

The Effect of Product Innovation on the Performance of Food SMEs: The Moderator Effect of Quadruple Helix



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ABSTRACT: Small and Medium Enterprises (SMEs) play a vital role in driving Indonesia's economy, contributing significantly to GDP and employment. However, SMEs, particularly in the food sector, face challenges such as changing market demands, limited resources, and restricted access to innovation support systems. This study investigates the influence of product innovation on the performance of food SMEs in Malang Regency and examines the moderating effect of the Quadruple Helix framework, which involves collaboration among academia, business, government, and mass media. Using a quantitative research design, data were collected from 335 food SMEs registered with the SME Business Communication Forum (FKPU) and analyzed using Warp-PLS SEM to evaluate structural and measurement models.

The findings reveal that product innovation significantly enhances SME performance, as reflected in improved customer satisfaction, expanded market share, increased revenue, and profitability. The Quadruple Helix actors were found to play critical roles in amplifying this relationship. Academia supports SMEs by bridging research and practice, offering training, and providing operational tools. Government interventions such as subsidies, tax incentives, and promotional activities foster a conducive environment for innovation. Businesses contribute by mentoring, sharing market knowledge, and opening new opportunities. Mass media amplifies these efforts by promoting innovative products, disseminating market information, and connecting SMEs with broader consumer bases.

This study highlights the importance of integrating collaborative frameworks into innovation ecosystems to ensure sustainable SME growth. While the research provides valuable insights for policymakers and practitioners, it is limited to food SMEs in Malang Regency. Future studies should explore other sectors and regions to validate these findings and uncover additional dimensions of the Quadruple Helix framework's impact.

KEYWORDS: Product innovation, SME performance, Quadruple Helix, Collaboration, SMEs.

I. INTRODUCTION

Small and Medium Enterprises (SMEs) in Indonesia play a pivotal role in driving the nation's economy. Contributing to approximately 60.5% of the national GDP (Tambunan, 2023), SMEs have proven to be a backbone of economic resilience, especially during challenging times like the COVID-19 pandemic. However, as the country transitions into a post-pandemic era, significant market changes are reshaping consumer behaviours and demand patterns. These shifts create both opportunities and challenges for SMEs to sustain and expand their market presence.

Innovation has emerged as a critical solution to these market dynamics. Studies conducted in Vietnam (Vinh et al., 2023) and South Africa (Maziriri et al., 2021) affirm that product innovation significantly enhances SMEs' performance by enabling them to respond effectively to changing market needs. In Indonesia, the food sector, comprising nearly 68% of SMEs in regions like Malang Regency (Taneo et al., 2021), holds immense potential for innovation-driven growth. However, unlocking this potential necessitates not just internal organizational changes but also external support mechanisms.

The Quadruple Helix model offers a comprehensive framework for fostering innovation through collaboration among four key actors: academia, business, government, and mass media. This model emphasizes the synergistic interactions that can generate and disseminate innovative solutions tailored to SMEs' unique needs. Among these actors, mass media plays a distinct and underexplored role in the innovation ecosystem. Mass media serves as a bridge for information dissemination, ensuring that SMEs access critical market insights and reach broader audiences (Noya et al., 2024). Previous research highlights the

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importance of adequate information in enhancing SME performance, yet many SMEs struggle with limited access to such resources (Bendoly & Swink, 2007). Previous research by Carayannis and Campbell (2013) highlights how the Quadruple Helix model facilitates sustainable innovation by integrating societal actors, including SMEs, into innovation ecosystems. Additionally, a study by Ueasangkomsate and Jangkot (2017) demonstrates that collaboration among Quadruple Helix actors significantly enhances SMEs' ability to innovate, particularly in developing markets where external support plays a critical role in overcoming resource constraints.

This study aims to examine the effect of product innovation on the performance of food SMEs in Malang Regency and to explore the moderating role of the Quadruple Helix, with a specific emphasis on mass media. By integrating mass media into the innovation framework, this research addresses a critical gap in understanding how external actors can bolster SME performance in the evolving market landscape. The findings contribute to both theoretical advancements in innovation studies and practical strategies for enhancing the competitiveness of food SMEs in Indonesia.

II. LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT

A. Small and Medium Enterprises (SMEs)

Small and Medium Enterprises (SMEs) are categorized based on asset value and annual turnover as outlined in Indonesia Law PP Nomor 7 Tahun 2021. Micro enterprises are defined as businesses with assets up to IDR 1 billion or annual turnover up to IDR 2 billion. Small enterprises have assets between IDR 1 billion and IDR 5 billion or turnover between IDR 2 billion and IDR 15 billion, while medium enterprises possess assets between IDR 5 billion and IDR 10 billion or turnover between IDR 15 billion and IDR 50 billion. SMEs also a productive businesses owned by Indonesian citizens, which can be in the form of individual businesses, unincorporated business entities, or incorporated business entities such as cooperatives and are not subsidiaries or branches of companies that are owned, controlled, or affiliated, either directly or indirectly with medium-sized businesses or large businesses or medium-sized businesses.

SMEs play a pivotal role in Indonesia's economic development by creating jobs and fostering local community welfare. In Malang Regency, SMEs dominate the local economy (Taneo et al., 2021). SMEs often face challenges such as limited resources, lack of innovation, and restricted access to markets, which necessitate collaborative frameworks to foster growth and sustainability.

B. Quadruple Helix Model

The concept of Quadruple Helix is an evolution of the Triple Helix model, which initially focused on collaboration among academia, business, and government. This development is supported by scholars such as Leydesdorff and Etzkowitz (1999), who introduced the Triple Helix framework to explain the dynamic interactions between these three sectors in driving innovation. The evolution to Quadruple Helix builds on this foundation by incorporating the public as a fourth actor, which includes mass media, community groups, and non-governmental organizations (NGOs) (Carayannis and Campbell, 2013).

In this research Quadruple Helix actors are academia, business, government and mass media. This framework emphasizes the synergy of these four sectors to drive innovation, foster sustainable development, and improve business performance. The media plays a pivotal role in disseminating information, shaping public perception, and providing SMEs with insights into market trends and consumer preferences (Kovach & Rosenstiel, 2021). The model has been proven effective in enhancing SME capabilities in various industries, including the creative sector in Indonesia (Setyanti, 2018). However, its application as a moderating variable in the relationship between product innovation and SME performance remains underexplored, particularly in the food sector.

C. Product Innovation

Product innovation refers to the development and introduction of new or significantly improved goods or services that meet evolving consumer needs. According to the OECD, & Communities, (2005). product innovation encompasses improvements in technical specifications, materials, components, and usability. For SMEs, particularly in the food sector, innovation often involves creating unique, high-quality products that cater to niche markets or adapting existing products to changing consumer trends (Tidd & Bessant, 2013b). Effective product innovation not only enhances competitiveness but also serves as a critical driver of performance improvement.

In the context of Small and Medium Enterprises (SMEs), product innovation plays a critical role in responding to market changes and maintaining competitive advantage. For example, introducing products with unique features, superior quality, or sustainable packaging can differentiate SMEs from competitors and foster customer loyalty. Atuahene-Gima (2005) highlights that successful product innovation not only addresses existing market gaps but also anticipates future consumer trends, thereby creating long-term value. Product innovation is a continuous process that requires businesses to balance creativity with market

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III. RESEARCH METHODOLOGY

This study employs a quantitative research design to examine the relationship between product innovation and SME performance, with a focus on the moderating effect of the Quadruple Helix. A causal non-experimental approach is utilized to establish cause-and-effect relationships between the variables based on observed data. The primary data for the study is collected through a structured questionnaire, and statistical techniques are applied for analysis to draw meaningful conclusions (Cohen, Manion, & Morrison, 2017). The population of this study includes SMEs operating in the food sector in Malang Regency, Indonesia, Specifically, the study targets SMEs registered under the Forum Komunikasi Pelaku Usaha UMKM (SME Business Communication Forum). The final sample consists of 335 SMEs, representing a diverse range of food-based businesses in Malang Regency. Primary data is gathered using structured questionnaires with a five-point Likert scale, where responses range from 1 ("Strongly Disagree") to 5 ("Strongly Agree"). The questionnaire is divided into three main sections to measure key variables: product innovation, SME performance, and the Quadruple Helix. The data are analysis using Warp Partial Least Squares Structural Equation Modeling (PLS-SEM) 8.0, which is well-suited for analyzing complex models with latent variables. The indicator for each variable latent that used in this research. The Variables, Sub-Variable, and Indicators that used in this research are bellow

