

Impact of Production Factors on the Competitiveness of the Service Industry in Thailand

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Abstract

This study investigates the impact of production factors on the competitiveness of Thailand's service industry, aiming to examine the relationships among key inputs and their influence on competitiveness. Multiple regression analysis was employed, with capital (CAP), labor (LAB), average wage (WAGE), and technology (TECH) as independent variables, and competitiveness (COMP) as the dependent variable. This research utilizes secondary time-series data comprising 32 annual observations from 1993 to 2024. The LAB variable was sourced from the Ministry of Labor, CAP and COMP from the National Economic and Social Development Council (NESDC), and WAGE from the Bank of Thailand. TECH was calculated using the Solow residual method based on Total Factor Productivity (TFP), allowing for a more precise estimation of technological impact. The findings indicate that capital and average wage are positively and statistically significantly associated with competitiveness in the service sector. Accordingly, the government should promote capital formation through measures such as tax incentives, low-interest financing, and infrastructure development and oversee the adjustment of the labor compensation structure to ensure appropriateness to enhance sustainable competitiveness over the long term. In contrast, labor exhibits a statistically significant negative effect, which may reflect issues related to low labor productivity or mismatches between workforce skills and market demand. Therefore, policy efforts should prioritize reskilling initiatives, digital skills training, and strengthened vocational education to improve labor quality. Although, technology does not demonstrate a statistically significant relationship with service sector competitiveness in this analysis, it remains theoretically important. Policymakers should thus continue to support technological adoption in the service sector particularly automation, artificial intelligence, and data-driven systems to foster long-term innovation and efficiency.

Keywords: The Service Industry; Diamond Model; New Growth Theory

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Introduction

The service sector is widely regarded as a key engine of Thailand's economic growth. This role has become increasingly important in the context of rapid global economic change and the expansion of free trade across regions, both of which have intensified international competition. In this environment, production factors—particularly labor, natural resources, and investment in technology—play a central role in strengthening service-sector competitiveness. Enhancing the efficiency and quality of these inputs has therefore become a critical determinant of the sector's capacity to compete in both domestic and international markets.

In recent years, Thailand's service sector has encountered numerous challenges, including the development of workforce skills, the enhancement of technological capabilities, and the need to adapt to changing consumer behaviors. These issues highlight the importance of studying the relationship between production factors and competitiveness within the service sector. Such an analysis can support both entrepreneurs and government agencies in designing strategic plans to elevate efficiency and competitiveness effectively. In 2023, employment in the service sector accounted for approximately 47 % of the total labor force. Moreover, the average monthly household income in the same year was approximately 29,030 baht (National Statistical Office, 2023). However, in 2024, the Thai economy is projected to experience a slowdown in growth, particularly in the export and manufacturing sectors. This is due to weakened global demand, the slow recovery of the Chinese economy, and structural factors that hinder the expansion of industrial goods exports and tourism. The impact of production factors on competitiveness is reflected in Thailand's ranking in the Global Competitiveness Index (GCI) 2024, where the country placed 25th out of 67 economies its highest position in five years (Office of the National Economic and Social Development Council, 2024). This achievement underscores the importance of enhancing the productivity and efficiency of production factors to strengthen Thailand's global market competitiveness.

Accordingly, this research aims to examine the relationship between production factors and the competitiveness of Thailand's service industry. The study seeks to provide insights that can assist both the public and private sectors in formulating strategies to improve production and service systems to compete effectively on a global scale. It will also assess the impact of these factors on competitiveness, thereby offering a foundation for future policy development aimed at enhancing the sector's long-term competitive potential.

Research Objective

1. To examine the relationship between production factors and the competitiveness of Thailand's service industry.
2. To analyze the impact of production factors on the competitiveness of Thailand's service industry.

Theoretical Background

1. Michael E. Porter's Diamond Model of National Competitiveness

Michael E. Porter proposed a conceptual model that analyzes the underlying reasons why certain countries possess greater competitive potential than others (Porter, 1990). This model identifies the core elements and determines factors that influence a nation's industrial competitiveness,

ultimately affecting the development and adaptability of its industries. The model consists of four key components that can shape and modify the competitive environment to create industrial advantages (Santipholwut, 2015).

1) Factor Conditions: the quality and availability of domestic inputs such as labor, infrastructure, and capital resources.

