

Looming Tech Bubble? A New Approach to Predicting Speculative Bubbles

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Abstract

This paper predicts the likelihood of a growing asset bubble in the technology sector. I first calculate various metrics of the dot-com companies that went public between 1995 and 1999, and then run multivariable linear regressions for data from years 1997, 1998, and 1999 to see which metrics correlate most with the stock price decline at the burst of the dot-com bubble in 2000. I find the price-to-book and debt-to-equity ratios to be the only significant regressors, and then calculate those values for the current batch of technology companies (those that went public between 2009 and 2014). After qualitatively comparing the metrics between the dot-coms and today's companies, and considering the similarities and differences between the time periods, I conclude that another technology bubble is not likely to occur given current circumstances.

1 Introduction

The Great Recession of 2008 has led many to rethink the way we understand bubbles. Financial historians argue that economic crises are often preceded by bubbles in asset prices or rampant credit growth (Allen and Gale 2000), the most recent examples being the dot-com and housing bubble. Calls for more regulation and caution in the financial system have been met with reforms in the Dodd-Frank Act and approval of the Third Basel Accord, meant to set more prudent guidelines for capital requirements and control “excessive credit creation” (Phillips 2012). However, understanding what is “excessive” in the market is near impossible, given how challenging the pricing of assets can be. Though bubbles are explainable ex-post, predicting when a bubble begins and bursts has proven difficult and controversial for even the most established economists of our time.

There are some, led by Nobel laureate Eugene Fama, who contend that bubbles do not actually exist (Cassidy 2012). The efficient market hypothesis asserts that markets are informationally efficient, and that crashes in price are a result of other economic events, not valuation errors. Others—like Robert Shiller—disagree, and believe that bubbles are caused by changes in behavior, and may be identified before they pop (Davies 2014). Most current literature concedes that speculative bubbles can and do exist, and are consistent with arbitrage-free prices because there is no riskless trading strategy that can exploit a pricing bubble:

Consider the obvious trading strategy of shorting the stock and covering the short position when the bubble bursts. The problem with this strategy is that the stock price can become arbitrarily large, violating the admissibility condition embedded in the definition of a trading strategy. When this happens, the short position must be terminated, and massive losses are incurred. In this case, the bubble lasts longer than the trader’s ability to borrow against the marked-to-market losses incurred. (Jarrow 2012)

Though bubbles may be proven to exist in markets, they are still very difficult to predict with certainty in the present.

Bubbles may seem obvious in retrospect, but a problem with predicting them is that no one can ever be sure the bubble existed until it deflates. Perhaps companies that are currently overvalued will generate large amounts of revenue using revolutionary business models, and so their stock price is justified. For example, Google’s IPO price of \$85 per share in 2004 was a bargain compared to its current price of \$542,¹ though at the time of Google’s IPO, many thought the company was overvalued (Watts 2011). This paper will assume that bubbles can be anticipated, and will draw from historical and economic trends of past bubbles as a way to predict the possibility of a future one.

Though there are many loose definitions associated with the word “speculative bubble,” this paper will assume the general and straightforward definition used by Markus Brunnermeier of Princeton:

Bubbles are typically associated with dramatic asset price increases followed by a collapse. Bubbles arise if the price exceeds the asset’s fundamental value. This can occur if investors hold the asset because they believe that they can sell it at an even higher price to some other investor even though the asset’s price exceeds its fundamental value. (Brunnermeier 2008)

¹Price of a Google share as of 2/12/2015

Amidst the bubble paranoia we have experienced over the last few decades, there has been talk of a speculative bubble in the technology sector. Many parallels have been drawn between today's technology companies and those from the dot-com era. Various companies with negligible revenue—think Snapchat, Whatsapp, and Pinterest—have been valued at over a billion dollars. Some claim that the post-recession low federal funds interest rate² (which corresponds to a lower risk-free Treasury bill rate) is leading to overzealous investing in stocks, since virtually any kind of investment will pay better than the low risk-free rate (Edwards 2014). Others point to the fact that the amount of investment money going to software firms has been growing, and now rivals the amount that was being invested into firms in 1999, just six months prior to the burst of the dot-com bubble.³ Additionally, the percentage of IPO's with negative earnings is also approaching its 1999 level,⁴ which was about 76% by the end of that year (Ritter 2014).

As a reaction to these growing concerns, this paper attempts to determine whether or not the technology industry is currently in a bubble. I will first outline the various reasons for the formation of the dot-com bubble, and then provide analysis on which financial (and other) metrics seem to best predict the stock price decline of the dot-com companies at the burst of the bubble in 2000. I will then compare those significant metrics with the metrics of today's technology companies, and determine whether another technology bubble is forming.

Previous literature on bubble analytics focuses on a few common characteristics of speculative bubbles—a departure from the fundamental price of an asset, rapid increases in stock prices, and unrealistic expectations of future earnings (Homm and Breitung 2009). Early work by Blanchard and Watson (1982) and Campbell, Lo, and MacKinlay (1997) derive the fundamental price of an asset as the present value of all expected payouts, with the only fundamentals affecting the stock price being the expected dividend payments and the interest rate. After making various assumptions about the economy and stocks at hand, the fundamental price of the asset is calculated and compared to the stock price to determine the existence of a bubble. However, with so many assumptions and choices of models to use, many discrepancies among papers arise.

