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The Influence of the Attributes of Electric Vehicles on Brand Image, Consumer Attitude, and Purchase Intention: Focusing on the Moderating Effects of ESG Management*

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ABSTRACT

Purpose – Direct and indirect factors affecting purchase of electric vehicles, and potential factors affecting purchase intention are studied. The effects of electric car attributes (functionality, economy, design, safety), brand image, and consumer attitude on electric car purchase intention was examined. The mediating effect of brand image and consumer attitude is examined. In addition, the moderating effect of ESG management between attributes and the brand image of electric vehicles was examined.

Design/Methodology/Approach – Electric vehicle attributes were set as independent variables, and purchase intentions were set as dependent variables. In addition, the mediating effect of brand image and consumer attitude and the moderating effect of ESG management were considered. An empirical study was conducted targeting Chinese consumers, and multiple regression analysis was used as the research methodology.

Findings – The attributes of electric vehicles (functionality, economy, design, safety) had a significant effect on brand image and purchase intention. Among the attributes of electric vehicles, economic feasibility, design, and safety had a significant positive (+) effect on consumer attitudes. Brand image and consumer attitude showed a positive (+) mediating effect between electric vehicle attributes and purchase intention. Further, the moderating effect of ESG management showed a positive moderating effect only between functionality and brand image.

Research Implications – The study provides academic, practical, and policy implications for establishing an electric vehicle marketing strategy in the Chinese market. In particular, it is meaningful to marketing and distribution strategies for foreign companies, including Korean companies that wish to advance into China.

Keywords: brand image, consumer attitude, electric vehicle properties, ESG management, purchase intention
JEL Classifications: M14, M31, O30

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I. Introduction

As is known through various media such as the Internet and TV, various environmental problems such as fine dust and carbon emissions are seriously emerging. Among these, global warming has emerged as a global problem. According to Hwang (2019), one of the causes of global warming is the increase in the use of engines, or internal combustion engines, which cause emissions, and eventually triggered warming as carbon dioxide increased. In particular, after COVID-19, the importance of environmental protection increased due to the perception that one of the causes of the COVID-19 outbreak was due to the environment. Naturally, many consumers have emerged that are interested in the environment and pursue changes in consumption behavior; these consumers are called green consumers. These consumers are very interested in their own health, and they also place a great weight on environmental issues and the future of mankind. In the end, according to this situation, consumer interest in green products has increased, the green market has emerged, and its market size is gradually increasing (Park et al., 2011).

On the other hand, the basic concept of automobiles is changing from simple transportation to eco-friendly and smart green cars. Therefore, related companies are focusing on developing eco-friendly cars. In other words, electric vehicles, which are continuously developing for eco-friendly, environmental protection, and energy saving in an era facing environmental pollution and an energy crisis caused by automobile emissions, are receiving attention from society as a whole. Electric vehicles do not emit harmful gases, so they can effectively relieve environmental pressure and reduce greenhouse effects. In addition, due to the operating characteristics of the electric vehicle, the electric vehicle can be operated more smoothly. After all, despite the economic recession caused by COVID-19, competition for developing electric vehicles is intensifying due to the "environmental problem response" around the world, "future competitiveness" among automakers, and "strengthening fuel efficiency regulations to save energy". In particular, sales of electric vehicles in China increased significantly due to strong support from the Chinese government. In 2016, global electric vehicle sales were about 770,000, of which more than 65% were sold in China (Wu et al., 2017). According to Chinese Customs, exports of electric passenger cars and off-road vehicles in China amounted to 240,300 in 2019, accounting for 96.38% of exports of new energy vehicles. As of 2020, China's electric vehicle production and sales topped the world for the fifth consecutive year. Many global companies are fiercely competing for this global market share. In this situation, this study conducted an empirical analysis on consumers in the rapidly growing Chinese electric vehicle market, and used the attributes of electric vehicles, purchase intention, ESG management, brand image, and consumer attitude as major variables.

Meanwhile, China's electric vehicle battery industry is globally competitive, centering on global giants such as CATL,[1] and maintains close cooperation with electric vehicle companies (Cho, 2019; Lee, 2021). Although the importance of electric vehicles and continuous growth are expected, research has not been sufficiently conducted to identify consumer purchase intentions for electric vehicles (Kim & Kim, 2019). Moreover, there are very few studies that simultaneously examine the recently emerging "ESG management" and "properties of electric vehicles". In addition, since the electric vehicle market is still considered to be in its early stages (Lim & Park, 2022), this study is judged to be of sufficient value. Therefore, considering the changing market environment and customers, it is necessary to discover various factors related to the "purchase intention" of electric vehicles, and furthermore, empirical studies related to these factors are needed. According to previous studies, brand image played an important role in corporate

1. CATL is a global battery company in China.

sales, profits, and market share, and product attributes played an important role in creating a friendly brand image. Nevertheless, there are not many studies on the effect of the attributes of Chinese electric vehicles on brand image, consumer attitude, and purchase intention.

