

Impact of ChatGPT Release on High-tech Company, Evidence of NVIDIA's Stock

Yuyu Zheng¹, Yiqi Feng²

¹*School of Management and Economics, The Chinese University of Hong Kong (Shenzhen),
Guangdong, 518000, China*

²*Beijing Open Economy Research Institute, University of International Business and Economics,
Beijing, 100105, China*

Keywords: ChatGPT, AI and finance, high-tech company

Abstract: This research examines the impact of ChatGPT releases on the graphics card manufacturer NVIDIA and finds that there is a significant positive cumulative abnormal return in NVIDIA's stock price during the event window around the release of ChatGPT-3.5 and ChatGPT-4 by difference methods. Furthermore, the research also delves into the potential influence of ChatGPT on investors' investment decisions.

1. Introduction

The underlying technologies of artificial intelligence, such as machine learning, natural language processing, and deep learning, heavily rely on the computational performance and parallel processing capabilities of graphics processing units (GPUs). Therefore, the release of ChatGPT models, such as ChatGPT-3.5 and ChatGPT-4, which are significant advancements in natural language processing and AI, leads to a surge in demand for high-performance GPUs. This increased demand directly benefits NVIDIA, as the company is a leading manufacturer of graphics processing units, and their GPUs are integral for training and running large-scale AI models like ChatGPT. This fosters a positive outlook for NVIDIA's future revenue streams, which would increase the value of the stock and is supposed to generate positive abnormal return in the event window. The launch of GPT and its application, marked a significant milestone, bringing AI to the forefront of industry and academia[1]. For industry development, A.Shaji George, A.S.Hovan George, and A.S.Gabrio Martin[2] delves into the significant advancements in artificial intelligence, highlighting ChatGPT's role in enhancing various sectors including e-commerce, education, entertainment, finance, health, news, and productivity. Through an examination of current and potential future use cases, the discussion further touches on the customization of user content and the optimization of business customer service. For the impact on stock return, Beckmann and Hark[3] empirically analyze US stock market reactions to ChatGPT's launch, and extracts the expectations of market participants to gauge potential future implications of ChatGPT for banks. The results indicate a significant negative stock market reaction of US bank stocks, with notable disparities between different bank types.

2. Event-study

2.1 Event Window Choice

I use the event-study method used by Flammer[4] to study the impact of ChaptGPT release. To observe the impact of the release of ChatGPT 3.5 and ChatGPT 4 on NVIDIA's stock price separately, I have selected the release date of ChatGPT 3.5, which is November 30, 2022, and the release date of ChatGPT 4, which is March 14, 2023, as the event dates (day 0) for the event study and (-30, 30) trading days as the event window. I expect that positive abnormal return could be found in both event windows, since both ChatGPT 3.5 and ChatGPT 4 achieve obvious technical improvement than former version and is a milestone in the development of large language model (LLM) and Artificial Intelligence Generated Content (AIGC). I choose these two events rather than just one event as the project guideline required to observe whether there is similar or difference between the impact of them.

2.2 Estimate the Abnormal Return

I first use the CAPM model to estimate the abnormal return (AR). The coefficients α and β of the CAPM model are estimated by ordinary least squares (OLS) based on pre-event estimation window, which is (-300, -60) trading days of the event date as the guideline required. Formally, I estimate:

$$R_t - R_{f,t} = \alpha + \beta \times (R_{m,t} - R_{f,t}) + \varepsilon_t$$

Where R_t is the return on the stock of NVIDIA on day t , $R_{m,t}$ is the daily market return, $R_{f,t}$ is the risk-free rate and ε_t is the residual. I use the S&P 500 index for $R_{m,t}$ and one month treasury bill rate for $R_{f,t}$. All the return data is downloaded from Wharton Research Data Services (WRDS).

