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기업 혁신전략 우선순위에 따른 제품디자인 혁신 성과: 정부지원 조절효과를 중심으로

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Product Design Innovation Outcomes Based on the Prioritization of Innovation Strategies: Focusing on the Moderating Role of Government Support

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Abstract

This study aims to empirically analyze the effects of prioritization of appropriate innovation strategies on product design innovation and the moderating role of government support. Using a sample of 7,500 firms from the 2018 and 2020 Korea Innovation Survey conducted by the Science and Technology Policy Institute (STEPI), logistic regression analyses were performed, focusing on five innovation strategies: existing products, new products, new customer acquisition, customer customization, and price competitiveness. The analysis reveals that for medium and large firms, government support positively moderates the potential for product innovation when interacting with both existing and new product strategies. In contrast, a negative moderating effect was observed for the new customer acquisition strategy. While government programs for product development primarily t arget SMEs, the findings indicate that for small firms, the moderating effects of government support on product innovation are minimal. These results highlight the need for differentiated government support policies based on firm size and provide insights into the optimal alignment of strategically prioritized innovation strategies and government support to improve innovation outcomes.

Keywords : Product Design Innovation, Logistic Regression, Innovation Strategy, Government Support, SMEs

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I. Introduction

Small and Medium-sized Enterprises (SMEs) face significant challenges in product design innovation due to limited funding and a lack of specialized per-sonnel (Lee et al., 2006). Although R&D and technological innovation drive corporate growth (Gemser & Leenders, 2001), the gap between large corporations and SMEs in R&D investment continues to widen. Despite some annual increases, SMEs' share of total national R&D expenditure has declined, limiting their ability to invest in design and innovation (Noh, 2019).

To address these challenges, the Korean government has introduced various initiatives to strengthen SMEs' design capabilities (Yang & Noh, 2015). However, empirical research assessing the effectiveness of these government programs remains scarce (Yoon et al., 2018). Understanding how government support interacts with SMEs' innovation strategies is crucial for enhancing product design outcomes (Strybel & Kumar, 2020).

Innovation strategies such as pricing, design, and demand influence product innovation by helping firms allocate resources effectively (Farida & Setiawan, 2022). For instance, pricing strategies can improve cost efficiency (Falahat et al., 2020), while design strategies enhance brand positioning (Joo, 2020). Demand strategies can expand market reach through customer-oriented innovation (Sameti et al., 2022). However, the extent to which government support strengthens or weakens these strategies remains unclear (Yoon et al., 2018).

This study addresses three key gaps. First, while previous research highlights the importance of innovation strategies for SMEs, limited empirical evidence exists on their direct impact on product design innovation. Second, although government support is critical in SMEs' innovation, its moderating effects have not been fully explored. Third, the effectiveness of government support may vary by firm size, yet little research has examined this issue.

To fill these gaps, this study examines:

How do SMEs' innovation strategies (pricing, design, and demand) influence product design innovation?

Does government support moderate the relationship between innovation strategies and product design innovation?

How does the impact of government support differ across firm sizes (small, medium, and large enterprises)?

How has the effectiveness of government support evolved (comparing 2018 and 2020 data)?

This research investigates the interaction between innovation strategies and government support by analyzing data from the 2018 and 2020 Korea Innovation Surveys. It provides insights into how firms can optimize their approach to product design innovation.

II. Theoretical Background

2.1 Product Design and Product Innovation

Product design plays a vital role in both process and product innovation within the framework of technological innovation (Armour & Teece, 1978). It can be categorized into aesthetic design and structural design, each serving distinct functions (Ulrich & Eppinger, 2011), which is visualized in <Figure 1>.

Aesthetic design focuses on sensory elements, such as form and color, influencing consumer preferences and brand perception (Micheli et al., 2012; Li & Liu, 2019). On the other hand, structural design enhances functionality, durability, and efficiency, making it essential for process innovation and cost reduction (Swink, 2000; Ulrich & Eppinger, 2011).

While traditionally associated with marketing, product design is now recognized as a key driver of technological advancement (Bocken et al., 2016). Beyond aesthetics, design contributes to financial performance and competitive positioning by integrating both functional and innovative aspects (Micheli et al., 2012).