Meanwhile, in recent years, leading global companies around the world have been rapidly introducing "ESG (Environment, Social, & Governance) management" (Baik et al., 2022). As a new paradigm of management strategy, sustainable management is emerging as an indispensable management strategy according to the needs of the new era. In other words, in the past, the improvement of environmental problems or corporate social responsibility (CSR) were optional, but the ESG management of companies became essential in the post-COVID-19 era (Lee & Lee, 2021). Specifically, companies with excellent ESG activities utilize improved brand image and reputation as a source of competitive advantage (Koh et al., 2022). Therefore, as ESG management spreads to all fields, research on ESG management is also needed in the electric vehicle sector in China.

The goal of this study is as follows. First, we would like to examine the attributes of Chinese electric vehicles, and how each of these factors affects purchase intention through brand image and consumer attitude. Second, we also would like to examine whether brand image and consumer attitude have mediating effects between 'attributes of electric vehicle' and 'purchase intention.' Third, we would like to examine the "moderating effect of ESG management" between the attributes of electric vehicles and brand image. Specifically, we would like to carry out empirical analyses of the above content for Chinese consumers. Fourth, this study aims to present the right direction for establishing strategies to increase the purchase intention of electric vehicles. Furthermore, we intend to derive not only theoretical development in the academic aspect but also meaningful implications in terms of companies and policies.

After that, the progress of this study is as follows. In Section II, the relevant literature will be reviewed. Section III attempts to derive a research model by establishing research hypotheses. Section IV will conduct empirical analyses through research results. Finally, Section V presents the summary, implications, and limitations of this study.

II. Literature Review

1. Definition and Precedence of Electric Vehicles

According to a study by Larson et al. (2014), electric vehicles obtain a synchronous reaction of energy from a reaction called an electric lattice. This driving method has the advantage of being eco-friendly because it is not based on fossil fuels. In detail, an electric vehicle is a vehicle propelled by a motor using battery energy. An electric vehicle is an automobile which uses unconventional fuel as its power source (using common fuel, new type of vehicle power unit) or combines the advanced technology of vehicle power control and drive. In other words, since electric vehicles do not use fossil fuels, they are pollution-free vehicles that generate little exhaust gas, and they generate driving power by supplying electric energy generated from high-voltage batteries to electric motors (Moon, 2019).

Unlike internal combustion vehicles, electric vehicles are expensive to purchase, so the initial investment is high, but they are cheaper than gasoline. Therefore, the fuel cost spent while using is lower than that of internal combustion locomotives (Lévay et al., 2017). In addition, since it is operated with a battery instead of an engine, the interior is simpler than that of an internal combustion engine, so maintenance and repair costs are low. For most of the total holding costs, the fixed cost is high and the marginal cost is low. As such, electric vehicles have various advantages in economic, environmental, and industrial aspects, so they are spreading worldwide. In particular, countries around the world are stepping up efforts by expanding production and establishing infrastructure for utilizing electric vehicles and reducing existing internal combustion

engine vehicles to increase the penetration rate of electric vehicles (Shim et al., 2020).

Despite this trend, there are not many studies on electric vehicles yet. Chu et al. (2017) set the factors affecting the purchase intention of electric vehicles as various factors, such as subjective knowledge of electric vehicles, eco-friendly tendency, anxiety about mileage, and fuel efficiency, and studied how they affect the purchase intention of electric vehicles. Electric vehicles are recognized to have a variety of functionality, economic feasibility, and environmental values. Various values of electric vehicles may have a statistically significant effect on consumer attitudes (Kim & Kim, 2019). Consumer intention to purchase electric vehicles increases when all instrumental, symbolic, and empirical properties of electric vehicles are positively perceived (Song et al., 2018). Wang et al. (2018) investigated and analyzed the factors of intention to purchase electric vehicles for potential buyers in Shanghai, China. As a result, it was revealed that individual risk awareness and moral responsibility for environmental protection were the main influencing factors.

2. Attributes of Electric Vehicles

Many previous studies have shown that the higher the initial purchase cost of an electric vehicle, the more negatively it affects the preference of electric vehicles (Hidrue et al., 2011; Jensen et al., 2013). On the other hand, since electricity prices are much cheaper than the fuel costs of internal combustion locomotives, driving and fuel costs also affect consumer preferences for electric vehicles (Chu et al., 2017) On the other hand, Choi et al. (2001) argued that when conducting 'design' activities, they can be differentiated from competitors by focusing on consumers and reflecting various functional parts. In other words, design is an important factor that affects consumer perceptions of the visual and functional aspects of the product. In the case of Lee & Kim (2010), it was emphasized that the 'functionality' of automobiles is a major feature that determines the efficiency of automobile use. In addition, Woo (2015) confirmed that the 'safety' of automobiles had an important effect on purchase intention.

