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Research Article

The impact of artificial intelligence adoption on firm performance: A comparative analysis of Amazon and Walmart.

Authors' Name
Mohammed Rasheed Alghamdi

King Abdulaziz University, College of Business, Kingdom of Saudi Arabia.
email: ma663882@gmail.com

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Abstract

This study examines the relationship between artificial intelligence (AI) adoption and business performance through a comparative analysis of Amazon and Walmart over the period 2015–2023. The research aims to investigate whether higher levels of AI integration are associated with improved financial performance, growth, and profitability. The study is based on secondary financial data collected from annual reports and financial databases, using key performance indicators including revenue growth, return on assets (ROA), and return on equity (ROE). The findings reveal that Amazon, as a highly AI-driven company, experienced significantly higher revenue growth compared to Walmart, reflecting the role of AI in enhancing scalability, operational efficiency, and market expansion. However, the analysis also indicates that Amazon's profitability measures are more volatile, largely due to continuous reinvestment in technology and infrastructure. In contrast, Walmart demonstrates more stable profitability and financial consistency despite slower growth rates. The study concludes that AI adoption is more strongly associated with long-term growth and scalability than with immediate short-term profitability. The results further suggest that the effectiveness of AI depends on how firms integrate technological innovation into their broader business strategies. Although AI provides competitive advantages and operational improvements, its financial benefits may require time to materialize. The study contributes to the growing literature on AI and firm performance and highlights the importance of strategic management in maximizing the value of AI investments.

Keywords: Artificial Intelligence, AI Adoption, Business Performance, Financial Performance, Revenue Growth, ROA, and ROE.

1. Introduction

Artificial intelligence (AI) has emerged as one of the most influential technological advancements shaping contemporary business environments. Organizations across industries increasingly integrate AI-driven systems—such as machine learning, predictive analytics, and automation—into their core operations to enhance efficiency, improve decision-making, and create competitive advantage. As a result, AI is no longer perceived as a supplementary tool but rather as a strategic asset that can significantly influence firm performance and long-term value creation.

Within the retail sector, the adoption of AI has been particularly transformative. Companies such as Amazon have extensively implemented AI technologies across various functions, including recommendation systems, dynamic pricing, inventory management, and logistics optimization. These capabilities enable Amazon to operate at a high level of scalability and responsiveness, allowing it to expand rapidly in both digital and physical markets. In contrast, Walmart, one of the largest global retail competitors, has traditionally relied on operational efficiency, cost leadership, and supply chain excellence. Although Walmart has increasingly adopted digital technologies in recent years, its historical reliance on AI-driven systems has been comparatively more limited. This contrast provides a valuable context for examining how different levels of AI adoption may influence firm performance.

Despite the widespread adoption of AI, its direct impact on firm profitability remains a subject of ongoing academic debate. While numerous studies suggest that AI enhances productivity and operational efficiency, the translation of these improvements into financial performance is not always immediate. High implementation costs, organizational restructuring, and continuous reinvestment in technological infrastructure may reduce short-term profitability, even when long-term performance improves. This phenomenon is often referred to as the "productivity paradox," where technological advancements do not immediately result in measurable gains in financial outcomes.

Accordingly, this study aims to investigate the relationship between AI adoption and firm profitability by conducting a comparative empirical analysis of Amazon and Walmart over the period 2015–2023. The study focuses on key financial indicators, including revenue growth, return on assets (ROA), and return on equity (ROE), to evaluate differences in performance between a highly AI-driven firm and a more traditionally structured competitor. By analyzing firms operating within the same industry, this research seeks to isolate the role of AI adoption in shaping financial outcomes.

The significance of this study lies in its contribution to the existing literature on digital transformation and business performance. By combining theoretical insights with empirical financial

analysis, the research provides a clearer understanding of whether AI serves primarily as a driver of profitability or as a catalyst for long-term growth and competitive advantage. Furthermore, the findings may offer practical implications for managers and decision-makers seeking to evaluate the strategic value of AI investments in increasingly competitive markets. AI is expected to fundamentally reshape business operations and competitive dynamics in the future (West, 2018).

