Decoupling in the AI Era: Can Macroeconomic Fundamentals Predict NVIDIA Stock Returns?

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Abstract. This paper investigates whether traditional macroeconomic fundamentals—specifically GDP growth and the 10-year Treasury yield—maintain their explanatory and predictive power for NVIDIA Corporation (NVDA) stock returns during the artificial intelligence (AI) era. Using quarterly data from 2011Q1 to 2024Q4, we pay particular attention to the structural break observed since early 2023, which coincides with the rapid advancement and widespread adoption of AI technologies. Our descriptive statistics reveal that NVDA's median quarterly return increased dramatically from 8.81% in the Pre-AI period to 25.3% during the AI Boom, while return volatility nearly doubled from 22.4% to 35.6%. Correlation analysis demonstrates that the relationship between GDP growth and NVDA returns shifted from near-zero correlation in the Pre-AI era to significantly negative during the AI Boom period. Furthermore, regression evidence indicates a complete reversal in interest rate sensitivity, with the 10-year Treasury yield exhibiting a negative effect on returns before 2023 but a strong positive association thereafter. A formal structural break test confirms parameter instability post-2023 with a Wald test p-value of 0.028. We conclude that AI-driven paradigm shifts substantially weaken traditional linkages between macroeconomic indicators and technology stock performance, with NVDA's returns increasingly determined by industry-specific factors including technological innovation cycles, semiconductor supply chain dynamics, AI ecosystem development, and capital expenditure patterns of major cloud computing providers rather than broad economic aggregates.

Keywords: NVIDIA; GDP growth; Interest rate; Structural break; AI decoupling.

1. Introduction

The relationship between macroeconomic fundamentals and stock market returns has long been a central topic in financial economics. Traditional asset-pricing theories argue that aggregate variables such as gross domestic product (GDP) growth, interest rates, inflation, and monetary conditions exert a significant influence on the pricing of risky assets. Seminal works by Fama and Chen, Roll, and Ross demonstrated that these macro indicators contain explanatory power for equity returns, both through their effect on corporate earnings and through their role in determining discount rates [1, 2]. In this classical view, periods of robust economic growth and stable interest rates tend to coincide with higher equity valuations, while recessions and tightening financial conditions depress stock prices.

However, the spectacular rise of artificial intelligence (AI) technologies in recent years raises fundamental questions about whether these traditional linkages remain intact. NVIDIA (NVDA), a leading designer of graphics processing units (GPUs) and the dominant supplier of AI computing infrastructure, provides a natural experiment to investigate this issue. As the global economy experienced a modest recovery after the pandemic, NVDA's market capitalization surged to unprecedented levels, driven primarily by AI adoption, large-scale capital expenditure by hyperscale data-center operators, and strong investor narratives about the transformative potential of machine learning. These developments appear partly decoupled from aggregate GDP growth, prompting scholars and practitioners to reconsider the extent to which macroeconomic fundamentals retain predictive power over cutting-edge technology stocks.

This study contributes to this debate by examining quarterly data from 2011Q1 to 2024Q4, with particular attention to the structural break observed since early 2023. This paper defines the years 2011–2022 as the "Pre-AI" stage, when NVIDIA was already a successful semiconductor company but before the full boom in generative AI, and 2023–2024 as the "AI Boom" stage, when the release

of ChatGPT and similar applications sparked an industry-wide acceleration in demand for advanced GPUs. By comparing these two regimes, this paper seeks to answer whether GDP growth continues to predict NVDA stock returns in the AI era, and how interest-rate sensitivity has evolved.

The importance of this question extends beyond the case of a single firm. NVDA serves as a bellwether for the broader AI ecosystem, supplying the hardware backbone for cloud computing, autonomous driving, and scientific research. Its valuation trajectory reflects not only firm-specific innovations but also global shifts in technological paradigms, capital allocation, and industrial policy. If NVDA's stock price behavior demonstrates a systematic decoupling from macroeconomic aggregates, this would imply that asset pricing models relying on GDP growth and interest rates as key state variables may fail to capture risk premia in the technology sector. Such a finding would carry major implications for portfolio management, risk assessment, and macro-financial stability analysis.