According to Liao et al. (2017), as a result of a survey on the general public's intention to purchase electric vehicles, it was considered to be affected by economic feasibility, technical, and infrastructure factors and policy characteristics. Jang et al. (2021) analyzed the selection factors of eco-friendly vehicles by dividing them into functionality, economic feasibility, service, safety, and image. In addition, factors of selection attributes of eco-friendly vehicles are classified into economic feasibility, safety, functionality and service convenience, and brand image (Yim, 2018). This research intends to study this by dividing the attributes of an electric vehicle into functionality, economic feasibility, design, and safety based on these preceding studies. In the case of Ajzen (1991), the difficulty of using products felt by consumers in the 'functionality' of automobiles was highly correlated in determining which service to choose. Functionality was defined as 'attributes related to the performance of a vehicle'. In the case of Lee & Kim (2010), the performance of the automobile was regarded as the ability of an automobile for use at the highest efficiency under certain conditions. As mentioned above, functionality is an attribute related to the performance of the automobile, including engine power, driving method, type of gear, acceleration force, noise, and safety (Park et al., 2014).

According to Weindel & Swoboda (2016), 'economic feasibility' is acquired from financial sacrifice. This reflects the overall evaluation of the service quality perceived by the customer based on the convenience received by the customer and the cost paid. Ahn et al. (2003) viewed economic feasibility as the monetary value paid in exchange for using or owning a product or service, and they considered it the value that consumers sacrifice to acquire a product or service. Lee & Kim (2010) defined 'economic feasibility' as an attribute related to costs incurred in a series of processes, such as maintaining or reselling a car after

purchase. Next is the study of 'design'. Buchanan (1990) defined design as conceptualizing and planning artificial materials by integrating five things: visual communication, symbolism, objects, organized service activities, and complex systems. The pleasing appearance, which began with the conceptual model design of a car, delights the eyes, and whether it suits the public's aesthetic sense and taste plays a very important role in car sales. Seo et al. (2015) emphasized design as an important factor in the attributes of automobile products, and used overall design, automobile interior, and exterior styling as major measurement items related to it.

Finally, the term "safety" of an automobile refers to the performance of avoiding accidents while driving the vehicle, and ensuring the safety of pedestrians and passengers. This basically includes active safety and passive safety. According to Kwon (2015), safety is body robustness, safe braking, the quantity and quality of airbags, and advanced accident prevention functions. Above all, there are four important factors that affect safety: structural energy absorption, interior design, safety devices, and safety glass.

3. Brand Image

A brand image is defined as a set of beliefs that consumers have about a company (Hwang et al., 2019). All emotional qualities that relates consumer feelings about products produced or sold by a company to a specific corporate brand are called a brand image (Lee, 2019). According to Lin & Hsu (2011), corporate brand image is directly related to product attributes, and are affected by tangible and intangible attributes such as product name, design, and price. Furthermore, brand image tends to form over a long period of time, and consumers that recall a brand image and purchase the brand generally have confidence in the product, and purchase it based on faith in quality (Aaker, 1996). The brand image in this study refers to the "general impression that consumers have on a specific electric vehicle brand", and is created through a combination of various associations related to the brand.

4. Consumer Attitudes

Consumer attitudes are generally defined as feelings that an individual likes or dislikes an idea or object. Through this, consumer behaviors can be guessed (Jung & Lee, 2016). The measurement of consumer attitude was extracted from a study by Fishbein & Ajzen (1975). Attitude toward a product means that consumers tend to consistently evaluate a particular product in a friendly or unfriendly manner, and for this reason, it is used as a factor in predicting consumer behavior. It is the attitude of consumers that appears after the experience of purchasing and consuming products (Tong & Hwang, 2021). This is presented as cognitive, emotional, and behavioral responses, and consumer attitudes are shown by recognizing empirical consumption value. Consumer attitudes in this study are defined as 'emotional and psychological reactions to electric vehicles as consumers with experience in purchasing and using electric vehicles'.

5. Purchase Intention

Ajzen (1991) defined consumer purchase intention as a subjective probability that beliefs and attitudes will become behavioral, and as the action of an attitude toward behavior and subjective norms. Rogers (1976) defined purchase intention as 'a measure of the possibility of a consumer purchasing a product or service'. Mullet (1992) saw that consumers consist of a 'personal attitude toward a product or brand', and the influence of external factors: that is, a 'consumer's intention to purchase'. In the end, purchase intention can be judged by an individual's action on whether he/she intends to perform an action on a specific issue. In the process, the importance of behavioral intention is emphasized, and intention is a factor that directly determines purchase behavior (Song, 2021). In this study, purchase intention was defined as 'the action of purchasing behavior and subjective norms that recognize, explore, select, purchase, use, and evaluate electric vehicles expected to satisfy consumers' needs'.

