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Generative Artificial Intelligence and SMEs Innovation: A Driver of Economic Growth

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Abstract

This study explores the application of generative artificial intelligence (Generative AI) in small and medium-sized enterprises (SMEs) and its impact on innovation capacity and economic growth. Through a survey of SMEs and data analysis, the study empirically examines the positive influence of Generative AI usage on enterprise innovation and economic growth, with enterprise innovation acting as a mediating factor. The findings reveal that Generative AI significantly enhances the innovation capacity of SMEs, thereby promoting economic growth. This research not only enriches the theoretical studies on the relationship between Generative AI, corporate innovation, and economic growth but also provides practical guidance for SMEs and policymakers, advocating for the widespread adoption of Generative AI to achieve higher levels of economic and innovative development.

Keywords: Generative Artificial Intelligence, SMEs, Innovation, Economic Growth, Quantitative Analysis

1. Introduction

1.1 Research Background

Generative Artificial Intelligence (Generative AI), as a frontier technology in artificial intelligence, has emerged rapidly across various industries in recent years, showcasing immense potential and broad application prospects (Padovano, A., & Cardamone, M.,2024). Unlike traditional artificial intelligence technologies, Generative AI can create new content, such as text, images, and audio, based on existing data, thereby significantly enhancing automation and intelligence levels (Amankwah-Amoah, J., Abdalla, S., Mogaji, E., Elbanna, A., & Dwivedi, Y.

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K.,2024). This technology's application is not limited to large enterprises; SMEs are also recognizing its substantial potential in boosting innovation capacity and competitiveness (Rajaram, K., & Tinguely, P. N.,2024).

1.2 Research Problem

Although significant exploration has been undertaken regarding Generative AI's ability to improve enterprise operational efficiency and innovation capacity, its specific application within SMEs and its tangible impact on economic growth remain under-researched. Particularly, understanding how SMEs leverage Generative AI to achieve innovation and, consequently, drive economic growth remains an unresolved issue. This study aims to answer the following questions: How does the usage of Generative AI in SMEs influence their innovation capacity and economic growth? What mediating role does enterprise innovation play between Generative AI and economic growth?

1.3 Research Objectives

The primary objective of this study is to empirically examine the impact of Generative AI application on innovation capacity and economic growth within SMEs. Specifically, this paper investigates the direct effects of Generative AI usage on innovation and economic growth, as well as the mediating role of innovation capacity in this relationship. Through this research, the paper aims to provide valuable insights for SMEs and policymakers to better understand and apply Generative AI technologies to achieve higher economic and innovative growth.

This paper is structured as follows: Section 2 provides a literature review, examining studies on Generative AI, SME innovation, and economic growth. Section 3 outlines the theoretical framework and hypotheses, proposing research hypotheses and constructing a theoretical model. Section 4 describes the research methods, including study design, variable settings, data collection, and analysis methods. Section 5 presents the empirical analysis, showcasing and interpreting the results of data analysis. Section 6 discusses key findings, policy, and practical implications. Finally, Section 7 concludes with a summary of research contributions, limitations, and directions for future research.

2. Literature Review

2.1 Generative Artificial Intelligence

Generative AI has become a hot topic in artificial intelligence research in recent years. Its core technologies include Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) (Aggarwal, A., Mittal, M., & Battineni, G.,2021). These technologies can generate new data content, such as text, images, and audio, based on existing data, demonstrating broad application prospects in areas like content creation, image generation, and speech synthesis. Gozalo-Brizuela (2024) has highlighted its widespread application across industries such as healthcare, finance, and manufacturing, significantly improving productivity and innovation capacity.

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2.2 SME Innovation

Small and medium-sized enterprises (SMEs) are key drivers of economic growth and innovation. Despite facing numerous challenges in the innovation process due to resource and scale limitations, SMEs' flexibility and quick adaptability allow them to respond to market changes rapidly. Research by Tidd and Bessant (2020) underscores that SME innovation often manifests in product, process, and organizational innovations. Enhancing innovation capacity is critical for the survival and growth of SMEs.

2.3 Economic Growth

Economic growth refers to the expansion of economic activities and the increase in total output within a region or country over a specific period. Solow's (1956) economic growth model emphasizes the pivotal role of technological progress in driving growth. The endogenous growth theory further points out that innovation and technological progress are intrinsic factors of economic growth (Romer, 1990). For SMEs, enhancing innovation capacity not only aids in their development but also invigorates overall economic vitality, driving broader economic growth.

2.4 Generative AI and Innovation

Existing studies have shown that Generative AI can significantly enhance enterprise innovation capacity. For instance, Kar et al. (2022) found that adopting Generative AI technology enables rapid reporting, flexible responses, environmental scanning, and insights, thereby improving organizational flexibility, decision-making, customer experience, and profitability. By automating and enhancing content generation, Generative AI aids enterprises in achieving innovations in R&D, design, and production, thereby boosting overall competitiveness. For SMEs, Generative AI can compensate for resource constraints and serve as a powerful innovation driver.