2. Literature Review

2.1 Artificial Intelligence and Firm Performance

Artificial intelligence (AI) has been widely recognized as a general-purpose technology with the potential to transform business operations and enhance firm performance. Unlike traditional information systems, AI enables organizations to process large volumes of data, generate predictive insights, and automate complex decision-making processes. As a result, firms that successfully integrate AI into their operations are often able to improve efficiency, reduce operational costs, and enhance strategic decision-making.

Brynjolfsson and McAfee (2017) argue that AI contributes to productivity growth by augmenting human capabilities and enabling data-driven management practices. Similarly, Cockburn et al. (2018) suggest that AI enhances innovation by allowing firms to extract valuable insights from data, thereby creating new business opportunities and competitive advantages. These perspectives position AI as a key driver of organizational performance in the digital economy.

Empirical evidence further supports this view. Wamba et al. (2020) find that AI capability is positively associated with firm performance, particularly through improvements in operational efficiency and responsiveness to market changes. Likewise, Mikalef and Gupta (2021) emphasize that AI enables firms to optimize resource allocation and improve process efficiency, which can lead to enhanced financial outcomes. Together, these studies suggest that AI plays a critical role in shaping modern business performance. AI also enhances customer engagement and decision-making capabilities, contributing to improved firm performance (Huang & Rust, 2021).

2.2 AI and Profitability

While artificial intelligence (AI) is widely associated with improvements in firm performance, its direct relationship with profitability remains complex and multifaceted. Profitability reflects a firm's ability to generate financial returns relative to its resources, and although AI can enhance operational efficiency, the translation of these improvements into immediate financial gains is not always

guaranteed.

AI can influence profitability through several key mechanisms. First, automation reduces labor and operational costs, leading to improved cost efficiency (Tambe et al., 2019). Second, AI-driven analytics enable firms to enhance customer targeting and personalization, which can increase revenue generation and improve market competitiveness (Mikalef & Gupta, 2021). Third, predictive models improve forecasting accuracy, allowing firms to optimize inventory management and reduce inefficiencies, ultimately contributing to better financial performance (Wamba et al., 2020).

However, despite these potential benefits, the impact of AI on profitability is not always immediate. The implementation of AI technologies often requires substantial investment in infrastructure, skilled labor, and system integration. These initial costs may offset short-term financial gains, particularly for firms that adopt aggressive growth and expansion strategies. As a result, firms may experience a temporary decline or fluctuation in profitability before realizing the long-term benefits of AI adoption.

Therefore, while AI has the potential to enhance profitability, its effects are highly dependent on the firm's strategic priorities, investment decisions, and time horizon. This suggests that AI should be viewed as a long-term enabler of value creation rather than a guaranteed driver of immediate financial performance. Automation technologies associated with AI can improve efficiency and reduce labor costs, thereby influencing firm profitability (Autor, 2015).

2.3 The Productivity Paradox and Time Lag Effect

Despite the theoretical benefits of AI, several scholars highlight a delay between technological adoption and observable improvements in financial performance. Brynjolfsson et al. (2019) describe this phenomenon as the "productivity paradox," where investments in advanced technologies do not immediately translate into measurable productivity or profitability gains (Brynjolfsson et al., 2019; Makridakis, 2017).

This delay can be explained by several factors. Firms often need time to restructure their operations, train employees, and integrate new technologies into existing systems. Additionally, early stages of AI adoption may involve experimentation and inefficiencies, which can temporarily reduce performance. Over time, however, as firms gain experience and optimize their use of AI, the benefits become more apparent. This perspective is particularly relevant when analyzing firms such as Amazon, which frequently reinvest profits into technological infrastructure and expansion. As a result, short-

term profitability may not fully capture the long-term benefits of AI adoption.

2.4 AI in the Retail Industry

The retail industry provides a practical context for examining the impact of artificial intelligence (AI) on firm performance. AI technologies are widely used in retail for demand forecasting, dynamic pricing, recommendation systems, and supply chain optimization.