2) Demand Conditions: the characteristics and sophistication of domestic demand for goods and services.

3) Related and Supporting Industries: the presence and strength of competitive and efficient supplier industries and supporting sectors, and

4) Firm Strategy, Structure and Rivalry: the context in which firms are created, organized, and managed, as well as the nature and intensity of domestic competition.

In addition to these four determinants, the model includes two external factors chance and government which influence all four components. These exogenous elements may exert both positive and negative impacts on a nation's overall competitiveness.

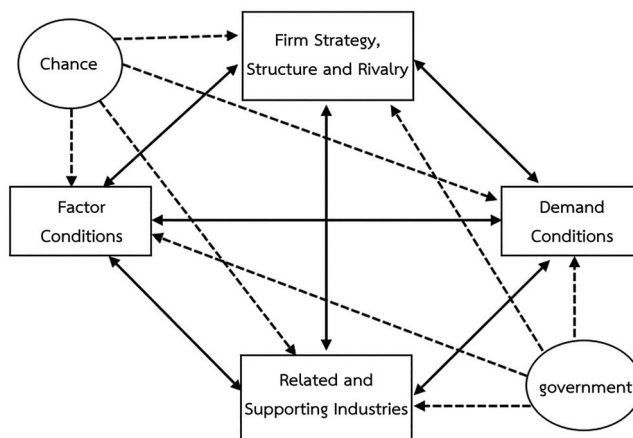


Figure 1 The Diamond Model of National Competitiveness by Michael E. Porter

Figure 1 (Porter's Diamond Model) provides a conceptual framework that underpins the variables examined in the present study. Specifically, the "Factor Conditions" element directly corresponds to the production factors analyzed in this research: labor (LAB), capital (CAP), average wage (WAGE), and technology (TECH). These variables reflect the availability, quality, and efficiency of input resources that determine a nation's competitive advantage. In the context of Thailand's service industry, labor (LAB) and average wage (WAGE) represent both the quantity and cost-efficiency of human capital, while capital (CAP) captures financial investment in infrastructure and operations. Technology (TECH), derived from Total Factor Productivity, reflects the role of innovation and digital transformation. Together, these factor inputs influence the dependent variable—competitiveness (COMP) as conceptualized in the Diamond Model. Thus, the present study operationalizes the abstract components of the Diamond Model into measurable variables, facilitating an empirical assessment of how foundational production factors affect the competitiveness of the service sector in Thailand.

2. New Growth Theory

This is an economic concept that explains how long-term economic growth can arise from internal factors within the economic system (endogenous factors), particularly through investments

in human capital, knowledge, and innovation. The theory posits that knowledge is non-rival in nature and can be transmitted or disseminated without incurring full marginal costs (knowledge spillover), thereby generating increasing returns to scale. Research and development (R&D), education, and learning-by-doing serve as critical mechanisms driving productivity and competitiveness. Moreover, the theory underscores the pivotal role of government in promoting growth through policies that support education, technology, and infrastructure development (Romer, 1990).

The aggregate productivity of an economy can be expressed as Equation (1):

$$Y = A(t) \cdot K^\alpha \cdot L^{1-\alpha} \quad (1)$$

Where: Y is Aggregate output (Gross Domestic Product, GDP)
 $A(t)$ is Technological progress at time t , which is driven by investment in research and development (R&D)
 K is Capital input
 L is Labor input
 α A parameter between 0 and 1, representing the output elasticity of capital

Literature Review

The study analyzes the competitiveness of the Italian wine industry using Porter's Diamond Model and Industrial District Theory. Despite a fragmented structure with numerous small producers, the industry leverages internal strengths such as cooperative networks, knowledge sharing, local resource use, and strong brand identity. External supports—including public policies, regional initiatives, and export diversification—reinforce its sustainable competitiveness. However, emerging challenges like climate change, shifting consumer demands, and environmental regulations necessitate strategic adaptation for continued success (Pomarici et al., 2021).

The study examines the decline in Indonesia's palm oil exports to India through the lens of Porter's Diamond Model and the Developmental State theory. Key contributing factors include an uncompetitive CPO tax structure, rising competition from Malaysia, and over-reliance on a single export market. In response, the Indonesian government has adopted proactive strategies, such as the establishment of the CPO Fund, trade promotion via ITPC Chennai, and development of POIC industrial clusters. While these measures have stabilized exports in the short term, the study concludes that long-term sustainability requires tax reform, market diversification, and enhanced regional cooperation (Yahya and Gunawan, 2019).