Some scholars assume that dividends follow a random walk with drift—thus the fundamental stock price also follows a random walk with drift—and a positive bubble would be indicated by the price shifting from a random walk

²See Figure 1 of Appendix

³See Figure 5 of Appendix

⁴See Figure 3 of Appendix

to an explosive autoregressive process. Phillips, Wu and Yu (2007) use unit root tests to determine when there is a switch to explosive stock prices with nonexplosive dividend payouts over a time series. More famous is Case and Shiller's work (2007), which argues that investors, or home-buyers in the case of the housing bubble, are often uneducated and misguided about the value of their investments, and overly optimistic about the potential for future increases in price.

The housing bubble, both before and after it occurred, was much more thoroughly researched than the dot-com bubble, potentially due to its more devastating and global impact. Additionally, houses as physical assets are much easier to value and compare than technology companies are, as the future cash flows of internet companies might not be as obvious or stable. Furthermore, some discrepancies may arise when valuing the success or profitability of an internet company, as the intangible assets of technology companies are not well-accounted for on the balance sheet, which in turn may affect the predicted cash flows of the company (Damodaran 2009). Thus, concrete analysis about the potential overvaluation of internet companies is scarce, and literature on the dot-com bubble is mostly limited to the behavioral changes of investors and trends towards risk over that time period.

2 Data and Methodology

According to previous literature, there does not seem to be a strong consensus on how best to measure or predict asset bubbles (if possible at all). Thus, this paper takes an original and unconventional approach to predicting bubbles by extracting information from past bubbles of similar assets and comparing it to the current group of suspicious assets. Specifically, I will use the historical trends of the 1990's as a way to measure the possibility of another growing tech bubble.

My regression will hopefully provide insight as to which financial characteristics of the dot-com companies contributed most to the fall in stock price between the peak of the bubble (March 10, 2000, when the Nasdaq Composite peaked at 5046 points) and the all-time low after the burst (October 9, 2002, when the Nasdaq Composite hit a low of 1114 points). To capture the various stages of the bubble formation, I will run a regression⁵ each year from 1997 to 1999, using data from the fourth quarter of each respective calendar year (December 31st) due to the availability of quarterly financial data:

⁵See beginning of Appendix for details of regressions and variables included

$$PriceDrop = \beta_0 + \beta_1 ROA + \beta_2 ROE + \beta_3 PriceToBook + \beta_4 DE + \beta_5 Age + \beta_6 PriceChangeOne + \epsilon \quad (1)$$

Most of the regressors I included were chosen based on previous literature about analyzing a company's aftermarket survival (Peristiani and Hong 2004). The debt-to-equity ratio was included as a replacement measure for the more commonly used shareholder's equity ratio, which was hard to estimate accurately with the dataset at hand.

The list of dot-com era companies that I will include in the regression will be all technology companies (with available data) that went public from January 1995 to December 1999. I will use the list of "internet IPO's" compiled and used by University of Florida's Jay Ritter (Loughram and Ritter 2004), which lists over 600 companies (and their SIC, ticker, IPO date, and individual stock offer price) in the technology sector that went public between 1990 and 2013. Ritter also has a compiled list of founding dates for all IPO's from 1975 to 2014; thus the age of each company will be calculated using the difference between the year of foundation and year of IPO.

The quarterly financial data for these companies are available through the Compustat database, accessible from the Wharton Research Data Services (WRDS) website. Compustat provides all of the financial data the explanatory variables require. Daily stock prices will be attained through the Center for Research in Security Prices (CRSP), which is also accessible through WRDS.

My yearly regressions will determine which explanatory variables are good predictors of the price decline. I will then collect data on the new generation of public technology companies (all that have gone public from 2009 to 2014) using Ritter's internet IPO data up to 2013, and then the Nasdaq website to filter for the technology companies that went public in the United States in 2014. I will qualitatively compare the metrics of the new generation of technology companies with the significant metrics of the dot-com companies, and see if there is reason to believe we are entering another bubble.

3 The Dot-com Bubble

Since this paper is studying past bubbles as a way to predict future bubbles, it is necessary to understand the previous technology bubble in detail. The

following section details the growth of the technology bubble that occurred at the turn of the 21st century, best known as the dot-com bubble.

The 1990s are often associated with the Internet boom and advent of the World Wide Web. Many companies rushed to exploit the opportunities provided through the growth of the commercial Internet, which resulted in the founding of many Internet-based companies, commonly referred to as the “dot-coms.” Huge amounts of money were poured into these Internet startups, in the hopes that they would one day become profitable. The value of equity markets grew exponentially, with the technology-intensive Nasdaq index increasing from 1,000 to 5,000 points between 1995 and 2000 (Investopedia 2010). By the end of the decade, it was evident that these companies were overvalued, and the growing bubble burst.⁶ The speculative dot-com bubble peaked in March of 2000 and then crashed, leading to the demise of many dot-coms and the recession of the early 2000s.