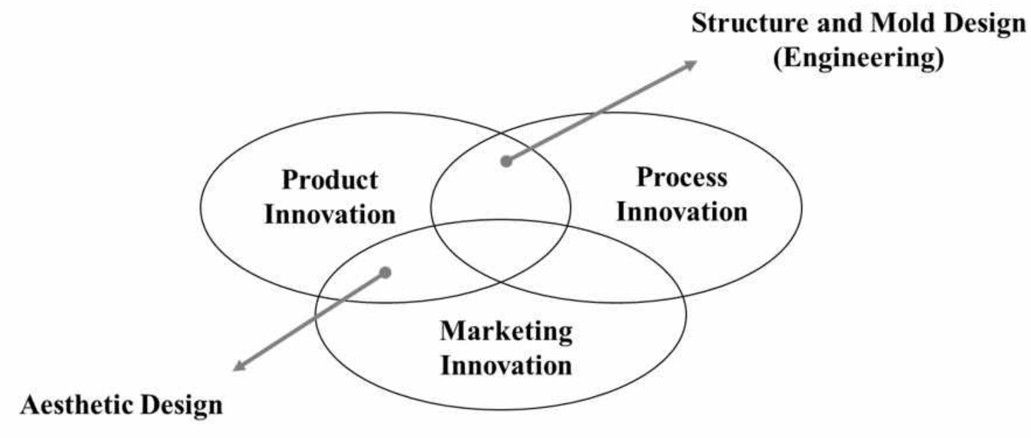
Emerging research underscores the synergy between aesthetic and structural design, suggesting that firms must strategically align design innovation with market and technological demands (Swink, 2000; Micheli et al., 2012). Successful product design innovation depends on prioritizing the right strategies to maximize both consumer appeal and operational efficiency (Bocken et al., 2016).

2.2. Operational Strategies and Product Design Innovation

Corporate innovation success depends on how firms prioritize and implement innovation strategies, which influence resource allocation and product design innovation (Lee, 2020; Armour & Teece, 1978). These strategies define a firm's ability to develop competitive products by optimizing technical and financial resources (Falahat et al., 2020; Micheli et al., 2012)..

Previous studies have investigated management strategies to drive product innovation through product design modification. First, price strategy-driven product design modifications contribute to creating added value through competitive pricing, offering cost-saving options, and strengthening market competitiveness (Mesa et al., 2022). For instance, 3D modeling and additive manufacturing technologies can accelerate design processes and redefine traditional design and manufacturing relationships. Additionally, such strategies enable integrated implementation without incurring extra management costs (Falahat et al., 2020). Companies emphasizing pricing strategies focus on maintaining competitive pricing through process innovation and efficiency, achieving a competitive edge in market pricing (Farida & Setiawan, 2022).

<Figure 1> Relationship Between Technological Innovation and Product Design



Appropriately selected design strategies are a strategic tool for enhancing brand image. They aim to differentiate products and align with market trends, creating new or improved products that stand out (Sameti et al., 2022; Dutta et al., 2021). This approach not only incorporates visual elements but also integrates sensory factors such as tactile and auditory aspects, leading to quality and durability improvements (Zhao et al., 2021). Design strategies are essential for responding sensitively to consumer-centric market demands and can take two forms: improving existing products or developing entirely new innovative products (Joo, 2020; Micheli et al., 2012; Zhao et al., 2021).

Design strategy-driven product design modifications, a key part of the demand strategy, are focused on identifying and meeting customer needs. This approach increases market-oriented sales demand and expands target markets, making it a customer-centric strategy (Farida & Setiawan, 2022). Companies adopting demand strategies develop products that either meet the requirements of existing customers or attract new ones, reflecting a deep understanding of customer needs (Falahat et al., 2020). However, the existing literature lacks a comprehensive discussion on the direct linkage between innovation strategies and product design innovation (Mallam et al., 2015).

2.3 Measuring Product Innovation Performance

Key indicators for evaluating product innovation performance include the number of patents registered, contributions to sales revenue, and the success rate of product innovations (Joo, 2020; Ryu & Kim, 2020; Lee, 2020). While these quantitative metrics offer an intuitive means of assessment, they can be influenced by various external factors such as market conditions and organizational capabilities, which may limit the reliability of the evaluation (Chiva & Alegre, 2009; Dutta et al., 2021). For example, metrics like sales revenue contributions and patents can be affected by not only the success of product innovations but also by market environments and commercialization capacities(Shin et al., 2018; Hungund & Mani, 2019).

Small enterprises, often dependent on government support due to limited R&D and product design resources, face difficulties in achieving measurable innovation outcomes. Despite efforts, these firms are frequently excluded from analyses due to insufficient data (Micheli et al., 2012). This exclusion may create bias in studies examining the relationship between innovation strategies and product innovation success, with analyses often focusing on larger enterprises with greater resources (Zhao et al., 2021).