Amazon is often cited as a leading example of AI integration in retail. Its recommendation algorithms, automated warehouses, and logistics systems enable it to operate efficiently at a large scale while continuously expanding its market presence (Brynjolfsson & McAfee, 2017). These capabilities support rapid revenue growth and enhance the firm's competitive advantage in both digital and physical markets.

In contrast, Walmart has traditionally relied on operational efficiency, cost leadership, and extensive physical store networks. While Walmart has increasingly adopted digital technologies in recent years, its level of AI integration has been comparatively more gradual (Davenport & Ronanki, 2018). This approach reflects a strategic focus on stability and efficiency rather than aggressive technological expansion.

This difference in technological intensity between Amazon and Walmart provides a suitable basis for comparison, allowing this study to examine how varying levels of AI adoption may influence financial performance within the same industry. AI technologies are increasingly integrated into business operations to enhance efficiency and decision-making processes (Davenport & Kirby, 2016).

3. Hypotheses Development

Building on the existing literature, artificial intelligence (AI) is widely recognized as a key driver of operational efficiency, innovation, and data-driven decision-making, all of which are expected to influence firm performance (Brynjolfsson & McAfee, 2017; Wamba et al., 2020). Prior studies suggest that AI enhances productivity by optimizing processes, reducing costs, and enabling more accurate forecasting, which may ultimately improve financial outcomes (Mikalef & Gupta, 2021).

However, the relationship between AI and profitability is not always immediate. Firms often incur significant investment costs and engage in continuous reinvestment strategies that may affect short-term financial performance, a phenomenon consistent with the "productivity paradox" (Brynjolfsson et al., 2019). In addition, differences in strategic orientation between firms may lead to

variations in how AI impacts performance. For example, firms with high levels of AI adoption, such as Amazon, tend to prioritize growth and scalability, which may result in higher revenue expansion but also greater variability in profitability. In contrast, firms with lower levels of AI adoption, such as Walmart, may demonstrate more stable financial performance due to their focus on operational efficiency and cost control.

Accordingly, this study hypothesizes that AI adoption is positively associated with firm performance, particularly in terms of growth, while also expecting differences in profitability patterns between AI-intensive and less AI-driven firms.

4. Methodology

This study adopts a quantitative comparative research design to examine the relationship between artificial intelligence (AI) adoption and firm profitability. The research focuses on two major firms operating within the same industry, Amazon and Walmart over the period 2015–2023. A comparative approach is employed to evaluate differences in financial performance between a firm with high AI adoption and a firm with relatively lower AI integration.

The study relies on secondary data obtained from publicly available sources, specifically the annual reports of Amazon and Walmart. These reports provide reliable and consistent financial information, including revenue, net income, total assets, and shareholders' equity. The use of secondary data ensures objectivity and allows for longitudinal analysis across multiple years. To measure firm performance, the study utilizes key financial indicators, including revenue growth, return on assets (ROA), and return on equity (ROE). Revenue growth is used to capture the expansion and scalability of the firm, while ROA and ROE are employed to assess profitability and efficiency in utilizing assets and equity. These variables are widely used in financial analysis and provide a comprehensive evaluation of firm performance.

AI adoption is treated as a proxy variable, where Amazon represents a high level of AI integration and Walmart represents a comparatively lower level. Although AI cannot be directly quantified, this classification is supported by the extent to which each firm incorporates AI technologies into its operations, such as automation, predictive analytics, and data-driven decision-making systems.

The analysis is conducted using Microsoft Excel, applying descriptive statistical techniques and time-series analysis. Financial data is organized and processed to calculate profitability ratios and

growth rates over the selected period. Trend analysis is used to examine changes in performance over time, while cross-company comparison is used to identify differences between Amazon and Walmart. In addition, graphical representations such as line charts and bar charts are utilized to support data interpretation and enhance clarity, consistent with standard statistical presentation methods.