The study compares the digital trade competitiveness of China and Malaysia using Porter's Diamond Model. China holds a stronger position due to advanced digital infrastructure, innovation capacity, and a large tech-savvy population. Malaysia has made regulatory and adoption strides but faces limitations in scale and innovation. To strengthen its competitiveness, Malaysia must invest in digital skills and innovation ecosystems. These findings offer strategic direction for enhancing digital trade and sustainable growth (Hu, 2024).

The service sector plays a vital role in regional economic growth through technological adaptation and productivity improvement. found that the service sector in Chachoengsao Province

part of Thailand's EEC showed a positive technological change of 0.0507 %, reflecting its contribution to sustainable economic expansion (Kasrisom, 2024b).

The study introduces a simplified growth model that challenges key assumptions of the Solow model by allowing savings to be partially invested in labor, not just capital. It demonstrates that output growth is independent of population growth and instead driven by the allocation of savings. The model explains how differences in parameter values such as savings allocation, productivity, and population growth can lead to either convergence or divergence in per capita income (Ahmed and Nawaz, 2024).

The study explores key trends in the New Growth Theory, particularly its relevance to financial risk management and broader economic impacts. The theory emphasizes the role of knowledge creation, human capital, education, R&D, and entrepreneurship as endogenous drivers of long-term growth. It highlights the importance of policy support in sustaining growth through innovation and technological investment. The theory also cautions against excessive intellectual property protection while acknowledging potential justification for trade restrictions amid global knowledge disparities. Overall, it links economic development closely with strategic investment in human capital and innovative ecosystems (Mubanani and Fadhil, 2023).

The digital industry plays a pivotal role in strengthening economic linkages and stimulating inter-sectoral growth. found that Thailand's digital industry exhibits both strong forward and backward linkages, with a multiplier effect of 1.91, indicating that a 1 % increase in digital industry activity raises total economic output by 1.91 %. This highlights the sector's crucial function as a driver of structural transformation and industrial integration within Thailand's economy (Kasrisom, 2024a).

One study examined the competitiveness of Thailand's cosmetic industry using Porter's Diamond Model. It found that government policies, strong domestic demand, and the presence of related supporting industries played key roles in enhancing competitiveness. However, basic factor conditions and internal firm strategy remained underdeveloped, suggesting a need for structural improvements to support sustainable growth (Jinachai et al., 2016).

Regional analysis of Southeast Asian countries using the Diamond Model demonstrated that nations with advanced human capital, strong domestic demand, and high technology adoption showed higher national competitiveness. The study confirmed the relevance of Porter's framework for cross-country benchmarking in developing economies (Kao et al., 2008).

An empirical study revisited Porter's original framework and proposed an extension called the "competitiveness web," emphasizing the role of networks, global supply chains, and cross-border institutional interactions. It argued that modern competitiveness requires a more dynamic and adaptive framework beyond traditional national boundaries (Vlados, 2019).

Comparative research between Singapore and Thailand evaluated the role of government in fostering competitiveness through targeted policies. The study concluded that proactive fiscal incentives, R&D funding, and human capital development were key to Singapore's superior positioning. It emphasized the critical influence of state intervention in shaping industrial success (Wonglimpiyarat, 2018).

Research into Thailand's apparel industry used Porter's model to assess export dynamics. It revealed that the country benefitted from sophisticated demand and established supplier linkages

but faced challenges in technology upgrading and global branding. The study recommended greater investment in innovation and workforce reskilling (Watchravesringkan et al., 2010).

Another study focused on traditional weaving clusters in Indonesia and found that local know-how, supplier networks, and community cooperation reinforced competitiveness at the grassroots level. However, challenges remained in accessing modern technologies and achieving global scale, limiting international market expansion (Indaryani et al., 2020).