So what caused the dot-com bubble? A common pre-condition to any speculative bubble is the existence of a low risk-free interest rate. The United States entered a year-long recession in 1990 and suffered a period of jobless recovery. As a result, the effective federal funds rate fell to half its value over just a few years.⁷ The risk-free rate correlates with the federal funds rate, and though stocks are not valued at these short-term rates, investors turn their money towards assets with the potential for higher returns (e.g. the stock market) when the risk-free rate is so low. Additionally, a low federal funds rate will lead banks to lower the interest rate they charge when loaning money, and so money becomes cheaper to borrow for both individuals and companies. When money is cheaper to borrow, it is easier to start new companies, and restless investors rush to finance them. At the peak of the bubble, over \$20 billion of investment were entering the technology sector in 2000 Q2 alone, and the number of investment transactions was also rapidly growing.⁸

More relevant to bubbles, however, is the long-term interest rate. Long term rates reflect the current and expected future values of short term rates, and affect asset valuations inversely; a low discount rate would imply a high present value. Fifteen years prior to the the dot-com bubble, the long term interest rate peaked at around 16%, but then continued to fall in the subsequent years, potentially pushing up asset prices as they were valued at this low discount rate.⁹

On the other hand, there may be other links between the interest rate and

⁶See Figure 4 of Appendix

⁷See Figure 1 of Appendix

⁸See Figure 5 of Appendix

⁹See Figure 2 of Appendix

dot-com boom. The Modigliani-Cohn hypothesis states that investors may irrationally discount real cash flows using nominal interest rates—a behavior trait that would lead to inflation-induced valuation errors (Lansing 2004). Research by *The Economic Letter* supports the Modigliani-Cohn hypothesis; in particular, that “the Standard & Poor’s (S&P) 500 stock index tends to be undervalued during periods of high expected inflation (such as the late 1970s and early 1980s) and overvalued during periods of low expected inflation (such as the late 1990s and early 2000s). This would imply that the bull market that began in 1982 can be partially attributed to the stock market’s shift from a state of undervaluation to one of overvaluation” (Lansing 2004). Thus, the dot-com bubble may have been fueled by a shift from high to low inflation, not just a low interest rate.

Another critique of the dot-com era was the increasing numbers of companies that went public, often with sub-standard financial measures: “Many industry analysts have attributed the technology IPO debacle of 2001-03 to the deteriorating quality of businesses that decided to ‘go public.’ In this view, enormous numbers of speculative firms entered the public markets in the late 1990s with poor business plans and little or no foreseeable earnings” (Peristiani and Hong 2004). An investigation of aftermarket survival of firms at the end of the 20th century shows that both the profitability and net worth of public companies (measured by the return on assets and the equity-assets ratio, respectively) sharply declined at the end of the decade, especially in relation to comparable non-public firms (Peristiani and Hong 2004).¹⁰

This same investigation also found a strong negative relationship between the probability of delisting and the firm’s return on assets. Additionally, the age of the company upon going public appears to be a good indicator for financial riskiness. The average age of newly listed companies remained fairly steady through the 1990’s, at around seven years, but during the dot-com explosion in the late 1990’s, the average age of companies that went public dropped to four years (Peristiani and Hong 2004).

The increase in new, speculative public firms was also assisted by the emergence of the Nasdaq in 1970. This new electronic stock exchange attracted many young technology-intensive companies due to its electronic nature, lower minimum listing requirements, and lower fees. It provided an avenue for riskier and more speculative companies, which is why the dot-com bubble hit the Nasdaq the hardest, though the NYSE also suffered a significant decline in stock prices in the late 1990’s.

Rational models have also been reconsidered as a way to investigate how incentives, market frictions, and non-standard preferences might create and

¹⁰See Figure 8 of Appendix

sustain bubbles. Herding in investment decisions may explain why asset bubbles propagate once formed. Investment managers competing in the market might follow the investment decisions of another manager because they do not have time to thoroughly investigate every deal; thus, they trust that other investors may have compelling information about an investment, and so they mimic their decision (Shiller 2002). Alternatively, it is very costly to “bet against the herd” when stock prices are on the rise, as managers who cannot keep up with other investment managers may lose clients who reallocate their money to more successful managers (Lux 1995).

The market structure of investing in public companies also provides incentives for investors to ride out bubbles. Though the upside of investing in a company is unlimited (investors can enjoy the growth of a company indefinitely), the downside is limited only to the amount of money initially invested into the company, regardless of how severely the company fails. This convex payoff structure—much like buying lottery tickets with a very large upside and relatively small downside—“generates a preference for risk and for riding bubbles,” which may be a contributing reason to the formation of asset bubbles (Allen and Gale 2002).

Whenever economic disasters occur, the incentives of major market players are called into question. The incentives of equity analysts might not always be aligned with the truth, as when a bubble rises, many market players profit from “higher trading volume, larger investment banking proceeds on the increased IPO and SEO activity, and the investment profits generated on the bubble upside” (Scherbina 2013). This, in addition to the downside risk limited by equity holders, firm executives, and government bailouts, have led many to investigate the incentives of equity analysts in the creation and prolonging of bubbles. In the aftermath of the dot-com bubble, it was admitted that analysts would often give “strong buy” recommendations even though they privately held skeptical views about the company. Three main reasons emerged: (1) analysts feared that if they were negative about a firm they would lose the favor of the management and be shut out of any future correspondence, (2) analysts stood to profit from the banking business generated by issuing favorable stock recommendation, despite the idea of the “Chinese Wall” separating the financiers and traders in a financial institution, (3) analysts are paid a portion of the trading commission that their analysis brings to the firm’s trading desk, and it is much easier to generate trade with a “buy” rather than a “sell” recommendation (Scherbina 2013).