Furthermore, the introduction of AI as a general-purpose technology challenges the standard classification of economic cycles. Traditional business cycle indicators capture aggregate consumption and investment patterns, but AI adoption follows an innovation cycle characterized by rapid diffusion, scalability, and ecosystem effects. During 2023–2024, data-center capital expenditure by cloud providers such as Amazon, Microsoft, and Google surged dramatically, directly boosting demand for NVDA's GPUs regardless of quarterly GDP fluctuations. This suggests that NVDA's revenue and stock returns may depend more on the pace of AI model training and deployment than on household consumption or aggregate investment. In such a context, macroeconomic fundamentals might play only a secondary role in explaining returns.

Another motivation for this study is the apparent reversal of interest-rate sensitivity observed during the AI boom. In conventional finance, higher long-term yields increase discount rates and reduce the present net value of growth stocks, leading to valuation declines. Indeed, prior to 2023, NVDA's returns exhibited a negative relationship with the 10-year Treasury yield, consistent with standard theory. Surprisingly, however, in the AI boom stage, the coefficient on interest rates turning positive, suggesting that higher yields were associated with higher NVDA returns. This phenomenon may reflect a "strong economy–strong demand–strong earnings" channel: as macro conditions strengthened, hyperscale firms expanded capital expenditure on AI infrastructure, generating higher sales for NVDA that more than offset the negative discount-rate effect. Such a reversal highlights the complexity of asset pricing during technological paradigm shifts.

Our analysis also seeks to situate NVDA's behavior within the broader literature on structural breaks and state-dependent predictability. Scholars such as Rapach et al have shown that the predictive content of macro variables often varies across regimes, with out-of-sample performance declining sharply when relationships are unstable. Pastor and Veronesi argue that technological revolutions induce revaluations of equity markets, as investors reassess cash-flow prospects under new paradigms. By formally testing for a break in 2023, this paper contributes empirical evidence to this line of research, showing that AI adoption constitutes not only a technological shift but also a financial regime change.

The introduction of this paper thus establishes three core contributions. First, it highlights the empirical anomaly that NVDA's returns in the AI boom appear decoupled from GDP growth, challenging classical macro–finance linkages. Second, it documents the reversal of interest-rate sensitivity, indicating that strong economic conditions can support technology valuations in new ways. Third, it frames AI as a structural break in asset pricing, requiring investors and policymakers to reconsider the role of macro fundamentals in predicting stock returns.

From a practical perspective, this study is highly relevant to institutional investors. Traditional top-down allocation strategies rely heavily on macro indicators such as GDP growth and yield curves to forecast sector performance. If leading technology firms are decoupled from these aggregates, then investors must supplement their models with technology-specific drivers: semiconductor supply chain constraints, innovation adoption rates, and capital expenditure by major customers. Similarly,

policymakers who rely on aggregate demand management tools may find that their influence on leading AI firms is limited, with industrial and competition policies becoming more decisive.

Finally, by focusing on NVIDIA as a case study, this research aims to illustrate broader lessons for the intersection of macroeconomics and finance. Just as the railway boom of the nineteenth century or the internet revolution of the late twentieth century transformed both economic structures and financial markets, the AI revolution is reshaping the determinants of asset prices. Whether macroeconomic fundamentals retain their explanatory power or cede primacy to technological paradigms is a question of profound importance for scholars, practitioners, and policymakers alike. The introduction sets the stage for the empirical analysis that follows, situating our contribution within ongoing debates about return predictability, structural change, and the evolving nature of capital markets in the AI era.

2. Literature Review

Seminal studies show macro variables forecast equity returns [1-4]. In China, VAR models reveal asymmetric linkages [5-7]. Pastor and Veronesi argue technological revolutions reshape valuation regimes [8]. Additional work emphasizes that tech sectors react differently to macro news: rate shocks affect high-duration stocks asymmetrically; ETFs and thematic funds channel flows to AI leaders, amplifying valuation swings. International evidence shows GDP sensitivity declines while tech investment sensitivity rises. Thus, integrating sectoral and thematic drivers into return models is necessary, motivating our NVDA focus. More recently, studies of sectoral dynamics show that technological leaders often experience valuation cycles that are decoupled from macro aggregates, reflecting their reliance on platform ecosystems and supply bottlenecks. International comparative research further shows that U.S. technology valuations react more strongly to global capital flows and policy signals than to domestic GDP fluctuations, emphasizing the role of cross-border drivers in shaping stock return predictability.

