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The Impact of Provincial Governance Efficiency on the Innovation Capacity of Vietnam's Food Processing Industry

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***Abstract*: This study analyzes the relationship between provincial governance and the innovation capacity of enterprises in Vietnam's food processing industry. Secondary data was utilized along with a Tobit regression model to clarify the impact level of certain intermediary variables that reflect the role of state management and firms' innovation activities (based on data from 1,424 enterprises).**

The research findings highlight key factors influencing innovation capacity in the food processing sector, including human capital, investment in science and technology, and administrative procedure reforms. Other factors, such as the business environment, attracting Foreign Direct Investment (FDI), and innovation incentive policies, have a positive impact but are not significantly influential in the current context.

Based on these findings, the authors propose several policy implications to enhance the innovation capacity of the food processing industry in the coming period.

***Keywords*: Public policy, state management, innovation capacity, food processing.**

I. INTRODUCTION

In the context of globalization and international competition, innovation has become a key determinant of business success in manufacturing industries, particularly in developing countries like Vietnam. The food processing industry currently plays a crucial role in Vietnam's economy, with exports of products such as coffee, seafood, rice, and many others. In recent years, Vietnam's food manufacturing and processing industry has achieved significant milestones, contributing greatly to the industry's growth as well as the country's overall economic development, as reflected in the increase in the industrial production index.

According to the General Statistics Office (2023), the annual growth rate of Vietnam's food manufacturing and processing industry was approximately 7% throughout the period from 2016 to 2020. The food processing industry accounted for 19.1% of the total manufacturing sector in Vietnam. Enterprises in the food processing industry have increasingly recognized the importance of innovation and have been investing more in research and development (R&D) of new products and technologies. In 2023, businesses focusing on innovation reported a 12.4% increase in export trends and a 1.4% increase in export intensity, in contrast to those without innovation activities (Hoang et al., 2024).

However, the current state of innovation capacity in this industry still faces many challenges. Enterprises often struggle with adopting new technologies, creating high value-added products, and developing products with strong competitiveness in international markets. Additionally, issues related to product quality, food safety, and environmental protection have become significant challenges to the industry's development (Nguyet et al., 2023).

In recent years, the World Bank and the Ministry of Science and Technology have conducted surveys, reports, and in-depth studies on the innovation activities of Vietnamese enterprises in general and the manufacturing sector in particular. However, most recent studies have primarily focused on innovation outputs, such as the number of patents, R&D investments, and workforce skills. An important aspect—the role of state governance in enhancing innovation capacity in Vietnam's food processing industry—has not yet been comprehensively studied and evaluated.

This paper provides an overview of the current situation and analyzes the impact of local public policies on the innovation capacity of food processing enterprises in Vietnam. Additionally, the study offers recommendations for the government to improve the innovation capacity of Vietnamese food processing enterprises toward 2030.

II. RESEARCH OVERVIEW

2.1. Innovation Capacity In Food Processing Enterprises

The food processing industry holds significant potential for innovation compared to other manufacturing sectors. This distinction arises from multiple factors, including its dependence on suppliers, market demands, the role of collaboration among stakeholders, and the integration of new technologies (Ciliberti et al., 2016).

One of the primary challenges facing the food processing industry is its reliance on suppliers, particularly in the agricultural sector. Research indicates that this dependency can hinder product and process innovation. Triguero et al. emphasize that higher reliance on suppliers is associated with lower innovation potential, highlighting that the industry's connection to its suppliers is crucial in understanding its innovation gap compared to other manufacturing industries (Triguero et al., 2013). This finding is echoed by Matopoulos and Bourlakis, who note that food companies often depend on external technological innovations rather than solely relying on internal capabilities (Matopoulos & Bourlakis, 2011). These dependencies underscore the importance of vertical integration and the establishment of robust supply chain networks to enhance innovation in the food processing sector (Bigliardi & Galati, 2013).