As with most bubbles, the imminent collapse of the dot-com bubble was clouded by new breakthroughs in technology and optimistic investors. The internet was a new, popular and powerful tool that the commercial world had never seen before. This foreign territory with untapped potential may

explain the deviation from conventional financial analysis we saw during this bubble episode. Or perhaps there were other incentives at play as well, as analyzed by the various rational models.

Evaluating the previous technology bubble in more analytic detail might help illuminate the future path of current technology companies, who are experiencing a similar macroeconomic environment and are subject to the same market flaws just mentioned. Though there are several similarities and differences between the dot-com era and today's technological environment as discussed in a later section, it seems the technology sector might be small and specific enough to accurately predict another potential bubble episode.

4 Regression Results

As mentioned previously, I will perform a regression on the dot-coms that went public between January of 1995 and December of 1999. There were 350 companies that went public over that time period, and the data used in each yearly regression (a regression for year 1997, 1998 and 1999) will be the fourth quarter financial data—December 31st of each respective year.

Although Jay Ritter's data set of Internet IPO's lists 350 technology companies that went public between 1995 and 1999, my regression was only able to include about 100 of them. One reason for this was because the dependent variable (the stock price drop after the burst) involves data between 2000 and 2002, and not all companies that went public in that time frame had stocks in 2000 and 2002; thus the number of companies that qualified for my regression was limited. There is a chance that this constraint of the dependent variable may introduce some survivorship bias (since healthier companies may be able to survive longer after the initial burst of the bubble) but the number of companies eliminated from this dataset because they lacked 2002 data was relatively small, thus it did not seem too problematic.

Additionally, obtaining the financial data from Compustat proved challenging, as many tickers that Ritter documented at the time of each IPO have been changed or slightly altered in the Compustat database since the time of the IPO. Some companies were simply not included in the Compustat database, which also eliminated potential data.

After calculating the necessary metrics for my regressors, I had to eliminate another ten companies from the dataset because they had negative levels of shareholder's equity (calculated as total assets minus total liabilities). Since three of my regressors use this value in the denominator, having a negative number in the denominator would prove problematic when interpreting results, since the sign of the value would be affected. Due to these limiting

circumstances, the number of companies able to be used in my regression was lower than anticipated.

The remaining data were separated by year, with the dependent variable being the same for each year (since the percentage decrease in stock price at the burst of the bubble is the same for each company, regardless of the year of regression). Predictably the regression for 1999 contained more data points than the 1997 or 1998 datasets. The regression results for each year are outlined in Table 1.

Table 1: Regression Results

	1997	1998	1999	1999 Robust
Variables	PriceDrop	PriceDrop	PriceDrop	PriceDrop
ROA	1.110 (1.142)	-0.9164 (0.3647)	-0.0295 (0.0583)	-0.0046 (0.0124)
ROE	-0.497 (0.661)	0.0482 (0.2108)	-0.0041 (0.0217)	0.0002 (0.0046)
PriceToBook	-0.0050 (0.112)	0.0048 (0.0158)	0.0061 (0.0182)	0.0100** (0.0039)
DE	-0.0250 (0.0389)	0.0048 (0.0524)	-0.0067 (0.0524)	-0.010*** (0.0026)
Age	-0.0038 (0.0153)	0.0019 (0.0036)	-0.0069 (0.0052)	-0.0003 (0.0011)
PriceChOne	0.0439 (0.108)	0.0085 (0.0092)	0.0013 (0.0189)	-0.0006 (0.0040)
Constant	0.9550*** (0.197)	0.9346*** (0.0376)	0.9157*** (0.0487)	0.9614*** (0.0103)
Observations	11	16	80	80
R-Squared	0.369	0.1280	0.034	0.185

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Unfortunately, none of the initial regressions produced significant variables, meaning the model was not able to capture the price drop well with the given regressors. One might think the 1999 dataset, which contains the most data points with presumably the newest and weakest companies, might be able to lend insight on which company characteristics correlate with a bubble burst; however, the results were not conclusive.

A further look into the data shows that the 1999 dataset contains multiple

points with either high leverage or large residuals.¹¹ I then ran a robust regression on the 1999 dataset to see if those points had much impact on the regression, and the results changed slightly. The robust regression (see last column of Table 1) found two significant variables (*PriceToBook* and *DE*), and variables such as *ROA*, and *PriceChOne* had lower p-values compared to the non-robust regression.

These results indicate that the only notable indicator variables from the dot-coms are the price-to-book ratio and the debt-to-equity ratio, which were significant at the 5% and 1% respectively. Though the regression was not able to explain the price drop very well, it seems useful to look at those two significant regressors in today's technology companies to help us determine whether or not a large stock price drop is foreseeable in the coming years.

5 Analysis of Current Technology Companies

To compare current technology companies to the dot-coms, I compiled a list of technology company public offerings from January of 2009 to December of 2014, using both Jay Ritter's "Internet IPO" dataset and the Nasdaq IPO listings online. 90 companies were included in this list, and the financial and stock information was acquired through Compustat and CRSP as before. As with the previous regressions, I sorted the company data by year, and examined the data for years 2012, 2013 and 2014 to see if any comparisons to the dot-com data could be made.