I then calculate the abnormal daily return AR_t of NVIDIA on day t and cumulative abnormal return (CAR) as follows:

$$AR_t = R_t - \hat{R}_t$$

$$CAR = \sum_{t=t_1}^{t_2} AR_t$$

Table 1: Abnormal Returns Estimation Methods for Two Events

Event	Abnormal returns	Estimation model	Pre-event estimation window	Purpose
GPT 3.5 release	AR1	CAPM	(-300,60)	guideline required
	AR2	CAPM	(-200, 60)	robustness check
	AR3	3 factor model	(-300, 60)	robustness check
	AR4	3 factor model	(-200, 60)	robustness check
GPT 4 release	AR5	CAPM	(-300, 60)	guideline required
	AR6	CAPM	(-200, 60)	robustness check
	AR7	3 factor model	(-300, 60)	robustness check
	AR8	3 factor model	(-200, 60)	robustness check

Where \hat{R}_t is the estimated return on the stock of NVIDIA on day t . For the robustness checks, I also estimate \hat{R}_t using CAPM model based on (-200, -60) trading days and Fama-French three factor model based on (-300, -60) and (-200, -60) trading days separately. The factor data is also downloaded from WRDS. For both the event study of ChatGPT 3.5 release and ChatGPT 4 release, I use the same method, as shown in Table 1.

2.3 Estimation Result and Discussion

As shown in Figure 1 and Figure 2, the abnormal returns estimated by different methods for the same event are closely aligned, despite minor discrepancies, with correlation coefficients exceeding 0.9. This demonstrates the robustness of the abnormal return estimation.