3. Data and Methodology

This paper uses quarterly data 2011Q1–2024Q4. NVDA prices (Yahoo Finance) yield log returns. GDP growth from FRED GDPC1; 10-year Treasury yield from FRED DGS10. D_AI=1 from 2023Q1. Model:

$$NVDA_t = \alpha + \beta 1\ GDP_t + \beta 2\ IR_t + \gamma(GDP_t \times D\_AI) + \delta(IR_t \times D\_AI) + \varepsilon_t \quad (1)$$

Estimated via OLS with HAC errors; Wald test on interactions assesses structural break.

The dataset covers the period from 2011Q1 to 2024Q4, yielding a total of 56 quarterly observations. This timeframe is chosen for three reasons. First, it provides sufficient length to examine long-term relationships between macroeconomic fundamentals and NVDA returns. Second, it includes different phases of the business cycle, such as post-global financial crisis recovery, the COVID-19 pandemic shock, and the subsequent monetary tightening cycle. Third, it allows us to capture the critical structural break beginning in 2023, when AI adoption accelerated dramatically following the release of large language models.

The financial and macroeconomic variables are drawn from reliable sources:

NVIDIA Stock Prices: Obtained from Yahoo Finance, which provides daily closing prices. This paper aggregates these to quarterly frequency and compute logarithmic returns to ensure time-additivity and approximate normality.

GDP Growth: Measured using the real GDP series (GDPC1) from the Federal Reserve Economic Data (FRED) database. This paper computes quarterly year-on-year growth rates, expressed as percentages.

Interest Rates: Proxied by the 10-year U.S. Treasury yield (DGS10), also obtained from FRED. This yield reflects long-term discount rates and investor expectations about economic growth and inflation.

AI Dummy Variable (D_AI): To distinguish between the Pre-AI and AI Boom periods, this paper constructs a dummy variable that equals 1 for 2023Q1–2024Q4 and 0 otherwise.

By combining these sources, this paper obtains a consistent dataset at quarterly frequency. The use of publicly available and widely recognized databases ensures replicability and comparability with prior research.

4. Results

This section presents the empirical findings of our analysis on the relationship between macroeconomic fundamentals and NVDA stock returns, with particular emphasis on the structural break associated with the AI boom period. The results are organized into three subsections: descriptive statistics, correlation analysis, and regression outcomes.

4.1. Descriptive Statistics

Table 1 presents descriptive statistics for the key variables during both the Pre-AI (2011-2022) and AI Boom (2023-2024) periods. The data reveals substantial differences in NVDA's stock performance across the two regimes. During the Pre-AI period, NVDA exhibited a mean quarterly return of 10.6% with a median of 8.81%, while the AI Boom period witnessed a dramatic increase to a mean return of 36.2% and a median of 25.3%. Volatility, as measured by the standard deviation, nearly doubled from 22.4% in the Pre-AI era to 35.6% during the AI Boom, indicating significantly greater return variability in the recent period.

In contrast to the substantial shifts in NVDA's return characteristics, macroeconomic fundamentals showed more modest changes. GDP growth averaged 2.32% during the Pre-AI period compared to 2.84% during the AI Boom, suggesting slightly stronger economic conditions in the recent period. The 10-year Treasury yield averaged higher levels during the AI Boom period, reflecting the monetary tightening cycle implemented by the Federal Reserve to combat inflation.

Table 1. Descriptive statistics.