For this batch of companies, I calculated the metrics of interest (price-to-book ratio, and debt-to-equity ratio) using the third quarter data of each year, rather than the fourth quarter data as I did for the dot-coms. This is because the 2014 fourth quarter data were not available for all companies yet through the Compustat database, as it is still being released and updated in the system. For each year I calculated the average of each of the four financial measures mentioned above and compared them to the dot-com era averages (see Table 2).

Comparing these values, it seems that there are not many similarities between the time periods. The *PriceToBook* ratio was high in 2013 at an average similar to the dot-com average; however, it dropped back down to 0.7017 in 2014. Current *DE* levels have been steadily rising, but the regression found a negative correlation between the debt-to-equity ratio and percentage price drop, so higher levels of *DE* are preferable in terms of avoiding a price collapse. There does not seem to be much similarity amongst the

¹¹See Figure 6 of Appendix

Table 2: Averages of Significant Metrics

	PriceToBook	DE
1997	1.1016	1.6833
1998	1.2311	0.4929
1999	1.5790	1.1847
2012	0.4911	2.8867
2013	1.3496	3.9283
2014	0.7017	5.6657

variables between the two time periods, which bodes well for current technology companies.

It could be that the current time frame of companies is too early to show signs of a bubble (if one is to emerge), and that over the next few years, the average levels may converge to values similar to those at the turn of the dot-com bubble. However, the analysis in this paper is limited to the data as of 2014.

6 Dot-com Era versus Today

This paper relies on the assumption that studying previous bubbles lends insight about the probability of a future one, which works best if the bubbles are of similar assets and are in a similar economic environment. Many similarities can be drawn between the dot-com time period and today's technology-driven climate, though there are also plenty of differences to note, as history seldom ever truly repeats itself.

As mentioned earlier, low interest rates were seen as one potential reason for the dot-com bubble. Today's short-term interest rates continue to remain low, as more money is needed to stir the economy as it recovers from the 2008 recession. Additionally, low long-term rates might once again be pushing up equity prices.

Robert Shiller's cyclically adjusted price to earnings ratio (CAPE) has also been under scrutiny, as it can generally be correlated with past bubbles and recessions.¹² Though it seems too early to see if the CAPE will increase enough to elicit concern of another bubble, it does seem to have risen to previous recession-high levels.

Most recently, the Nasdaq index crossed the 5,000 point level on March 2, 2015, marking the first time since the peak of the dot-com bubble. Both

¹²See Figure 7 of Appendix

the Dow Jones Average and S&P 500 have also been setting record-highs. However, the steady rise to 5,000 has been much slower than at the peak of the dot-com bubble, regarded by analysts as a “grounded rally” more so than a bubble (Strumpf 2015).

Another metric on the rise again is the amount of money being invested into tech companies, as well as the number of transactions into the tech sector. As Figure 5 of the Appendix shows, both the aggregate number of the investment dollars and the number of deals into the technology sector have surpassed the 1999 third quarter levels.

More specifically, late stage financing from venture capitalists has been growing the past few years. Looking at the average dollars raised per round of investing,¹³ the late stage rounds are approaching levels seen at the peak of the dot-com bubble (Maris 2015).

Technology is still seen as an exciting and innovative path with limitless possibilities. The emergence of social media seems to be the new twist on the importance and unknown potential of technology. In August of 2014, Snapchat (the app that sends self-deleting picture messages) was valued at \$10 billion after a new round of funding, despite never having turned a profit (Rushe 2014). Venture capitalists speak to the huge amount of risks being taken in the startup industry—Bill Gurley of Benchmark Capital states that startups are taking risks “unprecedented since 1999” (Rushe 2014).

Though the dot-com era and today share some similarities, there are also evident differences between the time periods. The sheer fact that there was a dot-com bubble is bound to make a difference. People are aware of what happens with new technology and overexcited investors, and don’t want to make the same mistakes so soon after the dot-com debacle. In the aftermath of the dot-com burst, “as much as companies had rushed to embrace the Internet when the mere mention of an Internet strategy—or the appendage of ‘dot com’ to the end of a company’s name—was enough to inflate a firm’s value severalfold, so did they now rush to distance themselves from it” (Frank 2001).

Venture capitalists seem to be remaining more selective this time around; although the amount of money being invested into the technology sector as well as the number of investment transactions into the technology sector has been on the rise as mentioned previously, venture capitalists seem to be less eager to fund new companies.¹⁴ The number of VC investments has remained fairly flat since 2007, whereas in the years leading to the dot-com burst there was a rapid increase. Though there might be other factors leading to steady

¹³See Figure 9 of Appendix

¹⁴See Figure 10 of Appendix

investing by venture capitalists, this suggests that they are still being selective in choosing what companies to support.

Additionally, the Nasdaq is not as young or tech-intensive this time around. The technology sector made up 57% of the Nasdaq exchange at the turn of the 21st century, whereas now only 43% of the exchange is comprised of technology companies (Menton 2015). The new 5,000 point marker that the Nasdaq recently reached is aided by growing companies in health-care (now 16% of index) and consumer services (now 21% of index). Thus, even if tech stock prices saw a decline, it would not have as dire an impact on the Nasdaq as it did at the turn of the 21st century.