6. ESG Management

ESG stands for Environment, Social, and Governance, and refers to management activities in which companies take the lead in environmental protection, perform social contribution activities such as support for the socially disadvantaged, and thoroughly comply with laws and ethics and transparently manage governance (Lee, 2022; Moon et al., 2022). This is a new paradigm management strategy that goes beyond corporate social responsibility (CSR) and shared value (CSV) to overcome issues such as environmental protection, which is a pan-human problem, and includes non-financial evaluation indicators (Park & Seo, 2021).

Recently, global companies and leading domestic companies have rapidly introduced ESG management and are accepting sustainable management as a demand for a new era. In other words, companies are trying to introduce ESG management to respond to a new change in the business environment called ESG (Oh, 2021), and governments and international organizations are also strongly promoting this at a global level due to the influence of COVID-19 and changes in the natural environment. ESG management internalizes negative external effects, such as social polarization and environmental pollution, through the realization of 'stakeholder capitalism', and is clearly distinguished from CSR management aimed at enhancing long-term shareholder value in finding optimal resource allocation between financial and social values to increase utility of various stakeholders (Park & Lee, 2021).

III. Research Design

1. Relationship between Attributes of Electric Vehicles and Brand Image

Lee & Kim (2010) found that the functionality, service and symbolism, appearance sensibility, economic feasibility, and convenience of automobiles all have a positive (+) effect on consumer satisfaction in a study on consumer satisfaction. Hyun & Park (2011) selected three factors, design, economic feasibility, and functionality, as attributes of automobiles in a study on Chinese customer car purchase decisions and customer satisfaction. According to Figenbaum & Kolbenstvedt (2013), in the case of Norwegians, 'safety' accounted for the highest percentage of the factors of concern when purchasing electric vehicles. Lee & Kim (2003) argued that the image of family restaurants and restaurant brand image has a significant positive (+) effect on customer satisfaction, and emphasized that continuous efforts are needed for this. Kwon & Kim (2019) revealed that brand image has a positive (+) effect on customer satisfaction through a study on the effect of bakery brand image on customer satisfaction. Based on the studies above, the following hypotheses were established in this study.

H1: The attributes of electric vehicles will have a positive (+) effect on brand image.
H1a: The functionality of electric vehicles will have a positive (+) effect on brand image.
H1b: The economic feasibility of electric vehicles will have a positive (+) effect on brand image.
H1c: The design of electric vehicles will have a positive (+) effect on brand image.
H1d: The safety of electric vehicles will have a positive (+) effect on brand image.

2. Relationship between Attributes of Electric Vehicles and Consumer Attitude

Various values of electric vehicles may have a significant effect on consumer attitudes (Kim & Kim, 2019). Son (2011) revealed through an empirical study on car preference that Chinese users prioritize functionality when purchasing cars. Lee & Kim (2016) emphasized that 'economic feasibility' is accepted as an essential factor for most consumers that purchase vehicles, which is a representative attribute factor of automobiles.

Automobiles have an important influence on the composition of the product image formed on the exterior as one of the overall attributes, and this also affects attitudes such as consumer preferences (Kwon et al., 2004). Therefore, in the case of automobiles, the value of 'design' has a significant impact on consumers (Leder & Carbon, 2005). Huh & Lee (2021) emphasized the importance of the consumer pursuit of 'safety' as a consumer characteristic variable that affects the preference and purchase of imported luxury cars. Based on the previous studies as above, the following hypotheses were established.

H2: The attributes of electric vehicles will have a positive (+) effect on consumer attitudes.
H2a: The functionality of electric vehicles will have a positive (+) effect on consumer attitudes.
H2b: The economic feasibility of electric vehicles will have a positive (+) effect on consumer attitudes.
H2c: The design of electric vehicles will have a positive (+) effect on consumer attitudes.
H2d: The safety of electric vehicles will have a positive (+) effect on consumer attitudes.

3. Relationship between Attributes of Electric Vehicles and Purchase Intention

In an empirical study on the choice of small and medium-sized cars by consumers in Korea, the U.S., and Japan, Lee (2002) revealed that the functionality attributes of cars affect the preference and purchase intention of small and medium-sized cars. As a result of research on the consumption market of hybrid cars by Axen & Kurani (2009), it was found that vehicle purchase behavior occurred after comprehensively considering whether consumer intention to purchase cars was economic feasibility, and whether they drew attention in various aspects of car performance and technology. In the case of Hyun & Park (2011), factors such as functionality, image, and economic feasibility were set as major attributes that influenced Chinese customer purchasing decisions. They also argued that the overall shape of a car's 'design' has the most decisive impact on consumer car purchases. Woo (2015) confirmed that when a consumer purchases an electric vehicle, the 'safety' of the electric vehicle significantly affects purchase intention. Based on the studies above, the following hypotheses were established.