Collaboration networks with stakeholders are another crucial factor influencing innovation in the food processing industry. The generation of ideas within food processing enterprises often originates from internal sources, such as technical staff and academic partnerships, rather than external collaborations (Ashfaq Bombaywala & Riandita, 2015). However, Ciliberti et al. (2016) argue that there is a growing trend toward open and networked innovation settings, where external relationships significantly drive product and process innovations within firms. Ghazalian and Fakih assert that innovation is essential for food processing enterprises to maintain competitiveness in both domestic and international markets (Ghazalian & Fakih, 2017). The establishment of networks involving customers, suppliers, and research institutions is increasingly recognized as a key strategy for enhancing innovation capacity in the food processing industry (Busse & Siebert, 2018).

Technological advancements also play a critical role in fostering innovation in the food processing sector. For example, 3D printing technology has been effectively applied to product design and packaging, significantly accelerating the development of new products (Sethi et al., 2018). Furthermore, the exploration of byproducts from fish processing for the development of innovative food products demonstrates how market concerns can stimulate investment and innovation in specific food industry niches (Silovs, 2018). Such technological innovations not only enhance product offerings but also improve operational efficiency, enabling companies to respond more effectively to consumer demands for healthier and more sustainable food options (Baregheh et al., 2014; Chaparro-Banegas et al., 2024).

2.2. The Impact Of State Governance On Innovation Capacity In The Food Processing Industry

Government policies significantly influence the innovation capacity of food processing enterprises by shaping adaptability, establishing competitive environments, and fostering development in a rapidly changing and highly competitive business landscape. The effectiveness of these policies varies considerably, depending on their design, implementation, and the specific contexts of the enterprises they aim to support (Zulu-Chisanga et al., 2021). In evolving economies, Ghazalian and Fakih emphasize that innovation serves as a crucial strategy for food processing firms (Ghazalian & Fakih, 2017). This underscores the importance of state policies not only in supporting innovation but also in creating a favorable environment for companies to adapt to market fluctuations. Such policies may include financial incentives, regulatory support, and initiatives to foster collaboration between companies and research institutions.

Government support plays a vital role in enhancing the innovation performance of small and medium-sized enterprises (SMEs) in the food sector, particularly those that may lack the necessary resources for research and development (R&D). Jeong et al. argue that while government support is essential, it often falls short in effectively boosting R&D investment and fostering cooperation among firms, both of which are critical for driving innovation performance (Jeong et al., 2021). This highlights a potential gap in policy effectiveness, suggesting that direct support alone is insufficient without a strategic approach that encourages collaboration and investment in innovation. The integration of both external and internal R&D investments is crucial for advancing innovation in the agri-food sector. Alarcón and Sánchez find that both types of R&D expenditures positively impact business performance, suggesting that policies promoting a balanced approach to R&D funding can lead to more effective innovation outcomes (Alarcón & Sánchez, 2013).

The relationship between government policy and innovation becomes even more complex depending on the type of innovation pursued by enterprises (Ashford, 2000). Therefore, a well-designed policy framework should create an ecosystem where businesses are free to develop while being supported in their innovation efforts (Fagerberg & Srholec, 2008). This suggests that innovation-promoting policies should be implemented through the creation of a business-friendly environment, thereby enhancing firms' innovation capacity by providing essential R&D resources and facilitating access to international markets.

National innovation policies directly influence the level of R&D investment by enterprises. Countries that implement incentives for technological research and international collaboration encourage businesses to enhance their innovation capabilities (Hasanah, 2024; Wu et al., 2007). The alignment of national policies with global technology standards enables enterprises to leverage competitive advantages, particularly in high-tech sectors. This alignment is crucial for fostering a conducive environment for innovation and economic development (Meyer-Krahmer & Reger, 1999). Countries are increasingly adjusting their policies to facilitate integration into global value chains, thereby improving access to advanced technologies (Cetulean & Tănase, 2024). This policy adaptation is essential for businesses to capitalize on international markets and strengthen their competitive advantages (Alejla, 2023).