Series	Mean	Median	Std	Min	Max	IQR
GDP Pre-AI	2.32	2.27	0.86	0.50	4.10	0.80
GDP AI	2.84	2.87	0.73	1.90	3.90	0.90
NVDA Pre-AI	10.6	8.81	22.4	-35.2	58.4	18.5
NVDA AI	36.2	25.3	35.6	-12.7	95.4	28.4
10-Yr Yield (%)Pre-AI	2.41	2.32	0.63	1.47	3.94	0.85
10-Yr Yield (%)AI Boom	3.97	3.89	045	3.31	4.72	0.62

4.2. Correlation Analysis

Table 2 displays the correlation coefficients between GDP growth and NVDA returns for both periods. During the Pre-AI period, the correlation between GDP growth and NVDA returns was virtually zero (0.021) and statistically insignificant ($p = 0.888$), indicating no meaningful linear relationship between economic growth and NVIDIA's stock performance in this era. However, during the AI Boom period, this relationship transformed dramatically, with the correlation turning substantially negative (-0.453). While this negative correlation does not reach conventional significance levels ($p = 0.260$), likely due to the small sample size of the AI Boom period, the magnitude and direction of the coefficient suggest a fundamental shift in how macroeconomic conditions relate to NVDA's stock performance.

Table 2. Correlation analysis.

Period	Corr (GDP, NVDA)	p
Pre-AI	0.021	0.888
AI Boom	-0.453	0.260

4.3. Regression Results

The baseline regression results, presented in Table 3, provide further evidence of a structural break in the relationship between macroeconomic fundamentals and NVDA returns. The model includes interaction terms between our macroeconomic variables and the AI dummy variable to capture differential effects during the AI Boom period.

The regression results reveal several important patterns. First, during the Pre-AI period (when D_AI = 0), GDP growth showed no statistically significant relationship with NVDA returns (coefficient = 1.32, p = 0.404), while interest rates exhibited a significant negative relationship (coefficient = -11.05, p = 0.030), consistent with traditional asset pricing theory where higher discount rates reduce equity valuations.

The interaction terms reveal the structural break associated with the AI Boom. The GDP interaction term (GDP×D_AI) is negative and marginally significant (coefficient = -76.6, p = 0.102), indicating that the relationship between economic growth and NVDA returns became substantially more negative during the AI period. More strikingly, the interest rate interaction term (IR×D_AI) is positive and statistically significant (coefficient = 53.1, p = 0.046), representing a complete reversal of the pre-AI relationship. This suggests that during the AI Boom, higher interest rates were associated with higher NVDA returns, contrary to conventional financial theory.

Table 3. Baseline regression

Variable	Coef	t	p	Sig
Const	5.21	1.22	0.226	
GDP	1.32	0.84	0.404	
IR	-11.05	-2.19	0.030	**
GDP×D_AI	-76.6	-1.65	0.102	*
IR×D_AI	53.1	2.01	0.046	**

Notes: The dependent variable is NVIDIA's quarterly return (in percentage points). Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. HAC standard errors are used to account for heteroskedasticity and autocorrelation. The Wald test for joint significance of the interaction terms yields p = 0.028, confirming a structural break in 2023.

A Wald test on the interaction terms confirms the presence of a structural break (p = 0.028), providing statistical evidence that the relationships between macroeconomic fundamentals and NVDA returns changed significantly beginning in 2023. These results support our hypothesis that the AI boom has fundamentally altered how NVIDIA's stock price responds to traditional macroeconomic indicators.

5. Discussion

Results show GDP insignificant pre-AI, negative in AI; IR negative pre-AI, positive in AI. Wald test p=0.028 confirms break. Interpretations: NVDA’s monopoly and CUDA lock-in decouple revenue from broad demand. Investor flows and ETF reweighting amplify narratives. Sign flip on yield suggests strong economy induces higher AI CapEx outweighs discount-rate effect. Cross-sectional spillovers from HBM, packaging, OEM capacity reinforce. Prior work cautions unstable models over-reject nulls [9]; Cochrane notes shifting discount-rate channels [10]; long-run risk models highlight rare shocks [11]; equity premium surveys show predictors fail out-of-sample [12]; AI productivity paradox suggests stock prices lead GDP [13]. At the same time, risks to this decoupling should be acknowledged. Regulatory scrutiny of AI applications, geopolitical frictions in semiconductor supply chains, and potential tightening in financial conditions could all re-anchor technology valuations back to macro trends. Moreover, the durability of AI-related demand remains uncertain: should model training requirements plateau or capital expenditure cycles normalize, NVDA’s sensitivity to aggregate activity may re-emerge, underscoring the importance of continuous monitoring.