2.4 Product Innovation and Government Support

Design support programs are structured to enhance corporate design capabilities, stimulating innovation and contributing to technological advancement and market expansion (Farida & Setiawan, 2022; Micheli et al., 2012). In Korea, the government has implemented various policies to strengthen the design capabilities and technological innovation of SMEs. <Table 1> outlines recent governmental support programs for SMEs. Over the past decade, local government bodies have actively promoted design support initiatives, primarily led by the Korea Institute of Design Promotion. These programs aim to strengthen SMEs' design capabilities and foster product innovation.

In recent years, government support has shifted from centralized, ministry-led initiatives to localized programs led by regional governments and design promotion agencies. This decentralization emphasizes tailoring support to regional industry needs and fostering local innovation ecosystems. For instance, local governments now implement their own design support programs, addressing region-specific challenges. These changes underscore the need to examine how such structural shifts affect the effectiveness of government support in promoting product innovation.

Despite widespread governmental support for SMEs, limited empirical studies have evaluated the effectiveness of these programs (Zhao et al., 2021). Yoon et al. (2018) examined how government support influences technological innovation capacity, financial outcomes, and intellectual assets like patents. However, their focus was on overall innovation capabilities, not the moderating role of government support on product innovation, which this study addresses.

While prior research underscores the importance of government support in innovation, a key gap remains: how prioritizing and selecting innovation strategies interact with such support to impact product design innovation (Lorentz et al., 2016). This issue is harder to explore due to limited quantitative data on SMEs’ R&D and design activities.

<Table 1> Government Support Programs for SME Product Innovation

Year	Name	Supporting institute
2022	Gyeongnam Small and Medium Business Design Development Support Project	Korea Institute of Design Promotion
2022	Manufacturing company design manpower support project	Korea Institute of Design Promotion
2022	Gyeonggi-do design development support project	Gyeonggi Economic Science Promotion Agency
2021	SME design development support project	Director of the Jeju Special Self-Governing Province Economic and Trade Promotion Agency
2019	SME design development support project Recruitment of tasks in the field of general company support	Korea Technopark Promotion Association
2019	SME design development support	Gyeongsangbuk-do Job Economy Industry Division Small and Medium Venture Business Division
2019	Announcement of recruitment of design-led social enterprises to support innovation capacity building	Korea Institute of Design Promotion Service Design Office

Ⅲ. Data & Method

3.1 Data & Variables

This study used data from the 2020 and 2018 Korea Innovation Surveys(KIS) conducted by the Science and Technology Policy Institute(STEPI), focusing on manufacturing and service industries. The analysis included 3,500 firms from 2018 and 4,000 firms from 2020. All samples responded to at least one of the five strategies, with no missing values for the selected variables, resulting in a total of 7,500 samples. <Table 2> presents the distribution and proportion of firms by type across the dataset.

Small enterprises comprised 1,580 cases (45%) in 2018 and 1,717 cases

(43%) in 2020, totaling 3,297 cases, or 44% of the total sample. Medium enterprises accounted for 1,829 cases (52%) in 2018 and 2,093 cases (52%) in 2020, totaling 3,922 cases, or 52% of the sample. Large enterprises made up approximately 4% of the dataset, with 91 cases (3%) in 2018 and 190 cases (5%) in 2020. Overall, 96% of the data consists of small and medium enterprises, making the dataset highly suitable for analyzing SME characteristics. <Table 3> provides additional statistical details.

<Table 2> Frequency of Firms by Type

Type	2018		2020		Total	
Small	1580	45%	1717	43%	3297	44%
Mid	1829	52%	2093	52%	3922	52%
Large	91	3%	190	5%	281	4%
Total	3500	100%	4000	100%	7500	100%

<Table 3> Descriptive Statistics

Variables	Obs.	Min	Max	Mean	Std. Dev.
Product Design Innovation (PDI)	7500	0	1	.24	.425
Design Strategy 1 (EP1)	7500	0	3	2.28	.918
Design Strategy 2 (NP2)	7500	0	3	1.38	1.132
New Customer Strategy 3 (NC3)	7500	0	3	1.75	1.178
Customization Strategy 4 (CS4)	7500	0	3	1.73	1.198
Price Competitiveness Strategy (PC5)	7500	0	3	1.63	1.130
Government Support (GovSub)	7500	0	1	.58	.493
Firm Type (Firm_type)	7500	1	3	1.60	.562
Researcher Ratio (Researcher)	7500	2	11	3.95	1.277
Venture Status (Inno)	7500	0	1	.14	.350
Firm Size (Size)	7500	0	100	7.31	10.470

The choice of 2015-2019 data reflects key market changes during this period and avoids the confounding effects of the COVID-19 pandemic starting in 2020. This timeframe enables a clearer longitudinal analysis of innovation trends and the mid-term impact of government support policies on innovation strategies.