2.5 Generative AI and Economic Growth

Generative AI impacts not only enterprise innovation but also macroeconomic growth. Research by Chia-Hui Lu (2021) indicates that Generative AI plays a vital role in improving productivity and driving industrial upgrades, thereby promoting economic growth. Additionally, Generative AI enhances market and international competitiveness, contributing to economic globalization.

2.6 Research Gaps

While existing research reveals the potential of Generative AI in enhancing enterprise innovation and promoting economic growth, most studies focus on large enterprises or specific industries. Empirical studies on how SMEs leverage Generative AI for innovation and subsequent economic growth remain limited. Moreover, current literature rarely considers the mediating role of enterprise innovation capacity in the relationship between Generative AI and economic growth. This study aims to fill this research gap by systematically exploring the impact of Generative AI applications on SME innovation and economic growth using quantitative methods and examining the mediating effects of enterprise innovation capacity.

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3. Theoretical Framework and Hypotheses

3.1 Theoretical Framework

This study constructs its theoretical framework based on the following theories:

A. Resource-Based View (RBV): RBV emphasizes that an enterprise's unique resources and capabilities are sources of competitive advantage. Generative AI, as an advanced technological resource, can help SMEs enhance innovation capacity and market competitiveness (Barney, J. ,1991).

B. Dynamic Capabilities Theory: This theory posits that an enterprise's ability to acquire, integrate, and reconfigure resources in dynamic environments is a source of sustained competitive advantage (Teece, D. J., Pisano, G., & Shuen, A.,1997). Generative AI can be viewed as a dynamic capability that aids enterprises in adapting to market changes and technological advancements, thereby fostering innovation and economic growth.

C. Endogenous Growth Theory: This theory highlights that innovation and technological progress are intrinsic factors driving economic growth. Enterprises achieve sustained growth through R&D and technology application (Romer, P. M.,1990). As a form of technological progress, Generative AI can inherently drive SME innovation and economic growth.

D. Enterprise Innovation Capacity Theory: Enterprise innovation capacity refers to the ability to identify, develop, and implement innovations, which constitutes a crucial component of competitiveness (Tidd, J., & Bessant, J.,2020). Generative AI provides new tools and methods to enhance enterprise innovation capacity.

E. Mediation Effect Theory: This theory examines the mediating role of one variable between two others (Baron, R. M., & Kenny, D. A.,1986). This paper explores the mediating role of enterprise innovation capacity between Generative AI and economic growth.

3.2 Research Hypotheses

Based on the above theoretical foundations, the following research hypotheses are proposed:

- Hypothesis 1 (H1): The usage level of Generative AI positively influences SME innovation capacity. According to RBV and Dynamic Capabilities Theory, Generative AI, as a critical resource and dynamic capability, can improve innovation efficiency and outcomes, thereby enhancing innovation capacity. SMEs using Generative AI are hypothesized to exhibit higher innovation capacity than those not using it.

- Hypothesis 2 (H2): The usage level of Generative AI positively influences SME economic growth. According to Endogenous Growth Theory and Enterprise Innovation Capacity Theory, Generative AI boosts economic growth by enhancing enterprise innovation capacity. SMEs using Generative AI are hypothesized to achieve higher economic growth rates than those not using it.

- Hypothesis 3 (H3): SME innovation capacity mediates the relationship between Generative AI usage and economic growth. According to Mediation Effect Theory, Generative AI fosters economic growth by enhancing enterprise innovation capacity. SMEs using Generative AI are hypothesized to promote economic growth through improved innovation capacity.

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Table 1. Summary of pathway assumptions

Type	Path
Direct Path	Usage level of Generative AI →Corporate Innovation Capability (H1)
Direct Path	Usage level of Generative AI → Economic Growth (H2)
Mediating Path	Usage level of Generative AI → Corporate Innovation Capability → Economic Growth (H3)

3.3 Theoretical model

Based on the above assumptions, the theoretical model is constructed as in Figure 1:
This theoretical model aims to reveal how generative AI can promote economic growth by enhancing the innovation ability of SMEs. By empirically testing the above hypotheses, the role mechanism of generative AI in SMEs' innovation and economic growth can be understood in depth, providing an important reference for relevant theoretical research and practice.