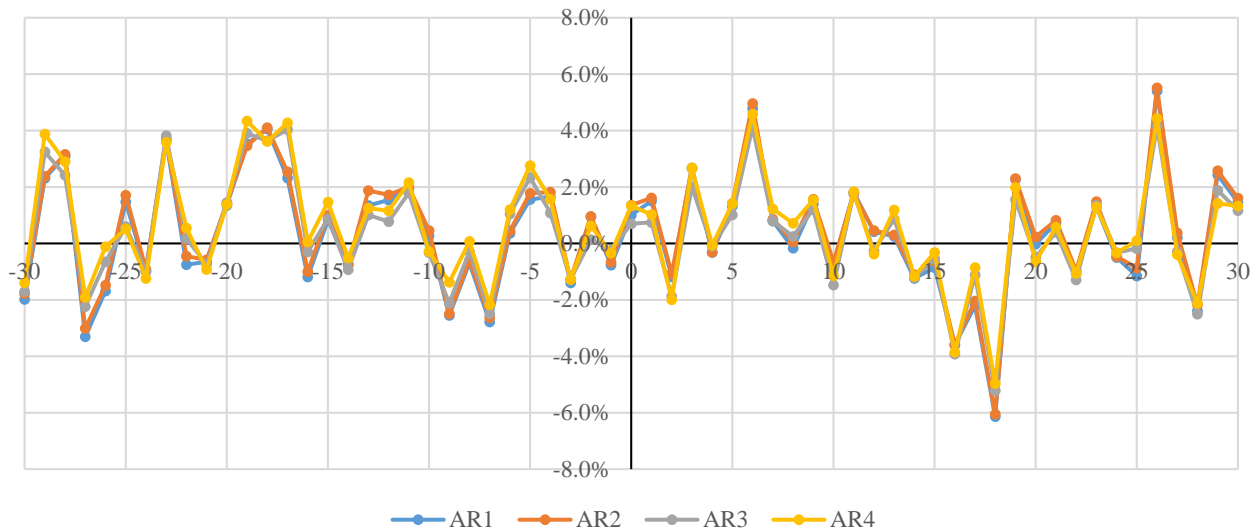


Figure 1: Abnormal Return for ChatGPT 3.5 Release

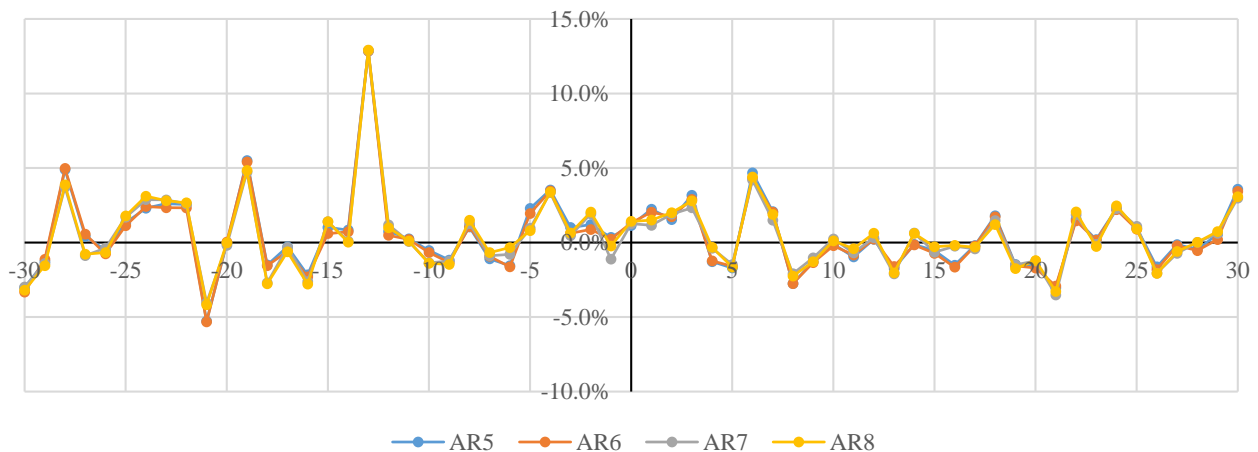


Figure 2: Abnormal Return for ChatGPT 4 Release

The cumulative abnormal returns for the ChatGPT 3.5 release and ChatGPT 4 release are illustrated in Figure 3 and Figure 4. Similar to the robustness displayed by the ARs, although the CARs estimated by different methods may exhibit slight variances, their overall trends are largely consistent. The CARs trend to increase during the event window for both the release of ChatGPT 3.5 and ChatGPT 4 and the overall CARs are around 20-30%, which would not be ignored. The

overall positive CARs consist with the previous hypothesis that the release of ChatGPT indeed increases the value of NVIDIA, which is driven by the increasing demand for GPUs as discussed previously. Medias also reported that Open AI used more than 10 thousand pieces of GPUs to train ChatGPT 3.5 and more than 30 thousand pieces of GPUs to train ChatGPT 4. The price of GPU also increased about 25% during last half year, as shown by the data of website BestValueGPU. It is plausible that the huge development of AI largely increases the demand for computing power and GPUs.