During this period, government support shifted from centralized, ministry-led initiatives to localized programs managed by regional governments and design agencies, aiming to better align with local industry needs. To capture these dynamics, the data were split into two periods (2018 and 2020), enabling a clearer comparison of how innovation strategies and the effectiveness of government support evolved. This approach reveals temporal trends in firm behavior and policy impact, offering deeper insight into their interplay.

3.2 Method

To assess whether product design innovation occurred based on the perceived importance of innovation strategies, logistic regression was employed. This method was chosen due to the binary nature of the dependent variable, indicating whether product design innovation was implemented. Logistic regression is specifically designed for categorical dependent variables and is similar to general regression in that it explains the dependent variable using a linear combination of independent variables. However, it is applied when the dependent variable consists of two categories, such as success-failure or 0-1.

When dependent data are represented as 0 and 1, simple linear regression can result in outcomes outside the [0, 1] range, leading to reduced accuracy. Logistic regression resolves this issue by ensuring that the dependent variable remains within the [0, 1] range through a logit transformation of the odds ratio. First, the odds ratio, representing the likelihood of success compared to failure, is calculated (1). Then, the logit transformation adjusts the output to fit within the [0, 1] range (2), resulting in the logistic function (3).

$$Odds = \frac{p(y=1 \mid x)}{1-p(y=1 \mid x)} \tag{1}$$

$$Logit(p) = \log\frac{p}{1-p} \tag{2}$$

$$Logistic\,function = \frac{1}{1+e^{-\beta X}} \tag{3}$$

Logistic regression is widely used in innovation research, as shown in Demirtas et al. (2009), Hungund and Mani (2019), and Yang and Roh (2015), for analyzing innovation outcomes. This study employs the same method to investigate how innovation strategies affect the likelihood of product innovation.

To assess the moderating effect of government support, interaction terms were added to the model (Swink, 2020). Significant results indicate that government support can amplify or weaken the effect of each strategy, offering insight into how strategic prioritization, combined with support, shapes innovation outcomes.

<Table 4> Definitions of Variables

Type	Variable Name		Operational Definition
Dependent	Product Design Innovation	PDI	1 = Product innovation launch (PDI Yes) 0 = No product innovation (PDI No)
Independent	Existing Product Strategy1	EP1	3 = High importance, 2 = Medium importance, 1 = Low importance, 0 = Not important
	New Design Strategy2	NP2	
	New Customer Strategy3	NC3	
	Customization Strategy4	CS4	
	Price Competitiveness Strategy5	PC5	
Control	Firm Size	Size	Logarithmic value of average number of employees
	Researcher Ratio	Researcher	Ratio of R&D personnel to regular employees
	Venture Status	Inno	1 = Venture company, 0 = Non-venture
	Firm Type	Firm_type	1 = Small enterprise, 2 = Medium enterprise, 3 = Large enterprise
Moderating	Government Support	GovSub	1 = Received government support (GovSub Yes), 0 = No government support (GovSub No)

3.3 Variables

The measurement criteria for the variables used in this study are as follows: The dependent variable for measuring the performance of product design in-novation is the "launch of innovative products," coded as 0 or 1 based on whether a completely new innovative product or an improved product was launched in the market. The independent variables evaluate the perceived importance of five innovation strategies through a survey. Responses were recoded into four categories: '0 = Not Important,' '1 = Low Importance,' '2 = Moderate Importance,' and '3 = High Importance.' The five innovation strategies include: Design strategies: "Existing Product Strategy" and "New Product Strategy.", Customer-centric demand strategies: "Customization Strategy" and "New Customer Acquisition Strategy.", Pricing strategy: "Price Competitiveness Strategy.", The moderating variable assesses whether firms valued and utilized government support. This was measured on a binary scale: 1 for "Received Support" and 0 for "Did Not Receive Support.", The control variables include firm size, the qualitative level of human resources, and venture firm status, as applied from previous studies. The operational definitions of these variables are summarized in <Table 4>.

3.4 Reliability and Validity

The reliability and validity of the five innovation strategy scales were assessed through Cronbach's Alpha, which was calculated at 0.799, indicating relatively high internal consistency. Additionally, a correlation analysis was performed to evaluate the relationships among independent, dependent, and control variables. The results of the correlation analysis are presented in <Table 5>, and All correlation coefficients between variables were below the threshold of 0.6.