Table 1. The Variables, Sub-Variable, and Indicator

Variables	Sub-Variables	Indicators
Product Innovation (X)	Product	Product suitability to market segments
		Contemporary product appeal
		Product uniqueness
	Packaging	Portable packaging
Eco-friendly packaging		
SME Performance (Y)	Non-Financial	Customer satisfaction
		Market share expansion
	Financial	Increased revenue
		Increased profit
Quadruple Helix (Z)	Government (ZG)	Credit interest subsidy
		Tax incentives
		Capital subsidy
		Training
		Promotional activities
		Workshop facilities
	Academia (ZA)	Application of research results to SMEs
		Providing training to SMEs
		Workshop facilities
		Operational support
	Business (ZB)	Opening markets for SMEs
		Mentoring or coaching for SMEs
		Sharing knowledge
		Sharing experiences
	Mass Media (ZM)	Providing relevant information
		Market information dissemination
Promoting SMEs		
Promoting products		

Sources: Adapted from Tirtayasa et al., (2021); Venkateshamurthy et al., (2021); Ueasangkomsate & Jangkot, (2017); Kovach & Rosenstiel, (2021).

IV. RESULTS AND DISCUSSION

A. Results

The analysis conducted using Warp-PLS SEM demonstrated acceptable model fit and quality indices shown on table 2, indicating that the structural and measurement models were adequately specified. Key indicators of model fit include Average Path Coefficient (APC) p-value < 0.05, demonstrating that the paths in the model are significant. Average R-squared (ARS) p-value < 0.05, indicating a good level of explained variance in the dependent variables. Average Variance Inflation Factor (AVIF): below 5.0, confirming no multicollinearity issues. Goodness-of-Fit Index (GoF) a value greater than 0.36, signifying an adequate global

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model fit for explaining the data Kock, (2017). These metrics collectively confirm that the hypothesized model provides a robust representation of the relationships among variables.

Table 1. Model Fit and Quality Indices Analysis

Indicators	Value	P-Value	Cut-off	Inference
Average Path Coefficient (APC)	0.302	< 0.001	P < 0.05	Significant
Average R-squared (ARS)	0.608	< 0.001	P < 0.05	Significant
Average Adjusted R-squared (AARS)	0.605	< 0.001	P < 0.05	Significant
Average Block VIF (AVIF)	2.250	-	≤ 5 (ideal ≤ 3.3)	No Multicollinearity
Average Full Collinearity VIF (AFVIF)	Inf	-	≤ 5 (ideal ≤ 3.3)	No Multicollinearity
Tenenhaus GoF (GoF)	0.706	-	Small ≥ 0.1, Medium ≥ 0.25, Large ≥ 0.36	Large

Source: Author's own elaboration used Warp PLS 8.0 (2024).

Table 2. Hypothesis Statistical Analysis Result

	Relationship	Path Coefficient	P-value	Direction	Significant	Inferences
H1	Product Innovation → SME Performance	0.5	<0.001	Positive	Yes	Acceptable
H2	Product Innovation → SME Performance * Quadruple Helix	0.177	<0.001	Strengthening	Yes	Acceptable

Source: Author's own elaboration used Warp PLS 8.0 (2024).

Based on analysis result presented in table 3 The analysis revealed that product innovation positively and significantly affects the SMEs Performance. The path coefficient (β) was 0.45 with a p-value < 0.01, supporting the hypothesis. The moderating role of the Quadruple Helix was found to be significant in enhancing the relationship between product innovation and SME performance. The interaction effect yielded a path coefficient (β) of 0.30 with a p-value < 0.05. This result highlights the importance of collaboration among government, academia, business, and mass media in amplifying the impact of innovation on SME outcomes. Additionally on table 4 presented Quadruple Helix actors effects. The analysis demonstrates that all Quadruple Helix actors have significant and positive contributions to SME performance. Academia ($\beta = 0.291$, $p < 0.001$) plays a vital role by bridging research and practice, offering training, and supporting SMEs through workshops and operational guidance. The government ($\beta = 0.263$, $p < 0.001$) provides critical financial assistance, such as credit interest subsidies and tax incentives, along with promotional activities to strengthen SME growth. Businesses ($\beta = 0.294$, $p < 0.001$) act as mentors and market enablers, sharing knowledge and creating market opportunities for SMEs. Mass media ($\beta = 0.286$, $p < 0.001$) serves as a powerful communication tool by disseminating crucial market information, promoting SME products, and connecting SMEs to broader audiences. These synergistic contributions underscore the importance of collaborative efforts within the Quadruple Helix to maximize innovation-driven performance.