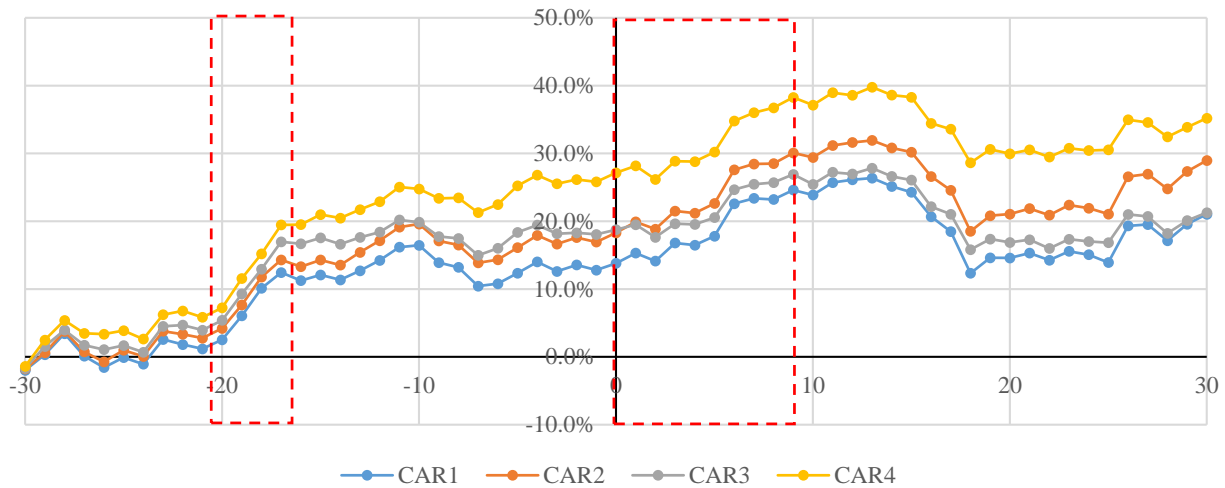


Figure 3: Cumulative Abnormal Return for ChatGPT 3.5 Release

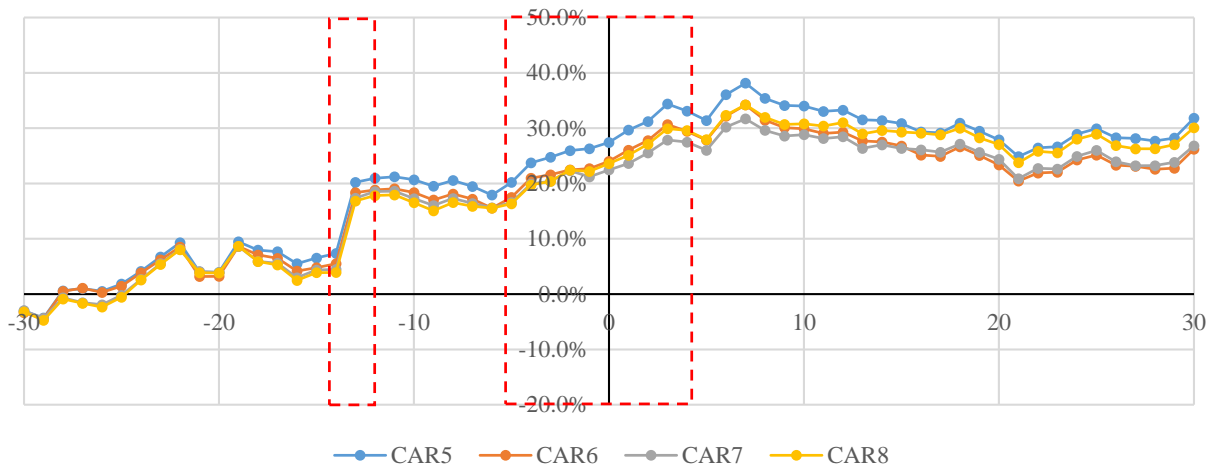


Figure 4: Cumulative Abnormal Return for ChatGPT 4 Release

There are also two interesting findings from the CAR plots. Firstly, in both events, there is a noticeable increasing in CARs approximately half a month before the event date, occurring between (-20, 17) trading days for the release of ChatGPT 3.5, and (-14, 13) trading days for the release of ChatGPT 4. The positive ARs during this period are attributed to the announcement and news of OpenAI's upcoming release of the new version of ChatGPT on the event date, which, as previously discussed, is favorable news for NVIDIA. Furthermore, while there are positive ARs surrounding the release of both versions of ChatGPT, the timing of these periods differs. The rise in CAR occurs in the 10-day event window of (0, 9) for the release of ChatGPT 3.5, and (-5, 4) for the release of ChatGPT 4. In essence, there are positive ARs in the days following the release of ChatGPT 3.5, as well as in the days both before and after the release of ChatGPT 4. This aligns with the average ARs

near the release of ChatGPT as shown in Table 2. The ARs in (-5, 4) trading days are all statistically insignificant, whereas the ARs in (0, 9) trading days are all statistically significant for the release of ChatGPT 3.5. Conversely, the ARs in (-5, 4) trading days are all statistically significant, and the ARs in (0, 9) trading days are all statistically insignificant for the release of ChatGPT 4.