Cohen and Cohen (1983) suggest that correlation coefficients below 0.7 indicate sufficient distinctiveness and lack of multicollinearity concerns. Following this guideline, the correlation analysis in this study demonstrated that all coefficients met this threshold, providing clear and reliable evidence of variable independence. As a result, additional multicollinearity tests were deemed unnecessary. Referring to prior studies that adopted this approach for multicollinearity validation, the correlation analysis results in this study confirmed that multicollinearity does not pose a significant issue and the variables are appropriate for further analysis (Shin et al., 2018; Lee, 2020).

<Table 5> Correlations Analysis

	NPI	EP1	NP2	NC3	CS4	PC5	GovSub
NPI	1						
EP1	.149**	1					
NP2	.325**	.375**	1				
NC3	.187**	.389**	.540**	1			
CS4	.157**	.420**	.449**	.557**	1		
PC5	.129**	.450**	.409**	.518**	.559**	1	
GovSub	.262**	.183**	.294**	.207**	.167**	.189**	1

* Pearson correlation analysis, n=7500

** p < .1 = *, p < .05 = **, p < .01 = ***

IV. Results

4.1 Frequency Analysis

A cross-tabulation analysis examined the distribution of firms by size and government support (GovSub) regarding product design innovation (PDI), as shown in <Table 6>. Among firms without government support, those that launched innovative products increased from 63 in 2018 to 377 in 2020, a six-fold rise. However, firms that did not launch innovative products also grew from 959 to 1,744, indicating a continued reliance on existing operations.

In contrast, among firms with government support, those that launched innovative products declined from 758 to 574, while non-innovative firms decreased from 1,720 to 1,305. Although fewer supported firms refrained from innovation, the overall innovation rate declined.

Firm size played a significant role. Small firms with government support experienced a sharp decline in product launches (328 to 99), while those without support saw an increase in non-innovative firms (640 to 1,075). Medium-sized firms without government support showed the most significant increase in innovation, from 32 to 261, while supported medium-sized firms remained stable at around 400. Large firms with government support experienced a modest increase in product launches, from 32 to 71, although their smaller sample size limits the impact.

<Table 6> Cross-Tabulation Analysis

Government Support (GovSub)	Product Design Innovation (PDI)	Year	Small	Mid	Large	Total
GovSub No	PDI No	2018	640	299	20	959
		2020	1075	637	32	1744
		Total	1715	936	52	2703
	PDI Yes	2018	27	32	4	63
		2020	94	261	22	377
		Total	121	293	26	440
	Total	2018	667	331	24	1022
		2020	1169	898	54	2121
		Total	1836	1229	78	3143
GovSub Yes	PDI No	2018	585	1100	35	1720
		2020	449	791	65	1305
		Total	1034	1891	100	3025
	PDI Yes	2018	328	398	32	758
		2020	99	404	71	574
		Total	427	802	103	1332
	Total	2018	913	1498	67	2478
		2020	548	1195	136	1879
		Total	1461	2693	203	4357
Total	PDI No	2018	1225	1399	55	2679
		2020	1524	1428	97	3049
		Total	2749	2827	152	5728
	PDI Yes	2018	355	430	36	821
		2020	193	665	93	951
		Total	548	1095	129	1772
	Total	2018	1580	1829	91	3500
		2020	1717	2093	190	4000
		Total	3297	3922	281	7500

<Table 7> Government Support Status for Product Design Innovation Firms

	2018		2020	
Product Design Innovation(PDI)	821	100%	951	100%
GovSub Yes	758	92%	574	60%
GovSub No	63	8%	337	35%

<Table 7> highlights changes from 2018 to 2020 in firms launching innovative products, especially by government support status. In 2018, 821 out of 3,500 firms (23%) launched such products, increasing to 951 out of 4,000 (23%) in 2020. Supported firms fell from 92% (758) to 60% (574), while unsupported

firms rose from 8% (63) to 35% (377). This trend suggests medium-sized firms are increasingly innovating without government support, indicating declining reliance on public assistance.

