COMPARATIVE STUDY OF STOCK VALUATIONS USING SHILLER'S P/E: FROM DOTCOM TO ARTIFICIAL INTELLIGENCE FINANCIAL BUBBLES

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Abstract: Following the release of ChatGPT in 2022, artificial intelligence (AI) has become a major investment trend, with NVIDIA rising to the position of the world's most valuable company and prompting frequent comparisons to the Dotcom internet bubble. This paper aims to compare valuations during these two technological booms by employing Shiller's price-to-earnings (P/E) ratio alongside performance indicators, such as total return and compound annual growth rate (CAGR). Our results indicate that while both periods exhibit signs of overvaluation, the Dotcom bubble was considerably more extreme, as evidenced by both higher historical returns and peak P/E ratios. AI valuations, though elevated, seem to for now be supported by stronger earnings growth. This research contributes to existing literature by providing data-driven comparisons between the Dotcom and AI booms, offering novel retrospective insights into sustainability of current AI valuations and associated bubble risks.

Keywords: artificial intelligence bubble, dotcom bubble, stock market, technology stocks, investment valuation

JEL classifications: G12

1 INTRODUCTION

Artificial Intelligence (AI) undoubtedly holds the position of one of the most significant investment trends of the 21st century. In 2024, global private investment in generative AI reached $33.9 billion, marking an 18.7% increase from the previous year and over 8.5 times higher than the 2022 levels (Stanford, 2025). This surge in investment has been accompanied by remarkable corporate valuations. Notably, NVIDIA's market capitalization soared to $4 trillion in July 2025, surpassing that of industry giants like

Microsoft and Apple (Reuters, 2025). Such rapid growth has naturally led financial experts to draw parallels between the current AI boom and historical technology bubbles, most frequently the Dotcom bubble of the late 1990s and early 2000s (J.P. Morgan, 2024; Morningstar, 2025; Floridi, 2024).

The primary aim of this paper is to quantitatively compare the valuation metrics of today's AI boom with those of the Dotcom period. After its collapse in 2000, the Dotcom episode was retrospectively identified as a speculative financial bubble by several empirical and econometric studies (e.g. Ofek & Richardson, 2003; Phillips, Shi, & Yu, 2011). By employing Shiller's Price-to-Earnings (PE) ratio (2001), alongside with graphical analysis and various performance indicators, our research seeks to assess whether the current AI market exhibits signs of overvaluation akin to those observed during the well-known internet era.

The research has in this regard the potential to contribute to the currently limited body of literature on the emerging phenomenon of the AI bubble, as few academic studies have yet addressed it in a more structured, empirical way. This paper thus advances the discussion by examining valuation dynamics at both the aggregate market level — through the NASDAQ stock index — and the firm level, comparing leading technology companies across two distinct periods (the Dotcom "Four Horsemen" and the AI-era "Magnificent Seven"). Moreover, by employing Shiller's P/E ratio as a central analytical tool, the study utilizes an objective and historically comparable metric for assessing valuation intensity. This methodological approach enriches both the theoretical understanding of speculative technology-driven bubbles, while simultaneously providing novel empirical evidence relevant to the ongoing debate on whether the current AI boom truly represents a sustainable growth trend or the early stages of a new financial bubble.

2 LITERATURE REVIEW

2.1 Stock valuation and financial bubbles theories

Stock valuation is the cornerstone of understanding whether asset prices reflect intrinsic values or speculative deviations. In finance, intrinsic value is commonly defined as the present value of all expected future cash flows generated by an asset (Aspers & Beckert, 2011). For equities, this can be

proxied through discounting dividends or earnings, while for non-yielding assets such as gold or real estate, valuation often relies on alternative measures such as production costs or rental yields (Shiller, 2007).

When asset prices significantly exceed intrinsic value, they may enter the territory of a financial bubble. Although no universally accepted definition of financial bubbles exists, most accounts converge on the notion of prices being driven away from fundamentals by speculation and investor sentiment. Notably, Charles Kindleberger (2005) in his publication *Manias, Panics, and Crashes* described bubbles as periods when asset prices rise sharply due to speculative enthusiasm rather than fundamental factors, often progressing through stages such as displacement, boom, euphoria, crisis, and eventual burst or revulsion. Keynes (1936) earlier emphasized the role of demand-driven disequilibrium, while Blanchard and Watson (1982) highlighted the speculative motive to sell overvalued assets at even higher prices.