Collectively, the reviewed literature illustrates that competitiveness whether at the firm, sectoral, or national level is driven by an interplay of internal capabilities and external institutional support. A recurring theme across various contexts is that sustainable competitive advantage emerges not merely from resource availability but from how effectively these resources are mobilized, coordinated, and upgraded. For example, Italy's wine industry and Thailand's cosmetics and apparel sectors exemplify how localized expertise, collaborative networks, and policy alignment contribute to regional strength and export performance (Pomarici et al., 2021; Jinachai et al., 2016; Watchravesringkan et al., 2010). Studies in Indonesia's palm oil and Malaysia's digital trade sectors further emphasize that market diversification, digital readiness, and responsive governance are essential to mitigating sectoral vulnerabilities and enhancing long-term positioning (Yahya and Gunawan, 2019; Hu, 2024).

These insights align with both Porter's Diamond Model and New Growth Theory. The former highlights the importance of advanced factor conditions, sophisticated demand, related industries, and firm strategy all of which are observed in empirical studies. The latter emphasizes endogenous drivers such as innovation, human capital, and learning-by-doing, validated by evidence showing that R&D and education amplify productivity and competitiveness. In the Thai context, particularly within the service and digital industries, progress has been observed in areas such as technological adoption, human capital development, and infrastructural improvement, especially in strategic regions like the Eastern Economic Corridor (Kasrisom, 2024b). Altogether, these findings suggest that fostering competitiveness requires not only investment in key production factors but also institutional coordination, innovation systems, and long-term capacity building.

Research Methodology

This study utilizes secondary data in the form of time-series data, comprising 32 annual observations spanning a period of 32 years, from 1993 to 2024. The focus is on analyzing the influence of production factors on the competitiveness of Thailand's service industry. The labor variable (LAB) was obtained from the Ministry of Labour (2024), reflecting both the quantity and quality of labor employed in the service sector. The capital (CAP) and competitiveness (COMP) variables were collected from the National Economic and Social Development Council (2024), a credible source of national-level economic data.

The technology variable (TECH) was calculated by the researcher based on Total Factor Productivity (TFP) using the Solow residual method, a standard technique for estimating technological progress. This method isolates the contribution of technology by removing the effects of labor and capital from total output, thereby providing a more accurate measure of technology's impact on

competitiveness. In addition, the wage variable (WAGE), representing labor cost in the service sector, was obtained from the annual labor wage statistics published by Bank of Thailand (2024), which consistently compiles national wage data.

This study employs a quantitative research approach, consisting of two main components. (1) an examination of the relationship between production factors and the competitiveness of Thailand's service industry using the Pearson correlation coefficient and (2) an analysis of the impact of production factors on competitiveness through multiple linear regression analysis. The regression analysis evaluates the slope coefficients (β) and statistical significance levels to assess the influence of each independent variable on the dependent variable.

This study adopts a quantitative research approach, employing a correlational research design and multiple regression analysis within the framework of Porter's Diamond Model. The analysis focuses on the factor conditions namely labor, capital, technology, and wages to examine their relationships and effects on the competitiveness of Thailand's service industry to Equation (2).

$$COMP = \beta_0 + \beta_1 LAB + \beta_2 CAP + \beta_3 TECH + \beta_4 WAGE + \varepsilon \quad (2)$$

Where:

- COMP* is competitiveness level of Thailand's service industry (dependent variable) (billion Thai baht).
- LAB* is labor, The total number of employed persons in the service sector. Number of workers (persons).
- CAP* is capital, referring to the level of investment or financial resources used in production (billion Thai baht).
- TECH* is technology, an index of technological progress calculated using the Solow residual method based on Total Factor Productivity (TFP), expressed as a dimensionless growth rate (percentage change per annum), as derived from Equation (1) A.
- WAGE* is average wage, representing labor cost or compensation in the service sector (Thai baht/month).
- β_0 is constant term (intercept).
- $\beta_1 - \beta_4$ is regression coefficients representing the effect of each independent variable on competitiveness.
- ε is error term, capturing the unexplained variation in the model.

The Regression Coefficient (β): $\beta > 0$: The variable has a positive effect, meaning it increases competitiveness. $\beta < 0$: The variable has a negative effect, meaning it reduces competitiveness. Significance Level (p): $p < 0.05$: The effect is statistically significant. Coefficient of Determination (R^2): Indicates the percentage of variance in COMP (competitiveness) that is explained by the independent variables in the model.