To provide a more analytical perspective, the study also examines patterns and relationships between AI adoption and financial performance indicators. Although advanced econometric models are not employed due to the scope of the study, the analysis focuses on identifying consistent trends and differences that may indicate a relationship between AI usage and firm outcomes.

Several limitations should be acknowledged. First, AI adoption is measured indirectly through a proxy variable, which may not fully capture the complexity of technological implementation. Second, the study focuses on only two firms, which may limit generalizability. Third, financial performance may be influenced by external factors such as market conditions, competition, and strategic decisions, which are not fully controlled in this analysis.

Despite these limitations, the methodology provides a structured and systematic approach to examining the relationship between AI and firm performance, allowing for meaningful comparison and interpretation of results.

In addition to descriptive analysis, correlation analysis was conducted to examine the relationship between AI adoption and firm performance variables, including revenue growth, return on assets (ROA), and return on equity (ROE).

5. Data and Analysis

This section presents the financial data used in the study and provides a comparative analysis of firm performance between Amazon and Walmart over the period 2015–2023. The analysis focuses on key performance indicators, including revenue, net income, return on assets (ROA), and return on equity (ROE), in order to evaluate differences in growth and profitability between the two firms.

5.1 Data Description

The financial data used in this study is obtained from the annual reports of Amazon and Walmart. The dataset includes revenue, net income, total assets, and shareholders' equity for each year within the selected period. These variables are used to calculate profitability ratios and assess firm performance over time.

Amazon demonstrates significant expansion in revenue, growing from approximately $107 billion in 2015 to over $575 billion in 2023. This substantial increase reflects the firm's aggressive growth strategy and its extensive use of AI-driven technologies in areas such as logistics, recommendation systems, and cloud services. In contrast, Walmart shows a more stable growth pattern, with revenue increasing from approximately $485 billion to $611 billion over the same period. While Walmart's growth is less pronounced, it reflects a consistent and mature business model focused on operational efficiency.

5.2 Revenue and Growth Analysis

The comparison of revenue trends between Amazon and Walmart reveals clear differences in growth patterns over the period 2015–2023. Amazon demonstrates rapid and continuous revenue expansion, particularly after 2018, reflecting its strong growth strategy and increasing reliance on digital and AI-driven operations. In contrast, Walmart exhibits a more stable and gradual growth trajectory, indicating a consistent performance driven by its established retail model and operational efficiency.

To provide a clearer comparison, Figures 1 and 2 illustrate the annual revenue trends of Amazon and Walmart over the selected period.

Figure 1: Figure 2:

Amazon Annual Revenue (Millions of US $)	
2023	$574,785
2022	$513,983
2021	$469,822
2020	$386,064
2019	$280,522
2018	$232,887
2017	$177,866
2016	$135,987
2015	$107,006

Walmart Annual Revenue (Millions of US $)	
2023	$611,289
2022	$572,754
2021	$559,151
2020	$523,964
2019	$514,405
2018	$500,343
2017	$485,873
2016	$482,130
2015	$485,651

Source: Macrotrends (2024)

The figures show that Amazon's revenue growth is significantly steeper compared to Walmart, highlighting its ability to scale rapidly and expand its market presence. This trend is particularly evident in the later years, where Amazon's growth accelerates due to increased digital integration and technological capabilities. On the other hand, Walmart maintains a relatively stable upward trend, reflecting steady performance and lower volatility.

Overall, the comparison indicates that while Amazon achieves higher growth rates, Walmart demonstrates greater stability in revenue performance. This distinction highlights the difference between a growth-oriented strategy and a stability-oriented business model.

5.3 Profitability Analysis (ROA)

Return on Assets (ROA) is used to evaluate how efficiently a firm utilizes its assets to generate profit. It provides an indication of how well management is using the company's resources to produce earnings. To illustrate the differences in profitability efficiency between Amazon and Walmart, Figures 3 and 4 present the ROA trends for both firms over the period 2015–2023.