Subsequent literature further refined these views. Stiglitz (1990) conceptualized bubbles as cycles of rapid price escalation followed by abrupt correction, while Garber (2000) underscored their behavioral dimension during the then ongoing Dotcom boom. Abreu and Brunnermeier (2003) distinguished between rational bubbles, where investors knowingly buy overvalued assets expecting resale profits, and irrational bubbles, which stem from purely behavioral biases and limits to arbitrage. Robert J. Shiller, a Nobel Prize laureate in Economic Sciences from 2013, in his breakthrough book from 2000 characterized bubbles as driven by so-called “irrational exuberance,” a form of contagious investor psychology that magnifies price surges through stories of success and speculative fervor. More recent literature like Greenwood, Shleifer, and You (2019) or Li et al. (2022) continues to explore these foundations of asset overvaluation, linking media news coverage, online buzzwords and market sentiment to speculative cycles.

From an empirical perspective, valuation ratios are frequently used to identify periods of potential overvaluation. Among these, the price-to-earnings ratio (P/E) and its cyclically adjusted version popularized by already referenced Robert Shiller (CAPE or Shiller’s P/E) remain central. The P/E ratio captures how much investors are willing to pay relative to company’s earnings — when it rises far above historical or fundamental benchmarks, it typically signals that assets are overvalued and expectations may be unsustainably high. Shiller (2001)

demonstrated that abnormally high P/E levels often precede corrections, making them going forward a key tool for studying speculative excess in equity markets.

2.2 Technological bubbles and the Dotcom internet bubble

Technological bubbles are distinct from other financial bubbles in that they are often fueled by breakthrough innovations perceived to hold extraordinary future profitability (Malkiel, 2015). The potential for disruptive technologies to reshape entire industries amplifies speculative enthusiasm, as investors are willing to pay premiums for uncertain but revolutionary growth prospects (Kindleberger et al., 2005; Lansing, 2009).

The Dotcom bubble of the late 1990s and early 2000s represents a paradigmatic example. Following the advent of the World Wide Web and milestones such as Netscape's 1995 IPO, which soared from USD 28 to USD 75 in a single day (Cassidy, 2002), investors flocked to internet and telecommunications firms. By 1999, nearly 500 technology IPOs had taken place (Shiller, 2000), many raising millions of dollars despite lacking viable business models. This enthusiasm was reinforced by easy monetary conditions and capital availability in the U.S. and Japan (Ofek & Richardson, 2003).

Valuations reached unsustainable heights, with the NASDAQ index quintupling from 1995 to 2000, peaking at over 5,000 points before collapsing (Valliere & Peterson, 2004). The crash was triggered by rising U.S. interest rates, concerns about non-profitable firms, and broader global economic uncertainty (DeLong & Magin, 2006). Within two years, the NASDAQ lost nearly 80% of its value, erasing trillions in market capitalization and leaving a lasting mark on the financial history of speculative manias (Sornette, 2003).

2.3 Characteristics of the current potential AI stock bubble

The most recent candidate for a technological bubble is linked to artificial intelligence (AI). The surge of interest in generative AI, particularly after the public release of ChatGPT in November 2022, sparked widespread enthusiasm about AI's transformative potential across industries (Floridi, 2024). This momentum has been reinforced by the so-called "Magnificent 7" — seven American technological companies Apple, Microsoft, Nvidia, Amazon, Meta, Alphabet, and Tesla — whose innovations and AI integration strategies

positioned them at the forefront of global markets (Cecconi, 2023; Basu, 2025; Sonnenfeld & Henriques, 2025). Collectively, these firms reached multi-trillion-dollar valuations, with NVIDIA in particular experiencing explosive stock price growth due to its dominant role in supplying GPUs essential for AI model training (The Economist, 2023).

Several factors underpin the rapid rise of AI-related valuations. First, the COVID-19 pandemic accelerated digital transformation, heightening demand for AI solutions in automation, efficiency, and remote work (PwC, 2021). Second, ChatGPT's success demonstrated tangible AI capabilities to the public and investors, intensifying narratives of revolutionary change. Third, NVIDIA's dominance in AI hardware positioned it as a critical supplier, leading to sharp increases in its market capitalization. Finally, investor sentiment and speculation play a central role, with capital inflows driven by a desire to participate in the AI boom despite yet uncertain profitability horizons (Newall & Weiss-Cohen, 2022). Recent evidence underscores this dynamic with Arnott, Commins, and Liu (2025) identifying the extraordinary post-2022 performance of the "Magnificent 7" as a key driver of the current market exuberance, while Karoui et al. (2024) argue that such AI-led outperformance reflects an increasingly asymmetric and potentially unsustainable valuation levels. Together, these studies suggest that the market is entering a high-returns phase characteristic of early-stage technological bubbles, where future innovation is rapidly capitalized into prices, often beyond what fundamentals can support.