The Nasdaq exchange is not only more diversified this time around, but is also not as in demand as it was during the dot-com bubble: “The price-earnings ratio of the Nasdaq, a measure of how much investors are willing to pay for every dollar of earnings the companies in the index generate, is 20...When the Nasdaq was at its highest, its price-earnings ratio reached 194” (The Associated Press 2015). Perhaps investors learned something from the dot-com era, or perhaps the Nasdaq has since lost some of its initial appeal to tech companies and investors. Though there might be some indications that the technology sector is showing signs of overvaluation as it did in the dot-com time period, it is not conclusive enough or supported by the analysis done in this paper.

7 Conclusion

The results from the dot-com regressions indicate that there were not many characteristics among the dot-coms that were related to the percentage stock price drop seen at the burst of the bubble in 2000. Two variables (*PriceToBook* and *DE*) captured some of the correlation, but the model overall was not very telling of how company metrics relate to asset bubble bursts.

To see if we might currently be entering another technology bubble, those same metrics of today’s public technology companies were calculated and averaged. It did not appear that current companies share comparable financial characteristics as their dot-com counterparts, concluding that either we are not entering another bubble, or it is too early to discern bubble-like metrics.

Although the post-2008 recession economy with low interest rates and high amounts of investment money might seem like the perfect environment to fuel another bubble, the technology sector is currently growing at a slower rate than the dot-coms did. If a price drop is to occur in the future, it will not be as drastic or damaging as before, given the diversification of the Nasdaq and the experience gained from living through the dot-com bubble.

Though predicting future bubbles based on past bubbles is not completely reliable, the similar post-recession economic environment of the 1990s and today, in addition to the innovative and unpredictable nature of technology, makes the comparison conceivable. The success and path of technology is difficult to predict, and so it is not unlikely that technology companies would be overvalued again so soon after the previous bubble.

This paper predicts that there will not be another dot-com incident soon; however, it is limited to data as of 2014 and will likely need to be updated as time passes. Further research might include the addition of other relevant variables to the regression equation, or the inclusion of additional tests for correlation within the data.

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9 Appendix

Details of Regression:

$$PriceDrop = \beta_0 + \beta_1 ROA + \beta_2 ROE + \beta_3 PriceToBook + \beta_4 DE + \beta_5 Age + \beta_6 PriceChangeOne + \epsilon \quad (2)$$

PriceDrop: the percentage change in the price of the stock between the price in March 2000 and October 2002, calculated as $(price_{03/2000} - price_{10/2002})/price_{03/2000}$

ROA: annual return on assets, calculated as net income divided by average total assets

ROE: annual return on equity, calculated as net income divided by shareholder’s equity, and with shareholder’s equity equaling total assets minus total liabilities

PriceToBook: price to book ratio, calculated as stock price divided by shareholder’s equity (same definition of shareholder’s equity as above)

DE: debt to equity ratio, calculated as total liabilities divided by shareholder's equity (same definition of shareholder's equity as above)

Age: age of the company prior to initial public offering, calculated as difference in years of company's establishment date and date of initial public offering

PriceChangeOne: percentage change in stock price after first day of initial public offering, calculated as $(price_{dayone} - price_{offer})/price_{offer}$