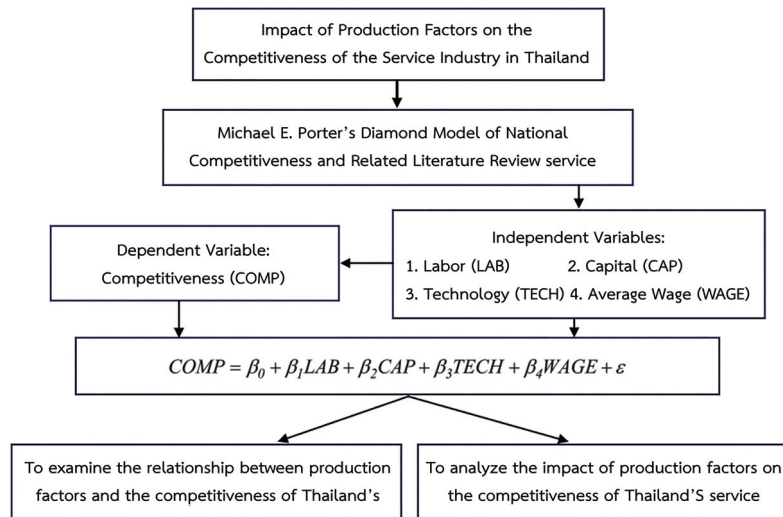


Figure 2 Conceptual Framework

Figure 2 presents the conceptual framework of this study which was developed based on Michael E. Porter's diamond model of national competitiveness and supported by relevant empirical literature. The framework posits that labor, capital, technology, and average wage are key determinants of competitiveness. It assumes that variation in these independent variables exert significant influences on the level of competitiveness, the dependent variable. Consequently, the framework provides a theoretical foundation for examining and empirically testing the proposed relationships among the study variables.

Results

The multiple regression analysis was employed to examine the relationships and effects of production factors on the competitiveness of Thailand's service industry. The independent variables included capital (CAP), labor (LAB), average wage (WAGE), and technology (TECH), while the dependent variable was competitiveness. Prior to conducting regression analysis, the stationarity of all time-series variables was tested using the Augmented Dickey-Fuller (ADF) test. The results are presented in Table 1.

Table 1 ADF Unit Root Test Results for Time-Series Variables

Variable	ADF Statistic	p-value	Conclusion (5 % level)
COMP	-4.85	0.0019	Stationary
CAP	-3.76	0.012	Stationary
TECH	-5.01	0.0007	Stationary
ΔLAB (diff)	-5.23	0.0003	Stationary (after diff)
ΔWAGE (diff)	-4.67	0.0011	Stationary (after diff)

Source: From calculation

Note: Variables LAB and WAGE were transformed using first-order differencing (ΔLAB and ΔWAGE) to ensure stationarity.

The results confirm that all variables are stationary at the 5 % significance level. Non-stationary variables LAB and WAGE were differenced before regression to ensure the validity of the statistical model.

The proposed regression model exhibits exceptional explanatory capability, with an R-squared value of 0.99766 and an Adjusted R-squared of 0.99698, underscoring its suitability and robustness in modeling the structural dynamics between production factors and service sector competitiveness. The F-statistic of 1465.698 achieves statistical significance at the 1 % level ($p < 0.01$), reaffirming the overall validity of the model. Furthermore, the Durbin-Watson statistic ($DW = 1.912$), being close to the benchmark value of 2, indicates the absence of first-order autocorrelation in the residuals in Table 1.

1. To examine the relationship between production factors and the competitiveness of Thailand's service industry. Based on the results of the multiple regression analysis examining the relationship between various production factors and the competitiveness of Thailand's service industry, the following findings were obtained:

1.1 Capital (CAP): Capital was found to have a statistically significant positive relationship with competitiveness. The regression coefficient was 0.2420, with a t-statistic of 3.671, which is significant at the $p < 0.01$ level. This suggests that increased investment in capital such as machinery, infrastructure, or relevant technologies has a significant impact on enhancing the competitiveness of the service sector in Thailand.

1.2 Labor (LAB): Labor demonstrated a negative relationship with competitiveness, with a regression coefficient of -0.339 and a t-statistic of -2.453, significant at the $p < 0.05$ level. This indicates that increasing the labor force in the service sector contribute negatively to competitiveness. Such a result may reflect issues related to low labor efficiency or a lack of adequate skills among workers, potentially diminishing overall system productivity.