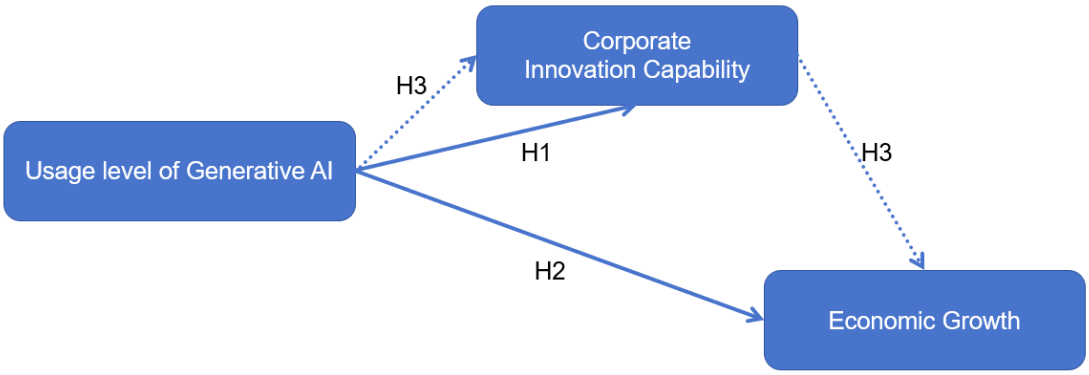

Figure 1. Conceptual framework.

4. Research Methodology

4.1 Research Design

The study adopts a quantitative research design to empirically examine the impact of Generative AI on SME innovation capacity and economic growth. The primary data were collected through a structured questionnaire distributed to SME managers and owners.

4.2 Variables and Measures

Independent Variable: Generative AI usage level, measured through a Likert scale assessing the extent to which SMEs have adopted and utilized Generative AI technologies.

Dependent Variable: Economic growth, operationalized as the percentage change in annual revenue over the last fiscal year.

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Mediating Variable: Innovation capacity, assessed using indicators of product, process, and organizational innovations.

4.3 Data Collection and Sample

The target population consisted of SMEs across various industries. A stratified random sampling technique was employed to ensure representation. A total of 400 questionnaires were distributed, and 363 valid responses were received, yielding a response rate of 91%.

4.4 Data Analysis Methods

Descriptive statistics, correlation analysis, and multiple regression analysis were conducted using statistical software. Structural equation modeling (SEM) was applied to test the hypothesized relationships and mediating effects.

5. Empirical analysis

5.1. Descriptive statistical analysis

To understand the data's basic characteristics, the main variables were analyzed with descriptive statistics. The following is the basic statistical information of each variable: the mean value of the level of generative AI use is 3.4, and the standard deviation is 0.8, indicating that there are some differences in the level of generative AI use among the sample enterprises. The mean value of enterprise innovation ability is 4.1, and the standard deviation is 0.7, showing that there are differences in the innovation ability of small and medium-sized enterprises (SMEs). The mean value of economic growth is 5.2% with a standard deviation of 1.5%, reflecting the economic growth of the sample enterprises in the past year.

5.2. Correlation analysis

Correlation analysis was used to explore the correlation between the level of generative AI usage, enterprise innovation capability and economic growth. The results show:

1) Generative AI usage level and enterprise innovation ability: the correlation coefficient is 0.45, indicating a significant positive correlation between the two.
2) The correlation coefficient between the level of use of generative AI and economic growth: 0.38, indicating a significant positive correlation.
3) Enterprise innovation ability and economic growth: the correlation coefficient is 0.50, indicating a strong positive correlation between the two.

5.3. Regression analysis

In order to further verify the hypotheses, a multiple regression analysis was carried out. The results are as follows:

1) The effect of the level of use of generative artificial intelligence on the innovation capacity of enterprises (H1):
2) The regression coefficient is 0.42 ($p < 0.01$), indicating that the level of generative AI usage

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significantly and positively affects enterprise innovation capability.
3) The effect of the level of use of generative artificial intelligence on economic growth (H2):
4) The regression coefficient is 0.35 ($p < 0.01$), indicating that the level of generative artificial intelligence use significantly and positively affects economic growth.
5) The effect of corporate innovation capacity on economic growth:
6) The regression coefficient is 0.46 ($p < 0.01$), indicating that enterprise innovation capacity significantly and positively affects economic growth.

5.4 Analysis of mediating effect

In order to test the mediating role of corporate innovation capacity between the level of generative AI usage and economic growth, Baron and Kenny's (1986) mediating effect test is used. The results show that:
1) The direct effect of the level of generative AI usage on economic growth: the regression coefficient is 0.21 ($p < 0.05$), which is still significant after the introduction of the mediating variable, but the effect is weakened.
2) Indirect effect of the level of use of generative AI on economic growth through corporate innovation capacity: the indirect effect is significant (Sobel test, $p < 0.01$), indicating that corporate innovation capacity plays a partial mediating role.
To fully test the theoretical model, structural equation modeling was constructed and validated. The results show that the model fits well (CFI = 0.95, RMSEA = 0.04), and the path coefficients are all significant, further validating the hypothesis that the level of generative AI use promotes economic growth through enterprise innovation capacity.