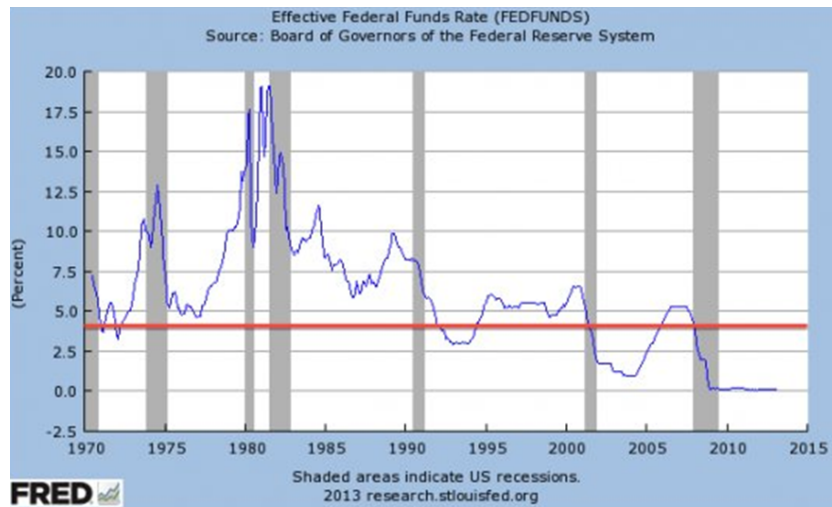


Figure 1: Federal Funds Rate

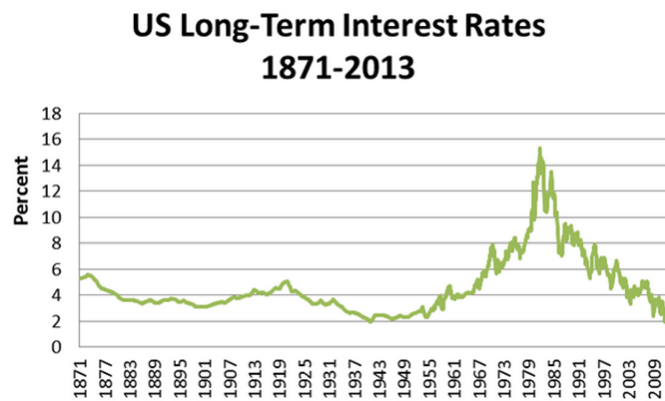


Figure 2: Long-Term Interest Rate

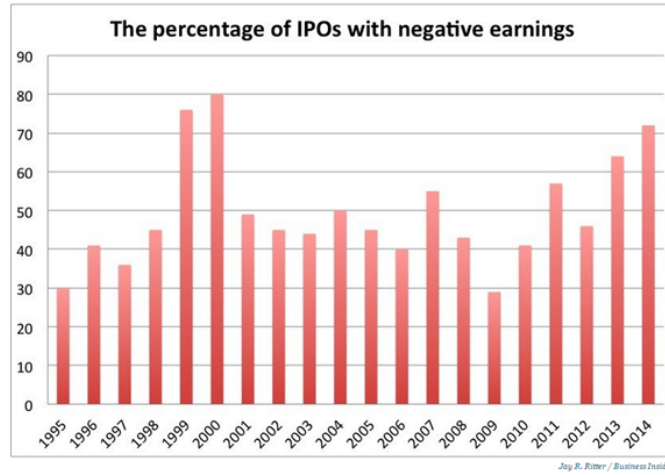


Figure 3: Percentage of IPOs with Negative Earnings



Figure 4: The Nasdaq Index

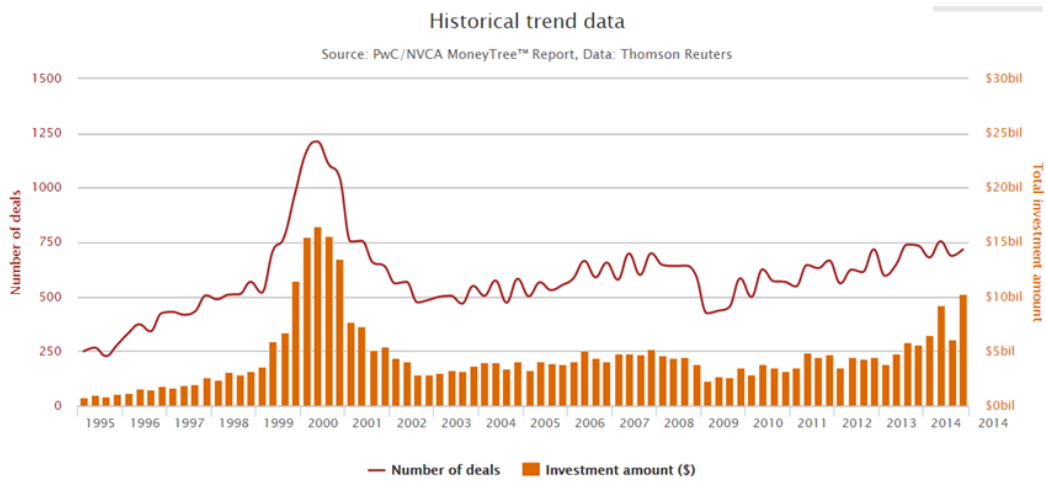


Figure 5: Investment (\$) and Number of Cash Investments into Technology Sector

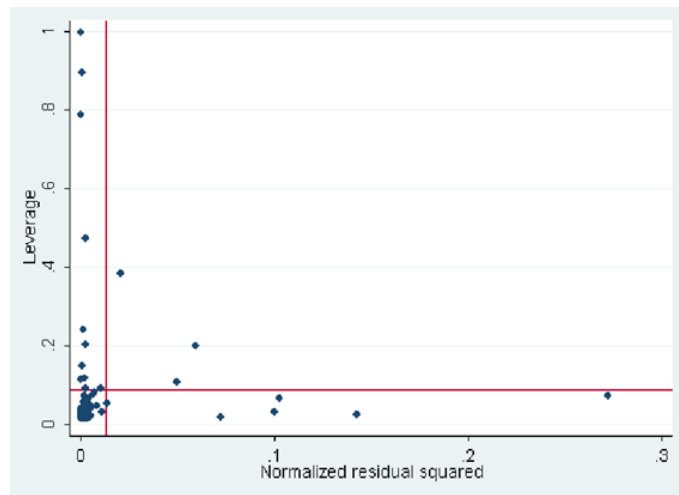


Figure 6: 1999 Dataset (Leverage vs Squared Residuals)