This confluence of technological promise and speculative fervor indeed mirrors the earlier patterns observed in the Dotcom era. A widening academic discussion, such as Floridi (2024), have likewise identified the rapid appreciation of AI-related equities as indicative of a potential technological bubble, drawing direct parallels to the already described dynamics of the Dotcom period. Whether AI represents a true economic transformation or a financial bubble therefore remains an open question — one that valuation metrics such as formerly mentioned Shiller's P/E are well-suited to help further explore.

3 METHODOLOGY OF THE RESEARCH

The methodology for this particular paper is based mainly on a quantitative approach that allows for a comprehensive assessment of potential overvaluation in technology stocks during the two key periods of market euphoria — the Dotcom bubble and the current AI-driven stock boom. By applying scientific methods of analysis, deduction, synthesis and comparison, the study aims to systematically evaluate whether the current market shows similar characteristics of speculative excess as the one previously observed at the turn of the millennium.

Empirical part of the research utilizes cross-sectional data capturing multiple firms in two distinct years that represent the respective technological boom: the year 2000 for the peak of the Dotcom bubble and 2025 for the ongoing AI stock surge. The analysis focuses on the leading companies that were central to each bubble episode. For the Dotcom period, these include Cisco Systems (CSCO), Dell (DELL), Intel (INTC), and Microsoft (MSFT), commonly referred to as the "Four Horsemen of Tech". For the current AI-driven market, the analysis covers the "Magnificent 7" companies, specifically Apple (APPL), Microsoft (MSFT), NVIDIA (NVDA), Amazon (AMZN), Meta (META), Alphabet (GOOG) and Tesla (TSLA).

All financial data were sourced primarily from Yahoo Finance and Bloomberg, supplemented where necessary by official company financial statements. The key variables under consideration are annual stock prices and annual earnings, which together allow for the calculation of both profitability and valuation indicators. These indicators include the Total return, Compound Annual Growth Rate (CAGR), and the Price-to-Earnings (P/E) ratio, defined by the following formulas 1 and 2:

$$\boldsymbol{Total\ return} = \frac{Total\ gain\ from\ investment}{Initial\ investment} \times 100 \quad (1)$$

$$\boldsymbol{CAGR} = \left(\left(\frac{Final\ Value}{Initial\ Value}\right)^{\frac{1}{n}} - 1\right) \times 100 \quad (2)$$

Total return measures the overall profitability of an investment, capturing both capital gains and dividends relative to the initially invested value. Second, the Compound Annual Growth Rate (CAGR) reflects the average annual rate of

growth of an investment over a multi-year period, providing a smoothed measure of performance.

$$\boldsymbol{P/E\ ratio} = \frac{Market\ price\ per\ share}{Earnings\ per\ share} \quad (3)$$

$$\boldsymbol{CAPE} = \frac{Current\ \ price\ per\ share}{10{-}year\ average\ of\ EPS} \quad (4)$$

The aforementioned P/E ratio (shown above in formula 3), popularized also in its cyclically adjusted form (CAPE) (formula 4), by Nobel laureate Robert J. Shiller, is used as the central valuation metric due to its ability to capture investor expectations relative to underlying earnings. Previous empirical research has shown that when the P/E or CAPE rises substantially above long-term historical averages, it often signals potential overvaluation. Historically, Shiller (2000, 2001) observed that for U.S. equities, a cyclically adjusted P/E above approximately 15–25 (depending on sector) has frequently preceded periods of significant market corrections. Subsequent studies confirm these benchmarks: for instance, Greenwood, Shleifer, and You (2019) and Kenourgios et al. (2021) note that elevated P/E ratios relative to their historical mean tend to coincide with periods of speculative excess, while recent quantitative analysis of technology stocks from the likes of Lombardi & Pinter (2024) have similarly identified P/E multiples substantially above 20 as indicative of potential bubble conditions in the technology sector.