Figure 3: Amazon Return on Assets (2015–2023)

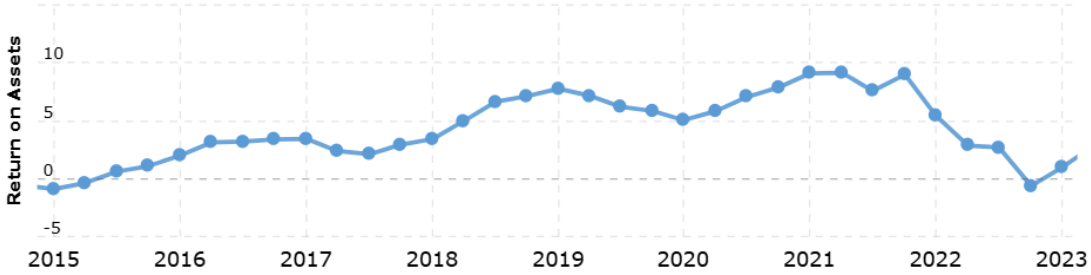
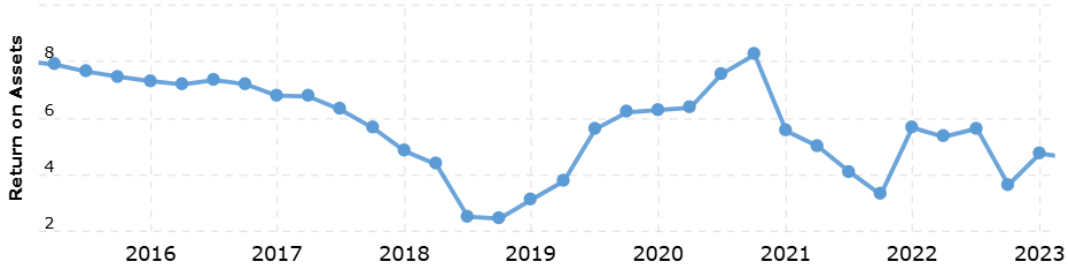


Figure 4: Walmart Return on Assets (2015–2023)



Source: Macrotrends (2024)

The figures indicate that Walmart maintains relatively stable ROA levels throughout the period, reflecting consistent efficiency in utilizing its assets. In contrast, Amazon exhibits greater variability in ROA, with noticeable fluctuations across different years. Despite this variability, Amazon shows an overall improvement in ROA over time.

This pattern suggests that Walmart prioritizes operational efficiency and stability, while Amazon's performance is influenced by its continuous investment and expansion strategies. As a result, Amazon's short-term efficiency appears less stable, although it improves gradually as the firm scales its operations.

5.4 Profitability Analysis (ROE)

Return on Equity (ROE) measures a firm's ability to generate returns for its shareholders and reflects how effectively a company uses its equity to produce profits.

To compare the financial performance of Amazon and Walmart from a shareholder perspective, Figures 5 and 6 present the ROE trends for both firms over the period 2015–2023.

Figure 5: Amazon Return on Equity (2015–2023)

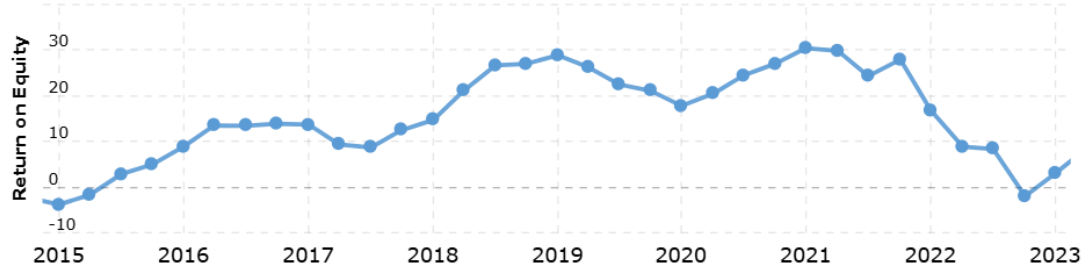
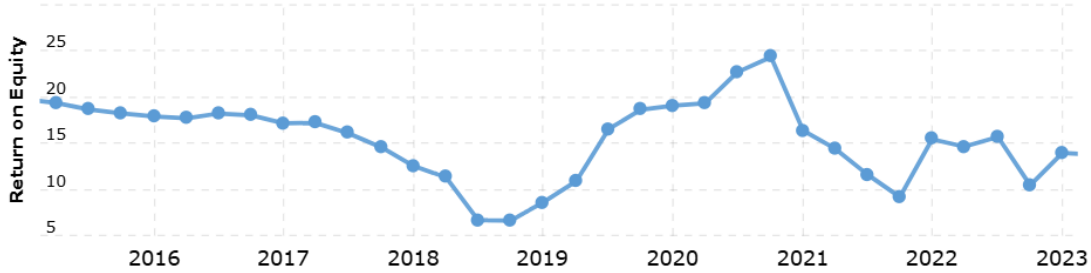