III. RESEARCH METHODOLOGY

3.1 Research Data

In this study, the author utilizes an initial dataset comprising over 600,000 enterprises, including both newly surveyed firms and those extrapolated based on the criteria set by the General Statistics Office of Vietnam in 2022 regarding revenue, assets, and profits from previous years. However, since the study employs production function calculations with randomly estimated components, the use of extrapolated enterprise data could lead to estimation biases. Therefore, the author excludes these firms and retains more than 200,000 enterprises.

After filtering the data, 2,434 enterprises were identified as primarily engaged in food technology manufacturing and processing. The dataset was further refined based on the following criteria: (1) Enterprises must have been established and operational for at least two years prior to the survey to ensure they are not outliers. (2) Enterprises must report positive administrative costs to confirm they responded seriously to the survey and provided complete information.

Following this screening process, the final dataset consists of 1,424 enterprises. The classification of the research sample by business size and enterprise type is presented in Table 1 and Table 2 below

TABLE 1. DISTRIBUTION OF SURVEYED FOOD PROCESSING ENTERPRISES BY ECONOMIC REGION IN 2022

Economic Region	Economic Region	Percentage (%)
Northern Midland and Mountainous Region	143	10.04
Red River Delta	729	51.19
North Central Region	68	4.78
South Central Coastal Region	120	8.43
Central Highlands.	80	5.62
Southeastern Region	193	13.55
Mekong Delta	91	6.39
Total number	1,424	100

Source: Compiled and analyzed by the author, 2024

TABLE 2. RESEARCH SAMPLE CLASSIFICATION BY ENTERPRISE SIZE

Enterprise Size	Number of Enterprises	Percentage (%)
Medium	1,136	79.78
Large	288	20.22
Total	1,424	100
Note: Small: ≤ 10 employees; Small: 11 ≤ employees ≤ 100; Medium: 101 ≤ employees ≤ 200; Large: ≥ 200 employees		

Source: Compiled and analyzed by the author, 2024

3.2 Research Methodology

This study employs the Tobit regression model (Tobin, 1958) to analyze the factors influencing enterprises' innovation activities.

The author assumes that the innovation process within enterprises occurs in two stages: first, the enterprise decides whether to engage in innovation activities, and second, it determines the level of investment in innovation.

If an enterprise does not engage in innovation activities, its investment in innovation is at the lower bound (zero). Thus, the use of the Tobit model is appropriate, as it considers all observations at the limit value as well as those above it to estimate a unified regression model. This contrasts with alternative models that only utilize observations above the threshold value (McDonald & Moffit, 1980).

The Tobit regression model is applied with one dependent variable, the total expenditure on innovation activities, and 14 explanatory variables. The empirical model can be formulated as follows:

$$y_i^* = z\beta + \omega_i \quad (1)$$

Where y_i^* is the latent dependent variable. In this study, we observe the variable Y, which represents the level of investment in innovation activities, with

$$y = \max(0; y^*) \quad (2)$$

Given the study assumptions, an observed **y>0** represents the total expenditure on innovation activities by enterprises in 2022.

For enterprises that do not engage in innovation activities, **y=0** represents the additional income compared to the baseline.