Following the data collection and initial calculation of the above marked out indicators, the empirical analysis will proceed in several stages. First, a graphical analysis of the NASDAQ index, which collectively contains technology companies of interest for both analyzed periods, illustrates the evolution of market valuation over time. Next, profitability indicators (Total return and CAGR) are presented for the selected top technology companies among each period — the Four Horsemen for the Dotcom era and the Magnificent 7 for the AI period — to evaluate investment performance at the firm level. Finally, the comparison of P/E ratios across the Dotcom and AI periods provides a quantitative basis for assessing whether current AI stock valuations reflect levels of overvaluation comparable to those observed during the ex-post confirmed Dotcom bubble.

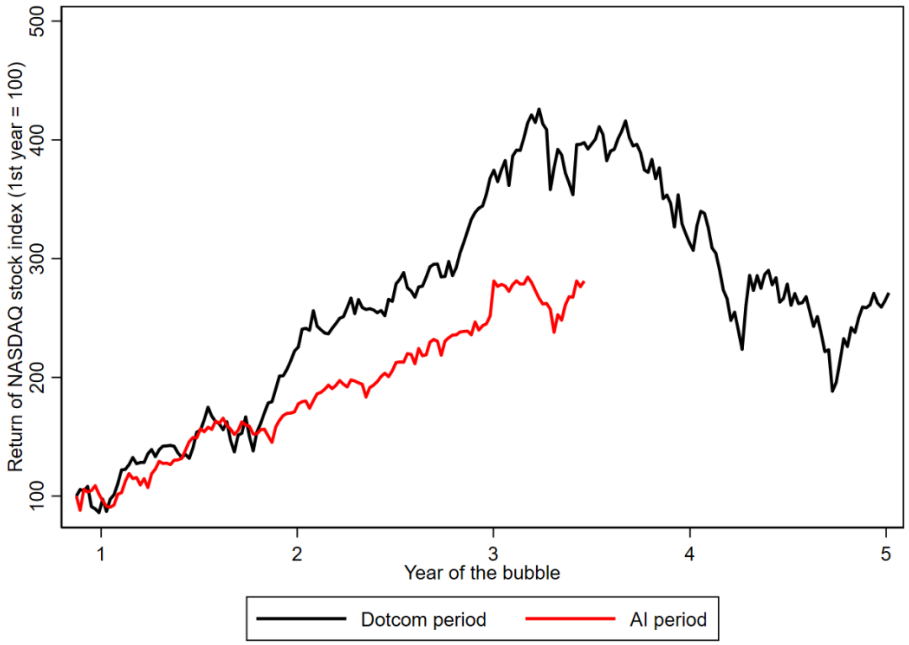
4 RESULTS

Our analysis begins with a simple graphical comparison of the market trajectories during the two investigated technology-inducted periods (shown below in Figure 1). For this purpose, the return of NASDAQ stock index was normalized to a starting value of 100. In terms of selected time horizons, they were intentionally chosen to ensure comparability, in both cases starting from the initial phases of technological euphoria (1998–2003 for Dotcom and 2022–2025 for AI), which represent potentially similar bubble-formation stages.

During the Dotcom period, the index experienced rapid growth, culminating in its peak on March 10, 2000 with price per share of 5,132 at approximately 399 points. Subsequently, the Dotcom bubble underwent a sharp price correction, during which the index declined precipitously back below the two hundred levels, erasing the majority of previously accumulated capital gains and marking the end of this speculative cycle.

The trajectory for the AI period shows a broadly similar pattern: following the launch of ChatGPT software and the surge of AI-related interest in late 2022, the NASDAQ index has steadily increased, though in the second year of the boom the growth pace started slightly lagging behind the slope of the Dotcom bubble. A notable correction occurred in early 2025, likely triggered by the newly announced U.S. tariff policies and concerns over a potential reignited trade war with China, a key supplier of AI chips. However, the index shortly resumed its upward trajectory afterwards, continuing to reach new highs by late 2025. This indicates that the AI boom has not yet reached a peak comparable to the Dotcom climax and may continue beyond the approximately three-year cycle observed during the Dotcom period before fully crystallizing its ultimate development path.