<Table 8> Results of Model 1 and Model 2

	Product Design Innovation(Y)			
	Model 1 (Direct effect)		Model 2(Moderating effect)	
(X)	2018	2020	2018	2020
EP1	0.301*** (.082)	0.046 (.045)	0.036 (.198)	0.038 (.058)
NP2	0.908*** (.069)	0.629*** (.056)	0.905*** (.197)	0.552*** (.092)
NC3	0.050 (.075)	−0.779*** (.066)	−0.280 (.225)	−0.390*** (.101)
CS4	0.038 (.076)	−0.140*** (.057)	0.060 (.194)	−0.414*** (.101)
PC5	−0.124 (.077)	−0.206*** (.057)	−0.302 (.207)	−0.477*** (.103)
GovSub	1.607 (.144)	0.826 (.109)	−0.555 (.506)	0.614 (.216)
Firm_type	−0.564 (.108)	0.160 (.119)	−0.548*** (.109)	0.158 (.120)
Size	0.268 (.052)	0.571 (.050)	0.261*** (.052)	0.568*** (.050)
Inno	0.361 (.109)	0.957 (.119)	0.359 (.110)	0.959*** (.120)
EP1 × GovSub			0.340 (.217)	0.024 (.094)
NP2 × GovSub			0.028 (.211)	0.090 (.117)
NC3 × GovSub			0.385 (.239)	−0.626*** (.134)
CS4 × GovSub			−0.007 (.211)	0.416*** (.126)
PC5 × GovSub			0.210 (.223)	0.425*** (.128)
Constant	−5.219 (.301)	−3.843 (.176)	−3.541 (.437)	−3.737 (.199)
Numbers of Obs.	3500	4000	3500	4000
Cox & Snell R^2	0.171	0.209	0.175	0.216
Nagelkerke R^2	0.257	0.314	0.264	0.324
−2 Log likelihood	3158.1	3447.78	3139.89	3441.63

* p < .1 = *, p < .05 = **, p < .01 = ***

4.2 Logistic Regression

The logistic regression analysis tested the relationship between innovation strategies and product design innovation. Model 1 examined the direct effects, Model 2 assessed the moderating effects of government support, and Model 3 explored additional moderating effects based on firm size. The results are presented in <Table 8> and <Table 9>. All models were analyzed separately for the 2018 and 2020 datasets to allow for period-specific comparisons. Beta coefficients (B) and standard errors (in parentheses) are presented.

4.2.1 Direct Effects of Operational Strategies on Product Design Innovation

Model 1 results indicate that in 2018, the Existing Product Strategy (EP1, $\beta = 0.301$, $p < 0.05$) and New Product Strategy (NP2, $\beta = 0.908$, $p < 0.01$) significantly increased the likelihood of product innovation. However, the New Customer Strategy (NC3), Customization Strategy (CS4), and Price Competitiveness Strategy (PC5) were not statistically significant. In 2020, EP1 lost significance, whereas NP2 ($\beta = 0.872$, $p < 0.01$) remained a strong predictor of product innovation. Interestingly, NC3 ($\beta = -0.524$, $p < 0.05$), CS4 ($\beta = -0.339$, $p < 0.05$), and PC5 ($\beta = -0.287$, $p < 0.05$) exhibited significant negative effects, suggesting that these strategies may have constrained innovation under changing market conditions.

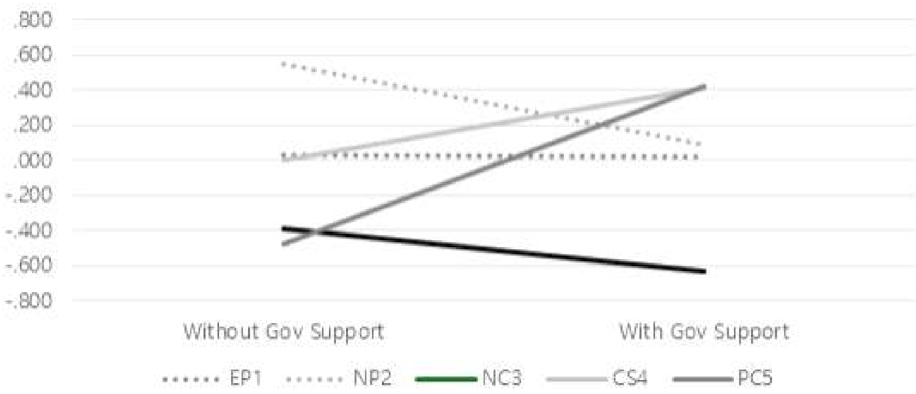
4.2.2 Moderating Effect of Government Support (Model 2)

Model 2 assessed how government support influenced the relationship between innovation strategies and product design innovation. In 2018, no significant moderating effects were detected. However, in 2020, government support positively moderated CS4 ($\beta = 0.416$, $p < 0.01$) and PC5 ($\beta = 0.425$, $p < 0.01$), reinforcing their positive effects on innovation by providing additional resources and financial stability.