Despite the lack of conclusive evidence, my intuition offers an explanation for this finding. Due to the significant advancements of ChatGPT 3.5 compared to 3.0, users and investors could not anticipate its groundbreaking progress before its official release. As a result, NVIDIA's stock did not exhibit significant positive ARs in the days leading up to the release. However, after the official release of ChatGPT 3.5, people marveled at its outstanding performance and substantial progress, leading to widespread recognition of its potential. Consequently, NVIDIA's stock experienced significant positive ARs. In the case of the ChatGPT 4 release event, due to the groundwork laid by ChatGPT 3.5, people already had some expectations regarding the capabilities of ChatGPT 4. As a result, NVIDIA's stock began to show positive ARs in the days leading up to the official release. In other words, compared to the release of ChatGPT 3.5, the 10-day event window during which NVIDIA's stock exhibited significant positive ARs for the release of ChatGPT 4 occurred earlier, as people did not need to wait for the official release to recognize its immense potential and value.

Table 2: Average Daily ARs near the Release of ChatGPT

ChatGPT 3.5	AR1	AR2	AR3	AR4
(-5, 4) trading days	0.0057	0.0069	0.0035	0.0063
	(0.0044)	(0.0044)	(0.0042)	(0.0050)
(0, 9) trading days	0.0118*	0.0131**	0.0089*	0.0125**
	(0.0053)	(0.0053)	(0.0048)	(0.0054)
ChatGPT 4	AR5	AR6	AR7	AR8
(-5, 4) trading days	0.0152***	0.0139**	0.0119**	0.0140***
	(0.0044)	(0.0043)	(0.0041)	(0.0038)
(0, 9) trading days	0.0078	0.0074	0.0074	0.0085
	(0.0076)	(0.0073)	(0.0062)	(0.0068)

*, **, *** denote statistical significance at 10%, 5%, 1% respectively

3. Investment Ability Effected by Generative Artificial Intelligence

3.1 Investment Utilizing Generative Artificial Intelligence

As the foundational technology of artificial intelligence is rooted in data science, there is an inherent link between AI and data analysis. This synergy can be leveraged to make informed investment decisions, which are heavily reliant on the interpretation and understanding of financial data. Khan and Umer [5] discusses the transformative advent of ChatGPT, a generative AI tool, in finance, highlighting its capacity for natural language interaction. However, its deployment raises significant ethical considerations, necessitating careful evaluation for responsible use.

The most profound impact of generative artificial intelligence on investment decision-making lies in text analysis. Text data, by its unstructured nature, presents a greater analytical challenge compared to more orderly data forms. However, this also implies that text data, including news, firm announcement and profit forecast, is rich with insights crucial for investment decisions, such as factual content, sentiment, and causal inferences, all of which are valuable for discovering market trends and investor behavior. The text analysis ability of generative artificial intelligence could greatly contribute to the solution for the problem, since it can deeply understand and handle the

complexity of natural language, provide valuable insights, and assist in making data-driven decisions. Scholars and researchers are actively exploring this frontier to harness its full potential. Chen, Kelly, and Xiu [6] utilize advanced large language models for extracting contextualized representations from news texts to predict stock returns, surpassing traditional word-based methods like bag-of-words. The study of Fatouros [7] breaks new ground by investigating the potential of large language models, particularly ChatGPT 3.5, in financial sentiment analysis, with a strong emphasis on the foreign exchange market.

Another notably important ability of generative artificial intelligence is programming effectively. Generative artificial intelligence such as ChatGPT is trained on extensive programming-related data, including code repositories, documentation, and forums. This exposure enables the model to understand and generate syntactically correct code. Developers can engage in dialogue with ChatGPT models to receive programming suggestions and solutions, which could significantly accelerate problem-solving. With the assisting of generative artificial intelligence, quant traders could be freed from the heavy workload of programming and focus more on alpha seeking and investment strategies.

Lastly, generative artificial intelligence could be directly utilized to analyze stock market data due to its remarkable ability in complex and real-time data processing, time-series analysis, and pattern recognition and prediction. In general, with the help of generative artificial intelligence, investor could make investment decision more effectively and accurately. While generative AI can enhance investor decision-making by providing deeper insights and more accurate predictions, it's important to acknowledge the diverse outcomes based on individual interpretation and application of these insights. Overall, generative artificial intelligence presents a powerful tool for investors, but its impact on the market should be assessed with a balanced understanding of its capabilities and limitations

3.2 Gap between Investors

While certain generative artificial intelligence tools are open-source and readily accessible, potentially enhancing performance and skill for retail investors, the disparity between retail and institutional investors could still be further widened.