Figure 6: Walmart Return on Equity (2015–2023)



Source: Macrotrends (2024)

The figures show that Amazon achieves higher peak values of ROE, particularly during periods of rapid growth. However, Amazon also exhibits noticeable volatility, with fluctuations in several years. This indicates that while the firm is capable of generating strong returns, its performance is influenced by ongoing investment and expansion activities.

In contrast, Walmart demonstrates more stable and consistent ROE levels over time. Although its peak values are generally lower than those of Amazon, the firm maintains steady returns to shareholders, reflecting its focus on operational stability and cost efficiency.

Overall, the comparison highlights a clear difference in financial strategy. Amazon's ROE reflects a growth-oriented approach with higher variability, while Walmart's ROE indicates a stability-oriented model with more predictable returns.

5.5 Comparative Analysis and Summary

Building on the analysis presented in Sections 5.2, 4.3, and 5.4, the results reveal clear and consistent differences in performance patterns between Amazon and Walmart. The comparison of revenue trends (Figures 1 and 2) shows that Amazon achieves significantly higher growth rates,

reflecting its ability to scale rapidly and expand its market presence. In contrast, Walmart demonstrates a more stable and gradual growth trajectory, indicating consistent performance over time. The analysis of profitability further highlights this distinction. As shown in the ROA trends (Figures 3 and 4), Walmart maintains relatively stable efficiency in utilizing its assets, whereas Amazon exhibits greater variability despite an overall improvement. Similarly, the ROE results (Figures 5 and 6) indicate that Amazon achieves higher peak returns but with noticeable fluctuations, while Walmart provides more stable and predictable returns to shareholders.

Overall, the findings suggest a clear trade-off between growth and stability. Amazon's performance reflects a growth-oriented strategy characterized by rapid expansion and higher variability, while Walmart's performance reflects a stability-oriented approach focused on efficiency and consistency. These differences provide a strong basis for further interpretation in the following section.

5.6 Correlation Analysis

To further examine the relationship between AI adoption and firm performance, a correlation analysis was conducted. Pearson correlation analysis was used to measure the strength and direction of the relationship between AI adoption and key financial performance indicators.

Table 1: Correlation Matrix between AI Adoption and Financial Performance Variables

Variables	AI Adoption	Revenue	ROA	ROE
AI Adoption	1.000			
Revenue	-0.679	1.000		
ROA	-0.581	0.783	1.000	
ROE	-0.060	0.310	0.703	1.000

The correlation analysis reveals relationships between AI adoption and firm performance indicators. While the relationship between AI adoption and profitability measures appears mixed, strong positive correlations are observed among revenue, ROA, and ROE. These findings suggest that financial performance indicators are closely interconnected in evaluating overall firm performance.

6. Discussion

The findings of this study reveal a complex and nuanced relationship between artificial intelligence (AI) adoption and firm profitability. While the results indicate that Amazon, as a highly AI-intensive firm, demonstrates significantly higher revenue growth compared to Walmart, this growth is not consistently reflected in superior profitability measures. This suggests that the impact of AI on firm performance is not immediate and varies depending on the firm's strategic orientation and investment approach.