Conversely, the interaction between NC3 and government support ($\beta = -0.626$, $p < 0.01$) was significantly negative, indicating that government-backed firms experienced lower innovation outcomes when adopting customer acquisition strategies. <Figure 2> illustrates these moderating effects, distinguishing between significant and non-significant relationships using solid and dotted lines, respectively. The graph highlights that CS4 and PC5 benefited from government funding, whereas NC3 firms showed higher innovation success without external support, suggesting that government intervention might limit strategic flexibility.

<Figure 2> further contrasts the results between 2018 and 2020, showing that while government support had minimal influence in the earlier period, its impact became more pronounced by 2020, particularly for CS4 and PC5. Meanwhile, the negative impact of government support on NC3 intensified, implying possible misalignment between policy measures and firms' market-driven strategies.

<Figure 2> Moderating Effect of Government Support in 2020



4.2.3 Moderating Effect of Government Support (Model 3)

Model 3 re-evaluated the firm size-specific moderating effects (small, medium, and large enterprises). This analysis uncovered some moderating effects that were not evident in Model 2. In 2018, no strong interactions were observed, though weak significance was noted for NC3 × GovSub in small ($p = 0.059$) and large ($p = 0.094$) enterprises. suggesting that when these firms combined government support with customer acquisition strategies, the likelihood of innovation slightly increased. For Medium firms showed a significant positive interaction for EP1 × GovSub, indicating that government-supported firms using EP1 had higher innovation success.

<Table 9> Results of Model 3

	Product Design Innovation(Y)					
	SMALL		MID		LARGE	
(X)	2018	2020	2018	2020	2018	2020
EP1	0.059 (.277)	0.120 (.100)	−0.159 (.314)	−0.041 (.078)	0.957 (1.386)	−0.019 (.269)
NP2	0.734*** (.286)	0.984*** (.165)	1.131*** (.306)	0.361*** (.118)	1.031 (1.072)	0.439*** (.322)
NC3	−0.482 (.322)	−0.861 (.211)	−0.013 (.348)	−0.246*** (.122)	−2.217 (1.383)	0.111 (.494)
CS4	0.235 (.277)	−0.203 (.177)	−0.235 (.308)	−0.454*** (.125)	−0.081 (1.051)	−1.037*** (.818)
PC5	−0.168 (.303)	−0.154 (.167)	−0.515 (.312)	−0.620*** (.134)	1.024 (1.496)	−0.203 (.687)
EP1 × GovSub	−0.223 (.311)	0.020 (.173)	1.009*** (.339)	0.048 (.118)	−0.054 (1.514)	1.695*** (.742)
NP2 × GovSub	0.418 (.313)	−0.314 (.223)	−0.365 (.321)	0.177 (.145)	0.116 (1.201)	1.354*** (.523)
NC3 × GovSub	0.666* (.353)	−0.129 (.267)	−0.047 (.364)	−0.708*** (.161)	2.533* (1.511)	−1.782*** (.787)
CS4 × GovSub	0.210 (.312)	0.109 (.232)	0.031 (.326)	0.499*** (.153)	−0.644 (1.219)	1.140 (.976)
PC5 × GovSub	0.367 (.334)	−0.090 (.225)	0.396 (.332)	0.613*** (.164)	−1.114 (1.631)	−0.106 (.772)
Constant	−4.587 (.700)	−2.960*** (.503)	−3.675 (.714)	−3.424*** (.342)	−4.324 (6.569)	−0.766 (1.262)
Numbers of Obs.	3500	4000	3500	4000	3500	4000
Cox & Snell R^2	0.282	0.120	0.122	0.206	0.230	0.241
Nagelkerke R^2	0.430	0.238	0.184	0.288	0.312	0.322
−2 Log likelihood	1160.732	986.928	1755.986	2134.988	98.346	210.893

* p < .1 = *, p < .05 = **, p < .01 = ***

In 2020, government support exhibited divergent effects depending on firm size. For small enterprises, no significant moderating effects were found. For medium enterprises, the negative moderating effect on NC3 × GovSub ($\beta = -0.488$, $p < 0.05$) strengthened, reinforcing that government-supported firms faced challenges in customer acquisition strategies. Conversely, government support positively influenced CS4 × GovSub ($\beta = 0.392$, $p < 0.05$) and PC5 × GovSub ($\beta = 0.401$, $p < 0.01$), indicating that customization and pricing strategies benefited from financial and resource-based support.