Figure 1: Comparison of historical return of the NASDAQ 100 index during the Dotcom and AI periods



Source: own processing according to data from Yahoo Finance

Next, we examine the return indicators presented in Table 1 to provide a more quantitative comparison of the Dotcom and AI periods. Starting with the Total return, it is immediately evident that over equivalent two-year periods (Dotcom: 10 March 1998 – 10 March 2000; AI: 10 October 2022 – 10 October 2025), the Dotcom bubble exhibited substantially higher growth than the AI boom, with a total return of 299.7% compared to 127.9%. This remarkable outperformance is further underscored when compared to the S&P 500 benchmark, which rose only 43.2% during the Dotcom period, highlighting the extraordinary concentration of gains in the technology sector at that time. In contrast, the AI period shows a less extreme outperformance relative to the overall market benchmark (86.9%), showing that the rally is to an extent more broadly distributed across the whole market and less narrowly tech-concentrated than during the Dotcom bubble.

Table 1: Return indicators for NASDAQ during Dotcom and AI period

Indicators	Dotcom Bubble (1998–2000)	AI Boom (2022–2025)
Total return	299.7 % benchmark: 43.2%	127.9 % benchmark: 86. 9%
Average annual return	173.3 %	63,9%
Compound annual growth rate (CAGR)	111.3%	31.7%
Highest growth within the index	1553 % (Innodata Inc.)	2027 % (Palantir Technologies)
Highest P/E ratio within the index	1001 (Yahoo!)	623 (Palantir Technologies)

Source: own calculations according to data from Yahoo Finance and Bloomberg

The difference in performance is also evident in average annual returns and compound annual growth rates (CAGR), with the Dotcom period showing 173.3% average annual return and 111.3% CAGR versus 63.9% and 31.7% for the AI period, respectively. However, when examining individual stock performers, it is revealed that the AI period has produced some exceptionally high growth cases: for instance, Palantir Technologies Inc. (PLTR) recorded a two-year return of 2,027%, surpassing the highest-performing Dotcom stock in our dataset (Innodata Inc., 1,553%). It should be noted, however, that during the Dotcom era most companies were not yet publicly traded and awaited IPOs, so other firms may have experienced even larger growth that is not captured in publicly available data.

Finally, in terms of valuation, both periods feature companies with extreme future growth expectations, as reflected in the highest P/E ratios: Yahoo! reached 1,001 at the peak of the Dotcom period, while Palantir reached 623 during current AI boom. These findings indicate that speculative expectations were significant in both episodes, setting the stage for our subsequent analysis of P/E ratios to assess potential overvaluation.

Within the below depicted Table 2 we present a comparison of P/E ratios for the dominant technology firms of each period to universally quantify the degree of market overvaluation. During the peak of the Dotcom bubble in 2000, the then famous Four Horsemen group — consisting of companies Microsoft (77), Intel (183), Cisco (196), and Oracle (159) — exhibited extraordinarily high P/E ratios, with Cisco reaching 196, meaning it was traded at nearly 200 times the earnings it actually generated. These extreme multiples highlight the

speculative nature of the market, where prices were driven far above fundamental earnings acquired from internet-related activities.

Table 2: P/E ratios of leading tech companies during each technological era

Time period	Company	Stock ticker	P/E ratio
Dotcom bubble	Microsoft	MSFT	77
(Four Horsemen)	Intel	INTC	183
	Cisco	CSCO	196
	Oracle	ORCL	159
AI boom	Apple	AAPL	37
(Magnificent 7)	Microsoft	MSFT	36
	NVIDIA	NVDA	67
	Amazon	AMZN	60
	Meta	META	27
	Alphabet	GOOGL	23
	Tesla	TSLA	79

Source: own calculations according to data from Yahoo Finance

In comparison, the AI period shows, as of end of 2024, definitely elevated, but relatively lower annual P/E ratios for the Magnificent 7. Tesla tops this group at 79, followed by Nvidia at 67, Amazon at 60, Apple at 37, Microsoft at 36, Meta at 27, and Alphabet at 23 times their earnings value. While all these ratios clearly exceed the commonly cited long-term benchmark of 20 for indicated overvaluation (Shiller, 2000; Lombardi & Pinter, 2024), for now they remain substantially below the extreme levels of the Dotcom era. Notably, the highest P/E ratio observed in the AI sample — 79 for Tesla — remains less than half of that highlighted during the Dotcom peak, where Cisco traded at a multiple of 196. This may reflect the fact that many AI-related companies are already generating substantially growing earnings — particularly firms like NVIDIA, which continues to deliver strong revenue and therefore somewhat support its unprecedently elevated valuation. Since the P/E ratio is, as was shown in formula 3, calculated by dividing price by earnings, higher earnings increase the denominator and therefore result in lower P/E values, helping to justify the comparatively lower ratios seen in the ongoing AI boom.