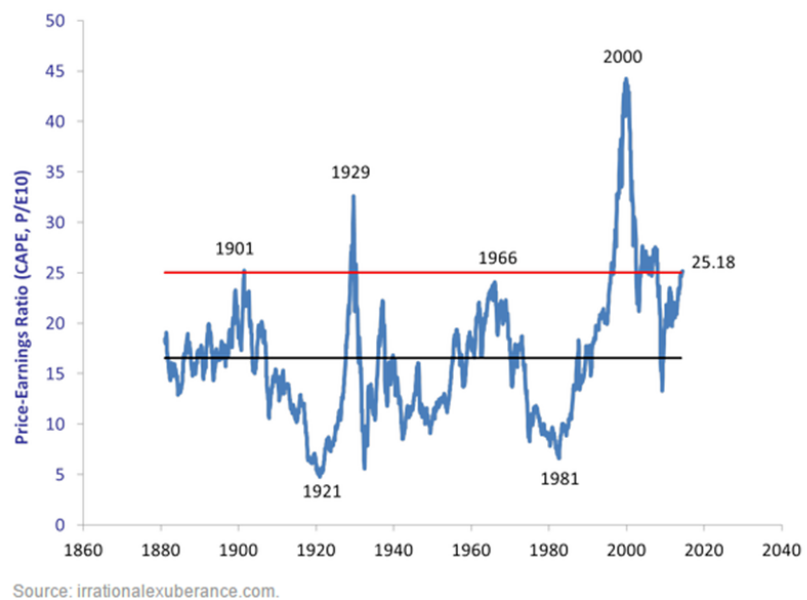
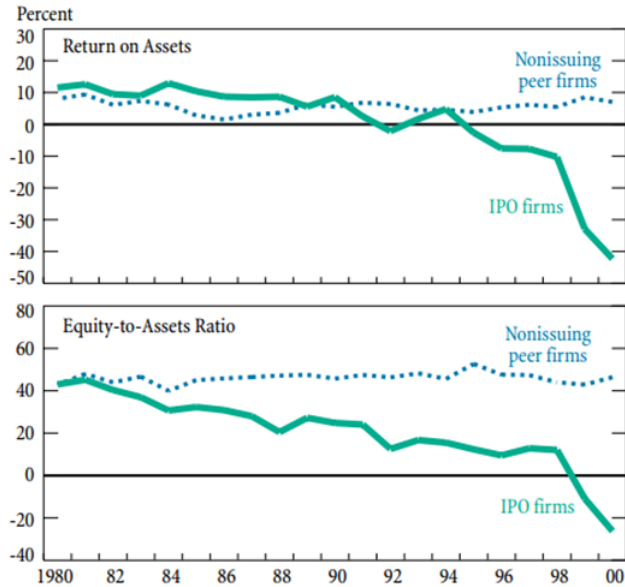


Figure 7: Shiller CAPE

Pre-Issue Financial Performance of IPO Firms, 1980-2000



Sources: Standard and Poor's Compustat database; Thomson Financial Securities Data Corporation (SDC).

Figure 8: Performance of IPO and non-IPO firms

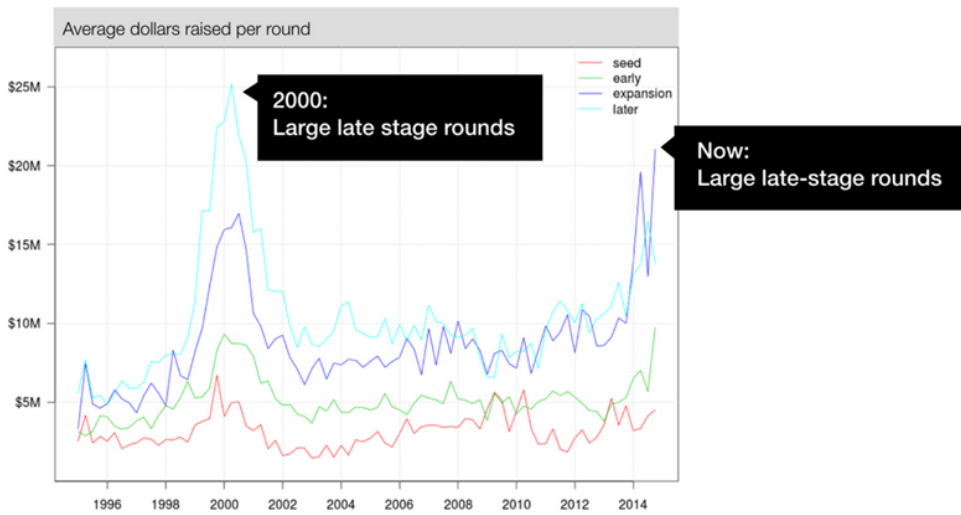


Figure 9: Average VC Funding by Round

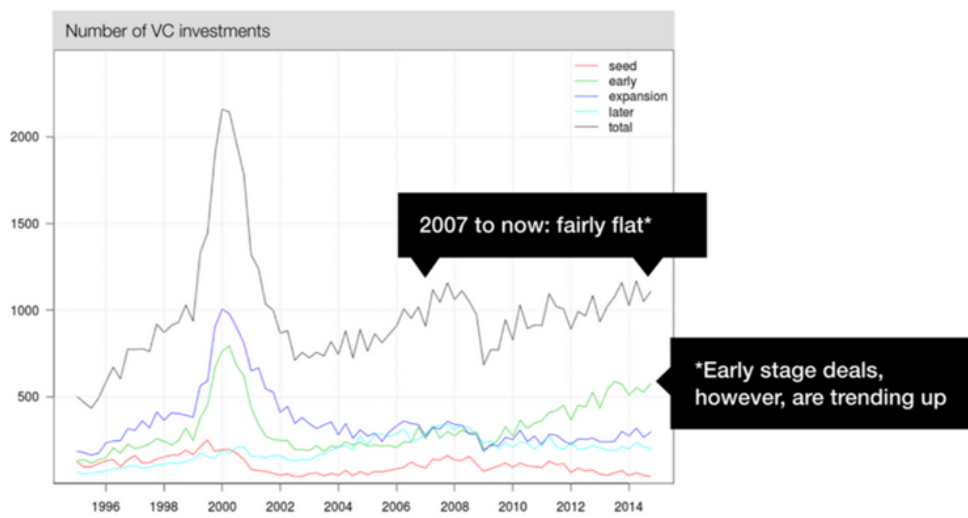


Figure 10: Number of Venture Capital Investments