For large enterprises, EP1 × GovSub ($\beta = 0.351$, $p < 0.05$) and NP2 × GovSub ($\beta = 0.612$, $p < 0.01$) showed positive moderating effects. However, NC3 × GovSub remained negative ($\beta = -0.532$, $p < 0.05$).

These results indicate that Medium and large enterprises benefited most from government support, particularly in product enhancement and pricing strategies, while small enterprises saw no significant effects, emphasizing the need for tailored support. The persistent negative impact of NC3 × GovSub across all firm sizes highlights the need for more flexible policies to support market-driven innovation better. These findings highlight the importance of tailoring government policies to the needs of different firm sizes to maximize innovation strategies' effectiveness.

V. Conclusion

This study empirically examined the impact of corporate innovation strategies and government support on product design innovation and the likelihood of new product launches. Using 2018 and 2020 data, the analysis compared the effects of government support across firm sizes, identifying key differences in innovation outcomes.

The findings indicate that the New Product Strategy (NP2) consistently played a crucial role in enhancing product design innovation in both years. While the Existing Product Strategy (EP1) had a positive impact in 2018, its effect was no longer significant in 2020, suggesting a shift in the factors driving innovation. In contrast, the Customization Strategy (CS4) and Price Competitiveness Strategy (PC5) negatively influenced innovation in 2020, highlighting the importance of aligning innovation strategies with market conditions.

Overall, Government support positively influenced product design innovation, but its effectiveness varied by firm size and strategy. Medium-sized enterprises benefitted the most from government support, particularly in EP1 and NP2, while small firms showed minimal moderating effects. Large enterprises experienced significant positive effects from government support only in NP2. Additionally, in 2020, government support reinforced the positive effects of CS4 and PC5 but weakened the impact of the New Customer Strategy (NC3), indicating that certain government interventions may constrain strategic flexibility.

VI. Discussion

Comparison with existing literature highlights consistent and divergent findings and is summarized in <Table 10>. Prior research (e.g., Falahat et al., 2020; Zhao et al., 2021) aligns with this study's results, emphasizing the strong influence of new product design on innovation. Similarly, previous studies (Farida & Setiawan, 2022; Lorentz et al., 2016) have identified pricing strategies as a significant determinant of product innovation, corresponding with the observed mixed effects of PC5 in this study. However, differences across market contexts underscore the need for a nuanced understanding of the interaction between innovation strategies and government support.

<Table 10> Literature on strategy-driven product design

Strategies	This study	Falahat et al., 2020	Zhao et al., 2021	Farida & Setiawan, 2022	Lorentz et al., 2016
Context	SMEs in Korea	SMEs in Malaysia	B2C in China	SMEs in Indonesia	SMEs in Finland
Pricing strategy	Competitive price	Pricing capability	Product pricing	Low price strategy	Low pricing
Design strategy	New product design	Product innovation capability	–	Process innovation	Ability to introduce new product design
Demand strategy	Customer acquisition	Marketing communication capability	Product packaging	–	–

This study advances knowledge in four key areas. First, it confirms that prioritizing NP2 is critical for product innovation, reinforcing the centrality of new product development. Second, it reveals the complex role of government support, which positively influenced CS4 and PC5 in 2020 but negatively affected NC3, highlighting the importance of strategic alignment. Third, the findings show that medium-sized firms benefitted most from government support in EP1 and NP2, whereas small firms exhibited limited effects. Finally, declining government-supported innovation participation from 2018 to 2020 suggests evolving firm dynamics in leveraging external support.

From a policy perspective, these results underscore the need for customized government interventions. Medium-sized firms responded most effectively to government support, indicating that targeted policies in EP1 and NP2 could enhance innovation performance. For small enterprises, additional measures to strengthen technological capabilities may be necessary.

From a practical standpoint, firms should align innovation strategies with market conditions and internal capabilities. Given the consistent impact of NP2, firms should prioritize investments in new product development. Strategies such as CS4 and PC5 require careful evaluation to ensure they align with evolving industry needs.

Despite its contributions, this study has several limitations. First, sample size variations by firm type may affect generalizability, particularly for large enterprises. Second, specific types of government support were not differentiated, limiting insights into their relative effectiveness. Third, the study covers only 2018 and 2020 data, which may not fully capture recent innovation trends.

Future research should analyze more recent data to capture evolving trends and assess how different types of government support, such as financial aid, tax incentives, and training programs, interact with innovation strategies. A deeper examination of how support mechanisms function across industries could offer valuable insights for policymakers and businesses.

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