H3: The attributes of electric vehicles will have a positive (+) effect on purchase intention.
H3a: The functionality of electric vehicles will have a positive (+) effect on purchase intention.
H3b: The economic feasibility of electric vehicles will have a positive (+) effect on purchase intention.
H3c: The design of electric vehicles will have a positive (+) effect on purchase intention.
H3d: The safety of electric vehicles will have a positive (+) effect on purchase intention.

4. Relationship between Brand Image and Consumer Attitude

According to Engel et al. (1995), brand image has beliefs that follow alternative evaluations that are affected by consumer evaluation criteria, and the sum of these beliefs and alternative evaluations appears as a friendly attitude toward the product or brand. Rook (1984) saw that elements that form the brand image, factors such as product design, price, quality, and advertisement, improve the overall brand image if the image of each element is good in order to reach the consumer's perception structure. Therefore, if the overall image is good, it will have a positive effect on the brand's intention to be chosen, and as a result, it will have a positive effect on purchase intention. Therefore, in this study, the following hypothesis was established.

H4: The brand image of electric vehicles will have a positive (+) effect on consumer attitudes.

5. Relationship between Brand Image and Purchase intention

The higher a consumer's trust in corporate image and brand image, the better the consumer's emotional attitude toward the company, and this emotional attitude has a positive effect on purchase intention (Park, 2009). For hotel companies, brand image affects consumer behavior and plays an important role in differentiating from competitors, securing target markets, and inducing purchase intentions (Han, 2017). Bhakar and Bhakar (2013) showed that brand image had a positive effect on the purchase intention in a study on the relationship between the country of origin and brand image for customers in India. Based on these previous studies, the following hypothesis was established.

H5: The brand image of electric vehicles will have a positive (+) effect on purchase intention.

6. Relationship between Consumer Attitude and Purchase intention

When consumers are satisfied with a particular brand, they have a preference for that brand. As a result, a purchase decision is made for a particular brand that is most preferred, and a purchase actually occurs (Brown & Stayman, 1992; Patchimnan et al., 2022). The consumer attitude formed for the product has a positive effect on the purchase intention of the product (Holbrook & Batra, 1987). As the promotion and market for electric vehicles are activated in China, efforts have been made to instill a positive perception of electric vehicles. Therefore, consumers with a positive attitude toward electric vehicles will increase their intention to purchase electric vehicles. Therefore, the following hypothesis was established.

H6: Consumer attitudes toward electric vehicles will have a positive (+) effect on purchase intention.

7. Mediating Effect of Brand Image

Brand image becomes a medium that emotionally connects customers and companies, and furthermore, it helps to establish a solid emotional relationship with the company and customers beyond purchasing behavior (Han et al, 2019). Positive brand image due to consumer experience or word of mouth directly leads to favorable feelings for the brand and purchase of brand products (Bhakar & Bhakar, 2013). Park (2009) said that the brand image of a family restaurant forms a complex of attributes that customers value, and remains a consistent impression of the restaurant in the customer's psychology, becoming an important factor in choosing the brand, and consumer behavior plays a mediating role in emotions. Kim (2020) verified the positive mediating effect of brand image between airline service quality and pur-chase intention. Based on the above studies, the following hypothesis was derived.

H7: The brand image will show a positive (+) mediating effect between the attributes of electric vehicles and purchase intention.

8. Mediating Effect of Consumer Attitude

In previous studies, the influence of consumer attitude on purchase intention as a mediating role has been proven (Jeon & Kim, 2016). Oh et al. (2017) studied the characteristics of CSR activities, the effect of consumer experience on repurchase intention, and the mediating effect of consumer attitude. As a result of examining the mediating effect of consumer attitude in the relationship between the characteristics of CSR activities and the influence of consumption experience on repurchase intention, the sincerity of CSR has a complete mediating effect, and the sociality of consumption experience has a partial mediating effect (Oh et al., 2017). Consumer attitude was found to play a mediating role in the relationship with repurchase intention. Ko & Lee (2012) verified the positive mediating effect of consumer

attitude between recognizing the attributes of the leisure sports industry and making service purchase decisions. According to these previous studies, the following hypothesis was established.

H8: Consumer attitude will have a positive (+) mediating effect between the attributes of electric vehicles and purchase intention.