The equation for the dependent variable is given by

$$E[y \mid x] = \underbrace{P(y = 0 \mid x) * E[y = 0 \mid x]}_{=0} + \underbrace{P(y > 0 \mid x) * E[y \mid y > 0, x]}_{>0} \quad (3)$$

Where :

$$P(y > 0 \mid x) = P(X * \beta + u > 0) = P\left(\frac{u}{\sigma} > -\frac{X*\beta}{\sigma}\right) = \Phi\left(\frac{X*\beta}{\sigma}\right) \quad (4)$$

Here **Φ** (.) **represent the cumulative normal distribution function evaluated at** $\frac{X*\beta}{\sigma}$

From these formulas, the Tobit regression function can be expressed as:

$$E[y \mid x] = \Phi\left(\frac{X*\beta}{\sigma}\right) * X * \beta + \sigma\phi\left(\frac{X*\beta}{\sigma}\right) \quad (5)$$

TABLE 3. DESCRIPTION OF VARIABLES IN THE MODEL ASSESSING THE IMPACT OF STATE POLICIES ON INNOVATION CAPACITY IN VIETNAM'S FOOD PROCESSING INDUSTRY

Intermediary Variables	Variable Name	Variable Description	Type
	Y	Total expenditure on innovation activities and R&D per province (Unit: million VND/year)	Continuous
Creating a Business Environment	PCI	Provincial Competitiveness Index	Continuous
	PAPI	Provincial Governance and Public Administration Performance Index	Continuous
	GRDP	Gross Regional Domestic Product (Unit: trillion VND/year)	Continuous
Infrastructure Investment	DTI	Digital Transformation Index	Continuous
	IIP	Provincial Industrial Production Index	Continuous
	HTKT	Technical Infrastructure Index	Continuous
	HTNL	Agricultural Infrastructure Index	Continuous
	ICT	Information Technology Application Index	Continuous
	HDI	Provincial Human Development Index	Continuous

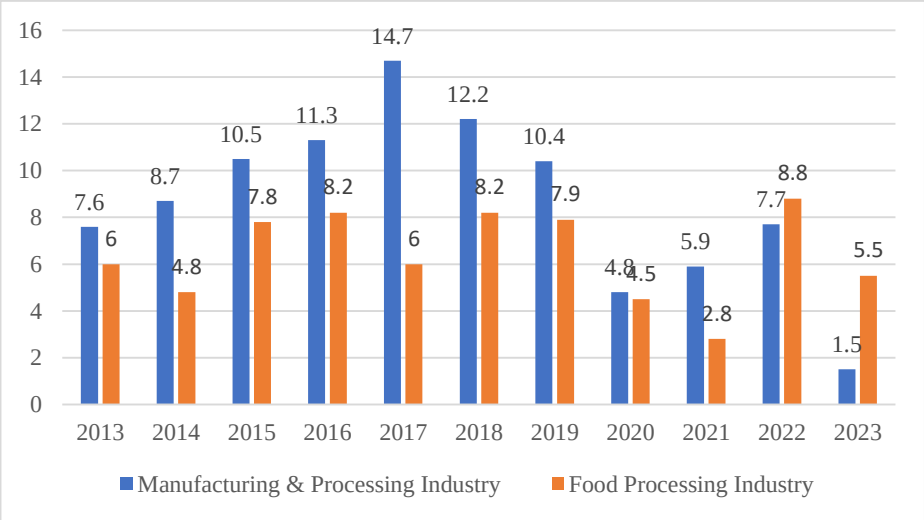
Investment in Science, Technology, and Human Resources	NSKHCN	Provincial/state expenditure on science and technology (as a % of total provincial/state budget)	Continuous
Attracting FDI	FDI	Number of FDI projects licensed (Total projects/year)	Continuous
	VFDI	Total FDI capital attraction (trillion VND/year)	Continuous
Enhancing Public Administration Efficiency	PAR-Index	Provincial Public Administration Reform Index	Continuous
	SIPAS	Satisfaction Index of Public Administration Services	Continuous

Source: Compiled and analyzed by the author, 2024

IV. RESEARCH FINDINGS

4.1 Current Status Of Innovation Capacity In Vietnam's Food Processing Industry

Vietnam's food processing industry has undergone significant transformations from 2013 to 2023, driven by various factors such as economic growth, modernization of agricultural production methods, and changes in consumer preferences. During this period, the industry has increasingly shifted towards more sustainable development strategies, enhanced food safety standards, and the integration of technology in food processing..