This all together suggests that while AI valuations are definitely above the historical norms and indicate potential overvaluation, the intensity of speculative excess has not yet reached the extreme levels observed during the

Dotcom bubble, and the growth story for AI companies may still have the momentum to continue if earnings keep expanding.

5 DISCUSSION AND CONCLUSION

This paper intended to examine the ongoing AI boom in the complementary context of historical technology bubbles, with a particular focus on the Dotcom era. To achieve this, we conducted a comparative analysis of valuation metrics and performance indicators, with special attention to the Shiller's P/E ratio as a benchmark for quantifying potential overvaluation.

Our results indicate that both the Dotcom and AI periods exhibit signals of overvaluation based on the historical threshold of P/E ratio at 20, as was previously formalized by Shiller (2000). During the Dotcom era, the NASDAQ technological stock index experienced an extraordinary total return of 299.7% over the two-year period from March 1998 to March 2000, with individual companies achieving growth of 1,553%, and extreme P/E ratios reaching over 1000. In comparison, the AI period from October 2022 to October 2025 also shows elevated aggregated returns (total return of 127.9%) and high-performing individual stocks such as Palantir Technologies Inc. with a two-year growth of 2,027% and a peak P/E of 623. While these numbers indicate significant optimism and potential overvaluation, they overall remain lower than the extreme multiples observed during the Dotcom bubble. These findings are consistent with referred previous research, such as Shiller (2000) and Ofek and Richardson (2003), who documented excessive optimism and unsustainable valuations as the defining features of the Dotcom era. Similarly, recent authors like Floridi (2024) and market analysts from Morningstar (2025) or J.P. Morgan Asset Management (2024) have pointed to comparable speculative dynamics in the ongoing AI boom, though often emphasizing stronger earnings fundamentals as a moderating factor. Our results therefore align with this view, suggesting that while the current AI market exhibits speculative tendencies, its valuation structure is more grounded in actual profitability compared to the purely irrational euphoria-driven Dotcom period.

However, several limitations of the research should be noted. First, regarding data limitations, the analysis relies exclusively on publicly available stock data, which excludes private companies, pre-IPO firms, and micro-level company financials that are often difficult to access or require multiple subscription-

based databases. Additionally, the relatively short time frame (three to five years for each technological boom) limits the assessment of long-term sustainability of valuations. Second, methodological limitations stem from the reliance on solely P/E ratios and aggregated return indicators as proxies for overvaluation or market irrationality. These metrics do not fully capture the scope of the impact of priced-in expectations, or other qualitative factors such as innovation's future potential and investor sentiment. Future research could therefore extend this study by incorporating a broader range of companies beyond the Magnificent 7, analyzing their role in larger technology indices to better capture market concentration effects, as well as eventually applying more complex econometric models that integrate economic, financial, and behavioral variables including the likes of investor sentiment, optimism, and herding — factors highly relevant for the study of innovation-induced financial bubbles.

Beyond these limitations, the paper contributes to the literature by presenting a systematic quantitative comparison of the AI boom with the Dotcom bubble, highlighting both similarities and differences in market behavior and valuation extremes. It fills a notable gap in current research, as few studies yet have examined AI-related market dynamics with this combined approach of graphical, performance indicator, and Shiller P/E analysis. Utilizing multiple research methods, our findings suggest in a novel way that although both technological waves demonstrate valuation levels exceeding traditional overvaluation thresholds, the AI period appears comparatively healthier due to stronger earnings performance — an insight that may be valuable for investors in forming unique strategies and making informed future decisions.

Nevertheless, while today's valuations are supported by better financial fundamentals, the sustainability of the AI boom seems to be dependent on continued exceptional earnings that markets are already pricing in. This dependency, coupled with other identified parallels to the Dotcom bubble, introduces a latent risk: should earnings growth fail to meet investors' expectations, the AI-driven stock market could experience sharp correction even if AI's technological transformation continues. This dynamic emphasizes the importance of ongoing monitoring and continued research, following up on the framework presented in this paper, to better anticipate and mitigate any potential negative consequences of another innovation-driven bubble.

AFFILIATION

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