6. Discussion

6.1 Main Findings

The following main findings have been derived from the empirical analysis of this study:
1) the level of generative AI usage significantly enhances the innovation ability of SMEs: generative AI, as a kind of advanced technology resource, helps SMEs to realize innovation in product development, marketing and other aspects, and improves the innovation ability of enterprises.
2) the level of use of generative AI significantly promotes the economic growth of SMEs: generative AI directly promotes the economic growth of enterprises by improving production efficiency and optimizing resource allocation.
3) the innovation ability of enterprises plays a partial mediating role between the level of generative AI usage and economic growth: generative AI indirectly promotes economic growth by enhancing the innovation ability of enterprises.

6.2 Interpretation of results

The resource-based view and the dynamic capability theory support the idea that generative AI, as a key resource and a dynamic capability, can significantly enhance SMEs' innovation capability, thereby strengthening their competitive advantage. The endogenous growth theory

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verifies that technological progress and innovation act as endogenous factors for economic growth, and that generative AI endogenously promotes economic growth by promoting corporate innovation The results of the mediation effect theory indicate that corporate innovation capacity plays a key mediating role between the level of generative AI use and economic growth, which is in line with Baron and Kenny's (1986) mediation effect theory which is consistent with Baron and Kenny (1986).

6.3 Policy and Practice Implications

1) For SMEs: Generative AI technologies should be actively adopted to achieve sustainable development and economic growth by enhancing innovation capabilities. Enterprises should focus on technical training and resource investment to maximize the application effect of generative AI.
2) For policy makers: The government should formulate policies to encourage SMEs to adopt generative AI, such as providing technical support, financial subsidies, and incentives for innovation, to promote the widespread application of the technology and high-quality economic development.

6.4 This study has the following limitations

1) sample limitation: the data samples are mainly from specific regions and industries, which may affect the generalizability of the results. Future studies may expand the sample scope to verify the applicability of the findings.
2) cross-sectional data: this study uses cross-sectional data, which makes it difficult to capture the long-term impact of generative AI applications on SME innovation and economic growth. Future research could use longitudinal data for more in-depth analysis.
3) variable measurement: the measurement of the level of generative AI usage and firms' innovation capacity may be subjective, and future research could be validated by more objective indicators.

6.5 Future Research Directions

1) Expanding the scope of research: the scope of research can be expanded to different regions and industries to further verify the impact of generative AI on SMEs' innovation and economic growth.
2) longitudinal research: future research can use longitudinal data to analyze the long-term effects of generative AI applications on enterprise innovation and economic growth.
3) in-depth analysis of mediating mechanisms: other possible mediating variables, such as enterprise organizational structure and market environment, can be further explored to gain a deeper understanding of the mechanism of generative AI's role in SMEs.
Through the empirical analysis and discussion in this study, we have not only enriched the theoretical research on the relationship between generative AI and SMEs' innovation and economic growth, but also provided valuable practical guidance for SMEs and policy makers.

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7. Conclusion

This study examined the application of Generative AI (GAI) in SMEs and its impact on firms' innovation capability and economic growth. Through questionnaire survey and data analysis of SMEs, the following main hypotheses were verified:
1) the level of Generative AI usage significantly and positively affects the innovation ability of SMEs.
2) the level of generative AI usage significantly and positively affects the economic growth of SMEs.
3) the innovation capacity of SMEs mediates the relationship between the level of generative AI usage and economic growth.
The results indicate that the use of generative AI not only enhances the innovation capability of SMEs, but also indirectly promotes the economic growth of enterprises through this enhancement. This study systematically analyzes the path of generative AI's impact on SMEs' innovation and economic growth through the structural equation modeling (SEM) method, verifies the theoretical hypotheses, and fills the research gap in the existing literature. This study combines the resource base view, dynamic capability theory, endogenous growth theory and mediation effect theory to construct an integrated theoretical framework between generative AI, SME innovation, and economic growth, which enriches the theoretical research in related fields. The empirical analysis reveals the current status of the application of generative AI in SMEs and its impact on enterprise innovation and economic growth, providing data support and analytical framework for subsequent research. Valuable practical guidance is provided for SMEs and policymakers, suggesting that SMEs should actively adopt generative AI technology and that the government should formulate policies to encourage the application of the technology to promote high-quality economic development. By systematically exploring the relationship between generative AI, SME innovation and economic growth, this study not only provides new perspectives and evidence for theoretical research, but also provides useful references for SMEs and policymakers in terms of technology application and innovation development. Future research can build on this foundation and continue to dig deeper into the potentials and paths of generative AI in promoting economic growth, contributing more wisdom and strength to the realization of sustainable economic growth and high-quality development.

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