9. Moderating Effect of ESG Management

ESG management is being emphasized as an uncertainty in the COVID-19 era, and a new trend in management for the future. ESG management-related marketing activities are expected to have a positive impact on consumers that value sustainable consumption value (Kim & Kim, 2022). The expansion of positive brand image is closely related to social responsibility by reducing the consumption of natural resources, protecting the environment, and contributing to community development (Gurlek et al., 2017; Ko et al., 2013). Interest in environmental protection and efforts to maintain the natural environment help improve the brand image of a company (Sen et al., 2006). In addition, brand image is improved when companies carry out social responsibility activities, such as conducting charity activities and supporting charitable institutions (Waddock et al., 2002). In addition, Kim et al. (2021) argued that among ESG activities, especially environmental and social activities, have a positive (+) effect on brand image. Based on these contents, the following hypotheses were established.

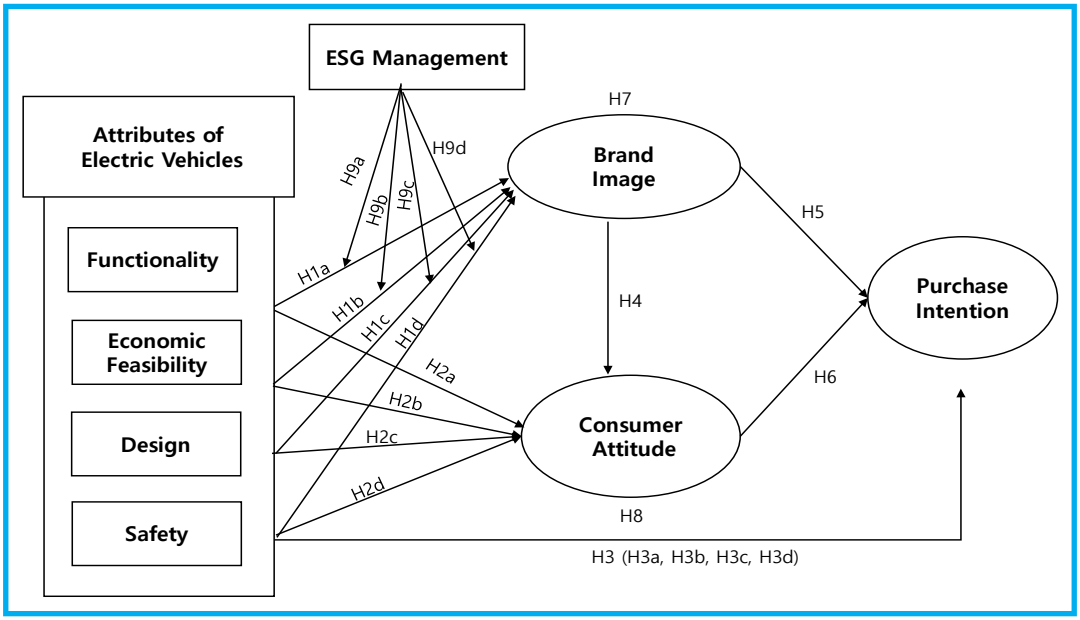
H9: ESG management will have a positive (+) moderating effect between the attributes of electric vehicles and brand image.

H9a: ESG management will show a positive (+) moderating effect between the functionality of electric vehicles and brand image.

H9b: ESG management will show a positive (+) moderating effect between the economic feasibility of electric vehicles and brand image.

H9c: ESG management will show a positive (+) moderating effect between the design of electric vehicles and brand image.

Fig. 1. Research Model.



H9d: ESG management will show a positive (+) moderating effect between the safety of electric vehicles and brand image.

Based on the above, the following research model was established.

IV. Data Analysis

For empirical analysis, this study conducted a questionnaire for general consumers interested in electric vehicles in northeastern regions, such as the Heilongjiang, Liaoning, and Jilin provinces in China. The survey was conducted for a month from February 24, 2022, to March 24, 2022. A total of 230 copies were distributed, and the final 213 copies of the questionnaire were collected and analyzed. The collected data were analyzed in frequency, and verified reliability and validity using SPSS 26.0, a statistical analysis program. The characteristics of samples are shown in Table 1.

Table 1. Sample Characteristics

Characteristics		No	%
Gender	Male	128	60.1
	Female	85	39.9
Marital Status	Single	78	36.6
	Married	135	63.4
Age	20s	72	33.8
	30s	78	36.6
	40s	53	24.9
	More than 50s	10	4.7
Education	High School Graduate	24	11.3
	Junior College Graduate	33	15.5
	College Graduate	89	41.8
	Master/Doctor	67	31.4
Field	Professional (doctors, lawyers, etc.)	23	10.8
	clerical work	33	15.5
	a public official	29	13.6
	Primary industry (agricultural/farming/breeding)	6	2.8
	a production/labor job	12	5.6
	self-employment	23	10.8
	a sales/service position	14	6.6
	Student	46	21.6
	a housewife	4	1.9
	unemployed/other	23	10.8
Average Monthly Income (Chinese Yuan)	not more than 3,000 yuan or less	66	31.0
	3,000 ~5,000 yuan	51	23.9
	5,000 ~10,000 yuan	69	32.4
	10,000 ~15,000 yuan	17	8.0
	15,000 yuan or more	10	4.7