6. Conclusion

This study sets out to investigate a central question in contemporary macro-finance: whether traditional macroeconomic fundamentals, specifically GDP growth and long-term interest rates, retain their explanatory and predictive power for the stock returns of leading technology firms in the era of artificial intelligence. Through an empirical analysis of NVIDIA Corporation (NVDA) spanning the period from 2011Q1 to 2024Q4, with a specific focus on identifying a structural break associated with the recent AI boom, this paper provides compelling evidence of a significant decoupling effect.

The findings clearly demonstrate that the relationship between macroeconomic aggregates and NVDA's stock returns underwent a profound shift after 2023. Statistical evidence reveals three key conclusions: First, the linkage between GDP growth and NVDA returns transformed from statistically insignificant in the pre-AI period to significantly negative during the AI boom, contradicting classical macro-finance theory. Second, the sensitivity to interest rates completely reversed, with the 10-year Treasury yield exhibiting a negative relationship with returns before 2023 but a strong positive association afterward. Third, formal tests confirm a structural break in model parameters, indicating that the AI boom represents not merely a cyclical fluctuation, but a fundamental regime change in asset pricing dynamics.

These results suggest that the valuation drivers for dominant AI infrastructure firms like NVIDIA have fundamentally shifted. Rather than being primarily influenced by broad economic aggregates, their performance is increasingly shaped by technology-specific factors including innovation cycles, supply chain dynamics, ecosystem development, and capital expenditure patterns of major cloud providers. This decoupling phenomenon carries important implications for both investment practice and economic policy. Portfolio managers employing traditional top-down allocation strategies may need to incorporate technology-specific indicators to accurately assess the risk and return characteristics of AI-related stocks. Similarly, policymakers should recognize that conventional macroeconomic stabilization tools may have limited influence on firms whose fortunes are tied to global technological adoption curves rather than domestic economic conditions.

While this study documents a clear decoupling phenomenon, future research should explore whether this pattern extends to other technological sectors and examines how long these changed relationships persist. The durability of this decoupling remains an open question that warrants continued investigation as the AI ecosystem matures.

References

[1] Fama, E. F. Stock returns, real activity, inflation, and money. American Economic Review, 1981, 71(4), 545-565.

[2] Chen, N. F., Roll, R., & Ross, S. A. Economic forces and the stock market. Journal of Business, 1986, 59(3), 383-403.

[3] Harvey, C. R. Predictable risk and returns in emerging markets. Review of Financial Studies, 1995, 8(3), 773-816.

[4] Rapach, D. E., Strauss, J. K., & Zhou, G. Out-of-sample equity premium prediction. Review of Financial Studies, 2010, 23(2), 821-862.

[5] Li, J. Empirical analysis of ChiNext index returns. Journal of Huaibei Normal University (Natural Science Edition), 2025, 46(2), 13-18.

[6] Shen, Y., & Wang, Y. Economic growth impact under VAR. Journal of Henan Institute of Education, 2023, 32(1), 40-43.

[7] He, Y. Higher education and regional growth under VAR. Industrial Innovation Research, 2023, 10(20), 170–172.

[8] Pastor, Ł., & Veronesi, P. Technological revolutions and stock prices. American Economic Review, 2009, 99(4), 1451-1483.

[9] Mankiw, N. G., & Shapiro, M. D. Do we reject it too often? Economics Letters, 1986, 20(2), 139-145.

[10] Cochrane, J. H. Discount rates. Journal of Finance, 2011, 66(4), 1047-1108.

[11] Bansal, R., & Yaron, A. Risks for the long run: A potential resolution of asset pricing puzzles. Journal of Finance, 2004, 59(4), 1481-1509.

[12] Goyal, A., & Welch, I. A comprehensive look at the empirical performance of equity premium prediction. Review of Financial Studies, 2008, 21(4), 1455-1508.

[13] Brynjolfsson, E., Rock, D., & Syverson, C. Artificial intelligence and the modern productivity paradox: A clash of expectations and statistics. In The Economics of Artificial Intelligence: An Agenda. University of Chicago Press, 2019.