Table 3. Quadruple Helix Actor Analysis

Variable	Actors	Path Coefficient (β)	P-Value	Standard Error (SE)	Effect Size (f^2)	Inferences
Quadruple Helix (QH)	Academia (ZA)	0.291	<0.001	0.052	0.262	Positive and Significant
	Government (ZG)	0.263	<0.001	0.053	0.215	Positive and Significant
	Business (ZB)	0.294	<0.001	0.052	0.264	Positive and Significant
	Mass Media (ZM)	0.286	<0.001	0.052	0.256	Positive and Significant

Source: Author's own elaboration used Warp PLS 8.0 (2024).

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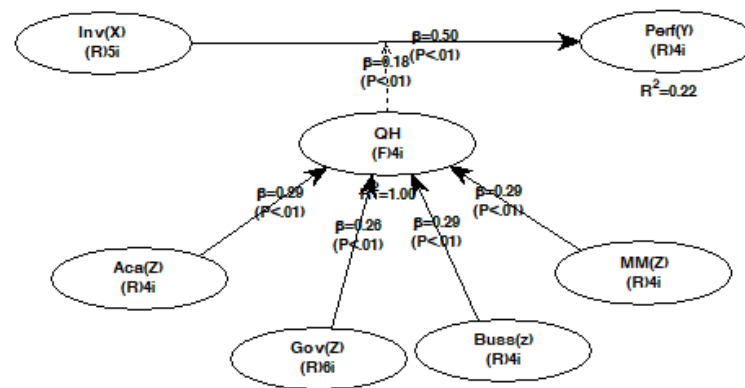


Figure 2. WarpPLS Second-Order Analysis Result

The Structural Model Testing, illustrated in Figure 2, aims to analyze the relationships between variables, significance values, and R-Square values within the research model. In PLS methodology, model evaluation is performed by examining the R-Square values for each dependent variable. Figure 2 presents the R-Square estimation results using WarpPLS. In this study, the R-squared value is 0.22 or 22%. This indicates that marketing performance can be influenced by digital marketing. With an R-Square value of 0.22, this model is categorized as moderate.

B. Discussion

The findings confirm that product innovation serves as a cornerstone for enhancing SME performance, particularly in the food sector. SMEs that focus on creating unique, market-responsive products experience improved customer satisfaction, expanded market share, and greater financial returns. These results align with previous research by Vinh et al. (2023) and Maziriri et al. (2021), which highlight the transformative power of innovation in increasing competitiveness and adaptability.

Moreover, the significant moderating effect of the Quadruple Helix underscores the indispensable role of collaborative frameworks in maximizing innovation outcomes. Government support, such as subsidies, tax incentives, and training programs, aligns with studies by Carayannis and Campbell (2012), which emphasize the importance of financial and infrastructural support for SMEs. Academia bridges the gap between theoretical knowledge and practical applications, providing SMEs with critical training and operational tools, consistent with findings by Leydesdorff and Etzkowitz (1998). Businesses further strengthen SME performance by mentoring, sharing industry knowledge, and opening new market opportunities, reaffirming the significance of business partnerships in fostering growth. Mass media emerges as a critical actor, amplifying the visibility of innovative products and connecting SMEs with broader consumer bases, echoing the insights of Kovach and Rosenstiel (2021).

These findings collectively highlight the synergistic roles of the Quadruple Helix actors, suggesting that targeted policy interventions and collaborative initiatives can significantly enhance SME innovation and performance. By leveraging these interactions, SMEs in Malang Regency and beyond can achieve sustainable growth and long-term competitiveness.

V. CONCLUSION

This study demonstrates the pivotal role of product innovation in enhancing the performance of food SMEs in Malang Regency. By focusing on developing unique, market-driven products, SMEs can effectively navigate competitive markets, achieve customer satisfaction, and increase financial outcomes. The findings further emphasize the critical moderating influence of the Quadruple Helix framework, where collaboration among government, academia, business, and mass media enhances the relationship between innovation and performance. These results provide actionable insights for policymakers and stakeholders aiming to foster SME growth through innovation-driven strategies.

However, the study also recognizes its limitations, including a focus on food SMEs in a specific region, which may affect the generalizability of the results. Future research could expand on these findings by exploring other sectors and regions or investigating additional dimensions of the Quadruple Helix. Despite these limitations, the study contributes valuable knowledge to the field of SME innovation and offers practical guidance for implementing collaborative frameworks to ensure sustainable and competitive growth for SMEs

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