Source: General Statistics Office, 2023

CHART 1: INDUSTRIAL PRODUCTION INDEX OF VIETNAM'S FOOD PROCESSING INDUSTRY (2013–2023)

Over the past few years, Vietnam's food processing industry has achieved remarkable progress, making substantial contributions to both industrial and overall economic growth. The sector accounts for 19.1% of the total manufacturing industry in Vietnam, making it the largest segment within the manufacturing sector. This highlights its importance in meeting domestic food demand as well as fulfilling export requirements. Additionally, the food processing industry is considered one of the least affected sectors by economic and social fluctuations, as food remains an essential consumer need. Recognizing this potential, the government has implemented strategic policies to support the development of this industry.

TABLE 4. INNOVATION ACTIVITIES IN FOOD PROCESSING ENTERPRISES

Sector	Enterprises with innovation		Enterprises Investing in R&D		Level of investment in technological innovation	
	Yes	(%)	Yes	(%)	Spending on technological innovation (Unit: billion VND/year/enterprise)	On total net revenue (%)
Meat processing & preservation	0	0	9	11.25	1.68	1.09

Seafood processing & preservation	4	1.47	65	23.81	2.04	0.43
Fruit & vegetable processing	12	6.82	29	16.48	4.27	1.03
Animal & vegetable oil production	0	0	3	7.69	1.77	0.58
Dairy processing	0	0	10	34.48	2.45	0.59
Rice milling & flour production	3	1.58	25	13.16	1.2	0.22
Other food manufacturing	14	2.99	65	13.89	9.97	4.01
Animal, poultry, and aquaculture feed production	3	1.78	35	20.71	2.73	0.33
Total	36	2.53	241	16.92	3.26	0.77

Source: Compiled and analyzed by the author, 2024

The data in Table 4 reveals a significant disparity between different sub-sectors in food processing regarding R&D investment and innovation activities. On average, the industry invests 0.77% of total net revenue in innovation, and only 2.53% of enterprises actively engage in innovation. This level of investment remains relatively low compared to the overall manufacturing sector.

4.2 Assessing The Impact Of State Governance On Innovation Capacity In The Food Processing Industry

Vietnam currently has 63 provinces and cities, and therefore, policy and administrative procedure evaluations are conducted based on 63 observations. The author aggregates and integrates these values with existing data using the variable "Province/City." The final dataset consists of 63 observations, incorporating indicators related to policies, transparency assessments, and key indicators from food processing enterprises.

It can be stated that the government has provided clear strategic directions and has introduced various policy solutions aligned with the industry's innovation capacity. However, there remains a lack of specific policies that directly focus on enhancing innovation capacity, particularly at the local level. As a result, evaluating the effectiveness of state governance policies related to innovation capacity requires an indirect approach, using economic, social, and administrative indicators at the provincial level.

TABLE 5. DESCRIPTIVE STATISTICS OF VARIABLES USED IN THE MODEL FOR ASSESSING THE IMPACT OF STATE POLICIES ON INNOVATION IN ENTERPRISES (2022)

Intermediary Variables	Variable Name	Min	Max	Mean	Standard Deviation
Creating a Business Environment	PCI	59.58	72.95	66.40	2.30
	PAPI	0	47.88	41.69	7.39
	GRDP	15,014.00	1,196,004.00	544,404.40	508,594.30
Infrastructure Investment	DTI	0.39	0.80	0.60	0.05
	IIP	75.90	132.90	111.59	5.69
	HTKT	0.25	0.97	0.62	0.11
	HTNL	0.11	0.77	0.46	0.08
	ICT	0.25	0.90	0.49	0.08
Investment in Science, Technology, and Human Resources	HDI	0.60	0.82	0.76	0.05
	NSKHCN	0.11	1.17	0.84	0.31
Attracting FDI	FDI	0	893.00	149.70	167.50
	VFDI	0	92,599.50	23,233.45	18,791.41
Enhancing Public Administration Efficiency	PAR-Index	75.99	90.10	86.96	2.81
	SIPAS	72.54	87.59	80.18	1.83

Source: Compiled and analyzed by the author, 2024

This dataset provides an overview of indicators related to the business environment, infrastructure investment, science and technology investment, FDI attraction, and public administration efficiency across Vietnam's provinces.

