR Inc		-3,25
08/12/2011	RRMS US	Rose Rock Midstream LP		0,78
02/02/2011	THR US	Thermon Group Holdings Inc		0,37
02/11/2011	NGL US	NGL Energy Partners LP		-1,08
03/31/2011	AMID US	American Midstream Partners LP		-0,76
03/04/2011	IRIGU US	Integrated Drilling Equipment		-0,1
09/20/2011	AVO CN	Avigilon Corp		0,64
07/22/2010	KNX US	Knight-Swift Transportation Ho	872,85	2,37
06/14/2010	MEG CN	MEG Energy Corp	680,404	-0,3
03/04/2010	OAS US	Oasis Petroleum Inc	676,2	-0,11
02/16/2010	WPZ US	Williams Partners LP	513,188	0,9
09/09/2010	TRGP US	Targa Resources Corp	414,289	-0,53
04/16/2010	MCPIQ US	Molycorp Inc	412,93	-2,7
02/22/2010	NKA US	Niska Gas Storage Partners LLC	412,562	-2,67
11/03/2010	2099 HK	China Gold International Resou	309,315	-0,01
10/20/2009	GNRC US	Generac Holdings Inc	269,107	3,86
05/19/2008	0852651D US	Metals USA Holdings Corp	239,953	1,42
11/16/2010	TOU CN	Tourmaline Oil Corp	235,863	1,14
04/01/2010	ECT US	ECA Marcellus Trust I	181,949	0,31
07/24/2008	RRTS US	Roadrunner Transportation Syst	154,055	-107,5
05/14/2010	CZE CN	C&C Energia Ltd	111,414	0,52
06/19/2008	NORNQ US	Noranda Aluminum Holding Corp	92	-26,09
03/31/2010	AMRC US	Ameresco Inc	90,3971	0,83
10/16/2009	GEGSQ US	Global Geophysical Services In	90	-4,03
05/05/2010	RHNO US	Rhino Resource Partners LP	76,4773	-1,12

04/07/2010	SMGIU US	SMG Industries Inc	25,4238	-0,11
11/08/2010	ZEN CN	ZEN Graphene Solutions Ltd	6,7072	-0,01

Appendix 4: complete list of Bloomberg industry codes

Level 1		Level 2	
CODE	**Macro Sector**	**CODE**	**First Level Microsector**
10	Communications	1010	Media Content
		1011	Telecom
11	Consumer Discretionary	1110	Apparel & Textile Products
		1111	Automotive
		1112	Consumer Discretionary Srvcs
		1113	Distributors
		1114	Home & Office Products
		1115	Leisure Products
		1116	Recreation Facilities & Srvcs
		1117	Retail Discretionary
		1118	Travel, Lodging & Dining
12	Consumer Staples	1210	Consumer Products
		1211	Dist/Whsl - Consumer Staples
		1212	Retail Staples
13	Energy	1310	Oil, Gas & Coal
		1311	Renewable Energy
14	Financials	1410	Asset Management
		1411	Banking
		1412	Institutional Financial Srvc
		1413	Insurance
		1414	Real Estate Oper & Srvcs
		1415	REIT
		1416	Specialty Finance
15	Health Care	1510	Biotech & Pharma
		1511	Health Care Facilities/Srvcs
		1512	Medical Equipment/Devices
16	Industrials	1610	Aerospace & Defense
		1611	Electrical Equipment
		1612	Engineering & Const Srvcs
		1613	Industrial Distribution
		1614	Machinery
		1615	Manufactured Goods
		1616	Transportation & Logistics
		1617	Transportation Equipment
		1618	Waste&Envrnmt Srvc Equip&Fac
17	Materials	1710	Chemicals
		1711	Construction Materials
		1712	Containers & Packaging
		1713	Forest & Paper Products
		1714	Iron & Steel
		1715	Metals & Mining
18	Technology	1810	Design, Mfg & Distribution
		1811	Hardware
		1812	Semiconductors
		1813	Software
		1814	Technology Services
19	Utilities	1910	Utilities

Appendix 5: List of SIC (Standard Industrial Classification) codes defining "tecch"

Technology Stocks	
Sector	**SIC Code**
Computer Hardware	3571
	3572
	3585
	3577
	3578
Communications Equipment	3661
	3663
	3669
Electronics	3671
	3672
	3674
	3675
	3677
	3678
	3678
Navigation Equipment	3812
Measuring & Controlling Devices	3823
	3825
	3826
	3827
	3829
Medical Instruments	3841
	3845
telephone Equipments	4815
	4813
Communications Services	4899
Software	7371
	7372
	7374
	7375
	7378
	7379

Appendix 6: Invested volumes in VC by total volume and sector

US Venture Capital Activity by Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Deal Value ($B)	29,226081	36,007683	36,936682	27,166359	31,274153	44,747965	41,506554	47,543752	71,03159	82,974879	77,229807	82,952144	130,9272
# of Deals Closed	3344	4319	4727	4487	5409	6759	7882	9301	10573	10740	9200	9489	8948

US VC Activity by Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Deal Value ($Bn)	29,23	36,01	36,94	27,17	31,27	44,75	41,51	47,54	71,03	82,97	77,23	82,95	130,93
# of Deals Closed	3.344	4.319	4.727	4.487	5.409	6.759	7.882	9.301	10.573	10.740	9.200	9.489	8.948
Angel/Seed	458	787	918	1.226	1.723	2.600	3.532	4.639	5.472	5.716	4.585	4.521	3.760
Early VC	1.750	2.117	2.260	1.830	2.101	2.426	2.584	2.780	3.067	3.061	2.849	3.119	3.156
Later VC	1.136	1.415	1.549	1.431	1.585	1.733	1.766	1.882	2.034	1.963	1.766	1.849	2.032
Angel/Seed	13,7%	18,2%	19,4%	27,3%	31,9%	38,5%	44,8%	49,9%	51,8%	53,2%	49,8%	47,6%	42,0%
Early VC	52,3%	49,0%	47,8%	40,8%	38,8%	35,9%	32,8%	29,9%	29,0%	28,5%	31,0%	32,9%	35,3%
Later VC	34,0%	32,8%	32,8%	31,9%	29,3%	25,6%	22,4%	20,2%	19,2%	18,3%	19,2%	19,5%	22,7%

US VC Activity segmented by sector													
Sector	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Software ($Bn)	7,29	9,52	10,11	7,29	8,43	15,33	13,73	16,03	28,64	29,39	29,39	30,32	46,82
Media ($Bn)	0,79	1,39	1,32	0,76	0,84	1,64	1,25	2,15	1,87	2,57	1,48	1,85	1,37
Information technology Hardware ($Bn)	5,45	4,81	3,64	2,48	3,11	2,87	2,51	2,51	2,09	2,55	1,87	2,57	2,28
Total Technology ($Bn)	13,53	15,73	15,07	10,52	12,39	19,84	17,49	20,69	32,59	34,51	32,74	34,74	50,47
Other ($Bn)	15,69	20,28	21,87	16,65	18,89	24,91	24,02	26,86	38,44	48,47	44,49	48,21	80,46
Total ($Bn)	29,23	36,01	36,94	27,17	31,27	44,75	41,51	47,54	71,03	82,97	77,23	82,95	130,93
Invested in Technology (%)	46,3%	43,7%	40,8%	38,7%	39,6%	44,3%	42,1%	43,5%	45,9%	41,6%	42,4%	41,9%	38,5%