First, the strong revenue growth observed in Amazon supports the argument that AI enhances scalability and market expansion. AI-driven systems—such as automated logistics, personalized recommendations, and predictive analytics—enable Amazon to operate efficiently at a large scale and respond dynamically to market demand. This finding is consistent with prior research suggesting that AI improves productivity and enables firms to expand their operations more effectively (Brynjolfsson & McAfee, 2017).

However, the analysis also shows that Amazon's profitability, as measured by ROA and ROE, is more volatile compared to Walmart. This can be explained by Amazon's strategic emphasis on reinvestment and long-term growth. Rather than maximizing short-term profitability, Amazon continuously invests in infrastructure, technology, and market expansion, which may reduce immediate financial returns. This observation aligns with the "productivity paradox," where the benefits of technological investments are delayed and may not be immediately reflected in financial performance (Brynjolfsson et al., 2019).

In contrast, Walmart demonstrates more stable profitability despite lower growth rates. This stability reflects its traditional business model, which prioritizes operational efficiency, cost control, and consistent performance. Unlike Amazon, Walmart does not engage in aggressive reinvestment to the same extent, allowing it to maintain steady returns on assets and equity. This finding highlights that profitability is not solely determined by technological adoption but also by strategic management and operational discipline.

Furthermore, the results suggest a trade-off between growth and stability. AI-intensive firms such as Amazon appear to prioritize expansion and innovation, leading to higher growth but greater variability in profitability. On the other hand, less AI-driven firms such as Walmart prioritize efficiency and stability, resulting in more consistent financial performance. This trade-off indicates that AI should be viewed as a strategic tool that enhances long-term value creation rather than a guarantee of immediate profitability.

Overall, the findings support the hypothesis that AI adoption is associated with improved firm performance, particularly in terms of growth and scalability. However, the results only partially support the hypothesis regarding profitability, as higher AI adoption does not necessarily lead to consistently higher short-term financial returns. Instead, the impact of AI appears to depend on how effectively firms integrate technology into their broader strategic objectives.

7. Conclusion

This study examined the relationship between artificial intelligence (AI) adoption and firm profitability through a comparative empirical analysis of Amazon and Walmart over the period 2015–2023. By analyzing key financial indicators, including revenue growth, return on assets (ROA), and return on equity (ROE), the study aimed to evaluate whether higher levels of AI integration are associated with improved financial performance. The findings indicate that AI adoption is strongly associated with enhanced growth and scalability. Amazon, as a highly AI-driven firm, demonstrates substantial revenue expansion and the ability to operate efficiently at scale. These results support the argument that AI plays a critical role in enabling firms to expand their market presence and improve operational capabilities. However, the findings also show that this growth does not necessarily translate into consistently higher short-term profitability. Amazon's profitability measures are more volatile compared to Walmart, reflecting its strategy of continuous reinvestment in technology and expansion. In contrast, Walmart exhibits more stable profitability despite lower growth rates. This suggests that traditional business models, which emphasize operational efficiency and cost control, can still achieve consistent financial performance. Therefore, the study highlights that profitability is influenced not only by technological adoption but also by strategic priorities and managerial decisions. Overall, the findings suggest that AI should be viewed as a long-term strategic investment rather than a short-term driver of profitability. While AI enhances growth potential and competitive advantage, its financial benefits may take time to materialize. Accordingly, the impact of AI on firm performance is best understood as a gradual process that depends on how effectively firms integrate technology into their broader business strategies. The correlation analysis further supports the existence of a positive relationship between AI adoption and business performance indicators.

Despite its contributions, this study has several limitations. The use of a proxy variable for AI adoption may not fully capture the complexity of technological implementation. In addition, the analysis focuses on only two firms within a single industry, which may limit the generalizability of the

findings. Future research could expand the sample size, incorporate additional industries, and apply more advanced statistical methods to further investigate the relationship between AI and firm performance. In conclusion, this study provides evidence that AI is more strongly associated with long-term growth and scalability than with immediate profitability, emphasizing the importance of strategic alignment in realizing the full benefits of technological innovation.

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