- PCI (Provincial Competitiveness Index) has an average value of 66.40, showing significant variations across provinces.
- Regarding infrastructure investment, the DTI index has an average value of 0.60, with Hanoi (Vietnam's capital) achieving the highest score of 0.80.
- The average HDI (Human Development Index) score is 0.76, with Ho Chi Minh City having the highest value (0.82) and Ninh Thuan Province the lowest (0.60).

TABLE 6. TOBIT MODEL ESTIMATION RESULTS

Variable	Model Coefficient	Standard Error
PCI	0.231 ***	(0.056)
PAPI	0.089 ***	(0.015)
lnGRDP	0.181	(0.219)
DTI	0.290	(0.285)
IIP	0.466 **	(0.199)
HTKT	-0.070	(0.204)
HTNL	0.356 **	(0.180)
ICT	0.455	(0.294)
HDI	2,304 ***	(0.473)
NSKHCN	2,227 ***	(0.332)
lnNumFDI	0.062 *	(0.035)
lnVFDI	0.070 ***	(0.026)
PAR_Index	1,387 **	(0.569)
SIPAS	1,617 ***	(0.348)
_cons	-11.684 **	(5,323)
N	*63*	
ll	*-3554.29*	
chi2	*371.14*	
p	*0.000*	

*Notes: *, **, *** indicate significance levels at 10%, 5%, and 1%, respectively*

Source: Compiled and analyzed by the author, 2024

The Tobit regression model results indicate that multiple factors influence innovation capacity in Vietnam's food processing industry:

- PCI (Provincial Competitiveness Index) shows that an improved business environment positively correlates with innovation capacity.
- PAPI (Public Administration Performance Index) also has a positive effect, contributing to the sustainable development of the industry.
- DTI (Infrastructure Investment Index) suggests that improving infrastructure fosters the growth of the food processing sector.
- HDI and NSKHCN indices highlight the strong relationship between human development, investment in science and technology, and innovation capacity.
- FDI indicators, including the number of FDI projects and FDI capital investment, confirm their positive impact on innovation.
- PAR-Index and SIPAS indices emphasize the crucial role of public administration reform in facilitating innovation

V. CONCLUSION AND POLICY IMPLICATIONS

The research findings indicate that, in general, the innovation capacity of Vietnamese food processing enterprises remains at a moderate level, as reflected in R&D investment and the number of enterprises regularly engaging in innovation activities. The quantitative results demonstrate a positive relationship between local government policies and the enhancement of innovation capacity in the food processing industry. Among the key influencing factors, the most significant contributors to enterprise innovation include: Investment in human capital, Government budget allocation for science and technology, Public administration reforms.

These findings align with previous studies, such as: Saleh (2018) and Bueno et al. (2010), which emphasize the role of human capital in innovation capacity; Silovs (2018), which highlights the importance of budget allocation for innovation activities; Shamsub (2023), which underscores the impact of public administration on innovation capacity in the food processing sector. Other assumptions within the research model also indicate a positive impact, though with relatively limited influence.

Based on the research findings, the government should focus more on human capital development, including: Enhancing education and scientific research, improving public health through nutrition programs and healthcare initiatives. Additionally, R&D investment must continue to be strengthened. Policies should be designed to increase annual science and technology funding to approximately 2% of GDP from now until 2030. Finally, administrative reform should be accelerated to facilitate easier access to government support for enterprises, encourage businesses to engage more actively in innovation activities.

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