Table 2. Variables and Item Description

Variable	Operational Definition	Measurement Item	Relevant Literature
Functionality	The degree of difficulty consumers feel using the product.	This vehicle has higher output than regular cars The maximum speed is higher than that of a regular car. The front and rear seats are more spacious than regular cars.	Lee & Kim (2010), Park, et al., (2014)
Economic Feasibility	The degree of economy arising from low costs and taxes, among others.	The price is cheap. The vehicles has low maintenance costs. It has high fuel efficiency. Low cost of maintenance (electricity, insurance, tax)	Weindel & Swoboda (2016), Lee & Kim (2010)
Design	Visual perception of the outside/inside	Interior space design is reasonable. Vehicle structure design is reasonable. There is a luxurious interior design. The vehicle has many design options.	Buchanan (1990), Seo et al., (2015)
Safety	Body robustness, safe braking, quantity and quality of airbags, advanced accident prevention functions, etc.	There is excellent body toughness. The vehicles is durable. The vehicles has excellent safeguards.	Kwon (2015), Woo (2015)
Brand Image	The definition of a consumer's psychological structure in which emotions about the product itself are combined with indirect elements of various information related to the product.	Electric vehicles are sophisticated and luxurious compared to general vehicles. Compared to ordinary automobiles, the brand of electric vehicle matches my image. I feel proud to own a brand of electric vehicles compared to ordinary vehicles.	Lin & Hsu (2011), Aaker (1996)
Consumer Attitude	Positive or negative about an object formed by gaining experience with a particular brand of product, consumer likes or dislikes about an object, bad emotional responses, or overall evaluation	I like electric cars more than regular cars. I like electric cars better than regular cars. Have a good feeling about electric cars compared to regular cars. I feel electric vehicles are more reliable than regular vehicles.	Fishbein & Ajzen (1975)
Purchase Intention	Functionality of consumers using current service providers repeatedly in the future	I am willing to buy electric vehicles compared to regular vehicles. I am more likely to buy electric cars than regular cars. I will purchase electric vehicles compared to regular vehicles.	Ajzen (1991), Rogers (1976)
ESG Management	Management activities in which companies transparently manage environmental protection, social contribution activities, and governance structures	Compared to general automobile companies, electric vehicle companies strive to increase reliability among stakeholders. Compared to general automobile companies, electric vehicle companies contribute to human rights and local communities. Electric vehicle companies perform transparent management compared to general automobile companies.	Oh (2021), Park & Lee (2021)

Table 3. Factor Analysis and Reliability Analysis

Measurement Items	Item								
	1	2	3	4	5	6	7	8	Cronbach's α
Consumer Attitude 2	0.870								
Consumer Attitude 3	0.831								0.813
Consumer Attitude 1	0.811								
Consumer Attitude 4	0.778								
Design 2		0.797							
Design 1		0.762							0.806
Design 5		0.742							
Design 4		0.739							
ESG Management 7			0.871						
ESG Management 5			0.866						0.823
ESG Management 6			0.866						
Purchase Intention 1				0.800					
Purchase Intention 2				0.781					0.803
Purchase Intention 3				0.773					
Economic Feasibility 1					0.790				
Economic Feasibility 3					0.735				0.840
Economic Feasibility 4					0.708				
Economic Feasibility 2					0.700				
Safety 2						0.829			
Safety 1						0.783			0.812
Safety 3						0.582			
Functionality 3							0.845		
Functionality 4							0.835		0.836
Functionality 5							0.649		
Brand Image 4								0.736	
Brand Image 3								0.672	0.790
Brand Image 5								0.671	
KMO	0.875								

1. Factor Analysis and Correlation Analysis

This study established a comprehensive research model by setting attributes of electric vehicles (functionality, economic feasibility, design, safety) as independent variables, brand image and consumer attitude as parameters, purchase intentions as dependent variables, and ESG management as control variables between independent variables and the parameters (brand image). In addition, all variables were measured using a 5-point Likert scale (1 = not at all, 5 = very much). As a method of measuring reliability, Cronbach's α was used for internal consistency test, and all were 0.6 or higher, so it was considered appropriate. In addition, as a result of factor analysis, the load value of the extracted factor was 0.5 or more, and the KMO value was 0.8 or more, so the validity of the measurement concepts was judged to be appropriate. The main contents are shown in Table 3.