The primary concern in leveraging generative artificial intelligence lies in the cost and resources required. Significant computing power is essential for both training and operating these AI systems, entailing substantial expenses that are often beyond the reach of retail investors. On the other hand, institutional investors usually possess more extensive resources, advanced infrastructure, and better access to cutting-edge models. This disparity in access and resource allocation potentially exacerbates the capability gap between individual and institutional investors, with the latter being better equipped to harness the full potential of these advanced tools.

Another concern is the skill requirement. Though the casual use of generative AI models is nearly zero-threshold, the effective use of generative AI models requires a certain level of skill, prompt engineering for instance, and understanding of both the technology and the financial markets. Institutional investors usually have teams with specialized skills to leverage these models optimally, while individual investors might find it challenging to use these tools to their full potential without similar expertise.

Last but not least, the application of AI models also comes with its associated risks and risk management is always essential for investment. Institutional investors are generally better equipped for risk management when using advanced AI tools, given their more comprehensive infrastructure and regulatory oversight. Individual investors might face higher risks, especially if they over-rely on AI without fully understanding its limitations.

4. Conclusion

This study illuminated the significant impact of ChatGPT releases on NVIDIA's stock, revealing notable positive cumulative abnormal returns around the release windows of ChatGPT-3.5 and ChatGPT-4. This phenomenon underscores the burgeoning demand for high-performance GPUs, essential for powering such advanced AI models, thus benefiting NVIDIA as a leading GPU manufacturer. Further exploration within this research highlighted ChatGPT's broadening influence on various sectors, including finance, where its capabilities can enhance investment decision-making through advanced text and data analysis. As we stand on the cusp of a new era marked by the integration of AI in everyday decision-making, it is imperative that stakeholders across the spectrum—from developers to investors, and policymakers—work collaboratively to foster an environment where the advantages of such technologies are accessible to all, ensuring that the promise of AI does not exacerbate existing inequalities but rather serves as a catalyst for innovation and inclusivity in the financial landscape and other areas of society.

References

- [1] Y. Cao and J. Zhai, "Bridging the gap – the impact of ChatGPT on financial research," *Journal of Chinese Economic and Business Studies*, vol. 21, no. 2, pp. 177–191, Apr. 2023, doi: 10.1080/14765284.2023.2212434.
- [2] A. Shaji George, A. S. Hovan George, and A. S. Gabrio Martin, "A Review of ChatGPT AI's Impact on Several Business Sectors," Feb. 2023, doi: 10.5281/ZENODO.7644359.
- [3] L. Beckmann and P. F. Hark, "ChatGPT and the banking business: Insights from the US stock market on potential implications for banks," *Finance Research Letters*, p. 105237, Mar. 2024, doi: 10.1016/j.frl.2024.105237.
- [4] C. Flammer, "Corporate Social Responsibility and Shareholder Reaction: The Environmental Awareness of Investors," *AMJ*, vol. 56, no. 3, Art. no. 3, Jun. 2013, doi: 10.5465/amj.2011.0744.
- [5] M. S. Khan and H. Umer, "ChatGPT in finance: Applications, challenges, and solutions," *Heliyon*, vol. 10, no. 2, p. e24890, Jan. 2024, doi: 10.1016/j.heliyon.2024.e24890.
- [6] Y. Chen, B. T. Kelly, and D. Xiu, "Expected Returns and Large Language Models." Rochester, NY, Nov. 22, 2022. Accessed: Nov. 25, 2023. [Online]. Available: <https://papers.ssrn.com/abstract=4416687>
- [7] G. Fatouros, J. Soldatos, K. Kouroumali, G. Makridis, and D. Kyriazis, "Transforming sentiment analysis in the financial domain with ChatGPT," *Machine Learning with Applications*, vol. 14, p. 100508, Dec. 2023, doi: 10.1016/j.mlwa.2023.100508.