1.3 Average Wage (WAGE): Although the regression coefficient for average wage was approximately 0.000, the t-statistic was remarkably high at 29.910, indicating a statistically significant relationship at the $p < 0.01$ level. This implies that average wage is significantly associated with competitiveness. The result may reflect that service industries offering higher wages tend to be more productive or employ higher-quality labor, thereby enhancing their competitiveness, even if the magnitude of the effect appears small.

1.4 Technology (TECH): The regression coefficient for technology was -0.017, with a t-statistic of -0.221, showing no statistical significance. This suggests that, under the current model specification, technology as defined in this analysis does not have a significant relationship with service sector competitiveness. A possible explanation could be that the adoption of technology in the Thai service industry remains limited or lacks measurable effectiveness at this stage.

2. To analyze the impact of production factors on the competitiveness of Thailand's service industry.

The results summarized in the preceding table underscore that both capital investment and average wage levels are significant positive determinants of competitiveness in Thailand's service sector. Notably, capital encompassing machinery, equipment, and infrastructure plays a pivotal role in enhancing firms' competitive capabilities.

Conversely, the negative association between labor and competitiveness may signal underlying issues related to workforce productivity or skill mismatches, suggesting that human capital

in the service sector may not be optimally aligned with the demands of a competitive environment. Although technology (TECH) is theoretically positioned as a driver of competitiveness, the regression analysis did not reveal any statistically significant effect. This may stem from constraints in measurement or from the limited diffusion and application of effective technology in the service sector at this stage of development. In conclusion, the empirical findings align with Research Objective 2, affirming that selected production factors specifically capital and average wage positively and significantly affect competitiveness, whereas labor has a detrimental impact, and technology does not yet manifest a statistically measurable role.

Table 2 Provides the regression estimates and corresponding statistical metrics that elucidate the dynamics between production factors and competitive performance within Thailand’s service sector.

Constant/Independent variable	Regression coefficient
	Service sector
Constant	13.422 (11.319)***
Capital (CAP)	0.2420 (3.671)***
labor (LAB)	-0.339 (-2.453)**
Average Wage (WAGE)	0.000 (29.910)***
Technology (TECH)	-0.017 (-0.221)
R ²	0.99766
Adjust R ²	0.99698
F	1465.698***
D.W.	1.912
N	32

Source: From calculation

Note: Numbers in parentheses are t-statistics values.

***, **, * is statistical significance at the 99, 95, and 90 percent levels, respectively

Conclusion and Discussion

The results of the multiple regression analysis indicate that capital and average wage have a positive and statistically significant relationship with the competitiveness of Thailand’s service industry. These findings are consistent with the principles of New Growth Theory (Romer, 1990), which emphasizes the role of investment in human capital and internal economic resources as key drivers of long-term growth. The results also align with Porter’s Diamond Model, which highlights the importance of factor conditions, such as capital and labor resources, in enhancing national competitiveness (Santipholwut, 2015).

In contrast, labor was found to have a negative impact on competitiveness, which may reflect issues related to labor productivity or skill mismatches with market demand. This observation is supported by Kasrisom (2024b), who asserts that adaptability in terms of technology and workforce skills is central to driving the service economy.

Although technology is theoretically acknowledged as a crucial factor, the empirical findings did not reveal a statistically significant relationship. This may be due to current limitations in the application or integration of technology within Thailand's service sector. Nevertheless, the development of policy strategies that prioritize investment in human capital, technology, and infrastructure remains essential for achieving sustainable competitiveness in the future.

Summary of Policy Recommendations: The analysis reveals that capital investment and average wage significantly enhance the competitiveness of Thailand's service sector. The government should therefore promote capital formation through measures such as tax incentives, low-interest financing, and infrastructure development (e.g., logistics systems and digital platforms). In addition, it should oversee improvements in the labor compensation structure to ensure that remuneration levels are appropriate. These efforts are essential for enhancing sustainable competitiveness over the long term.

Conversely, labor shows a negative effect, likely due to skill mismatches. Policies should focus on reskilling, digital skill training, and vocational education to improve labor quality. Average wage has a significant positive impact, implying that high-quality labor boosts competitiveness. A productivity-based wage system is recommended to incentivize skill development. Although technology did not yield significant results in this study, it remains theoretically vital. Policymakers should continue to support technological adoption in the service sector such as automation, AI, and data systems to drive long-term innovation and efficiency.

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