Table 4. Correlation Analysis

	1	2	3	4	5	6	7	8	VIF
Functionality	1								1.302
Economic Feasibility	0.101	1							1.160
Design	0.361***	0.315***	1						1.737
Safety	0.380***	0.228**	0.481***	1					1.600
Brand Image	0.440***	0.312***	0.601***	0.561***	1				
Consumer Attitude	0.232**	0.273***	0.431***	0.404***	0.510***	1			
Purchase Intention	0.354***	0.270***	0.416***	0.530***	0.597***	0.556***	1		
ESG Management	0.179**	0.289***	0.458***	0.283***	0.499***	0.401***	0.378***	1	

2. Hypothesis Testing

Table 5 shows that functionality (β = 0.188, t = 3.466), economic feasibility (β = 0.114, t = 2.196), design (β = 0.356, t = 6.011), and safety (β = 0.293, t = 5.024) all have statistically significant effects on brand image. Therefore, hypotheses H1-1, H1-2, H1-3, and H1-4 were adopted.

Table 6 shows that economic feasibility (β=0.133, t=2.098), design (β=0.265, t=3.668), and safety (β = 0.233, t = 3.286) all have statistically significant effects on consumer attitudes. However, it was found that functionality (β = 0.034, t = 0.509) did not have a

statistically significant effect on consumer attitude. Therefore, hypotheses H2-2, H2-3, and H2-4 were adopted, and H2-1 was rejected.

Table 7 shows that functionality (β = 0.146, t = 2.350), economic feasibility (β = 0.124, t = 2.085), design (β = 0.142, t = 2.100), and safety (β = 0.378, t = 5.692) all have statistically significant effects on purchase intention. Therefore, hypotheses H3-1, H3-2, H3-3, and H3-4 were adopted.

Table 5. Relationship between Independent Variables and Brand Image

Dependent Variable	Independent Variables	R^2	Adjusted R^2	F	β (T-Value)
Brand Image	Functionality	0.497	0.487	51.324	0.188(3.446**)
	Economic Feasibility				0.114(2.196*)
	Design				0.356(6.011***)
	Safety				0.293(5.024***)

Note: *p<0.1, **p<0.05, ***p<0.01.

Table 6. Relationship between Independent Variables and Consumer Attitudes

Dependent Variable	Independent Variables	R^2	Adjusted R^2	F	β (T-Value)
Consumer Attitude	Functionality	0.253	0.238	17.577	0.034(0.509)
	Economic Feasibility				0.133(2.098**)
	Design				0.265(3.668***)
	Safety				0.233(3.286**)

Note: *p<0.1, **p<0.05, ***p<0.01.

Table 7. Relationship between Independent Variables and Purchase Intention

Dependent Variable	Independent Variables	R^2	Adjusted R^2	F	β (T-Value)
Purchase Intention	Functionality	0.345	0.332	27.372	0.146(2.350**)
	Economic Feasibility				0.124(2.085**)
	Design				0.142(2.100**)
	Safety				0.378(5.692***)

Note: *p<0.1, **p<0.05, ***p<0.01.

Table 8 shows that brand image (β = 0.510, t = 8.618) has a significant effect on consumer attitude when looking at the relationship between brand image and consumer attitude. Looking at the relationship between brand image, consumer attitude, and purchase intention, it was found that brand image (β = 0.597 t = 10.824) and consumer attitude (β = 0.556, t = 9.723) had a statistically significant effect on purchase intention. Therefore, hypotheses H4, H5, and H6 were all adopted.

Table 8. Relationship between Mediation and Mediation and Variables

Dependent Variables	Independent Variables	R^2	Adjusted R^2	F	β (T-Value)
Consumer Attitude	Brand Image	0.260	0.257	74.265	0.510(8.618***)
Purchase Intention	Brand Image	0.357	0.354	117.151	0.597(10.824***)
	Consumer Attitude	0.309	0.306	94.543	0.556(9.723***)

Referring to Table 9, in the case of functionality, the regression coefficient in the first stage is 0.440, which has a positive (+) effect, and in the second stage, the independent variable is 0.113, and the parameter is 0.548. The t-value and p-value, which can measure the significance level, show significant results at all stages. In addition, the effect of the independent variable in step two is greater than that of the independent variable in step three. That is, the 'partial mediation effect' may be confirmed. The same goes for safety, and the partial mediating effect can be confirmed. The economic feasibility and design showed insignificant results in step three of the t-value and p-value, which can measure the significance level; that is, the complete mediating effect can be confirmed. Therefore, hypothesis H7 was adopted.

Table 9. Mediating Effect of Brand Image

Independent/ Parameter/ Dependent Variable	Stage	β	T	P	R^2	Adj. R^2	Result
Functionality/ Brand Image/ Purchase Intention	Stage 1	0.440	7.110	0.000	0.193	0.189	Partial mediation
	Stage 2	0.354	5.498	0.000	0.125	0.121	
	Stage3 (Ind._Var.)	0.113	1.853	0.065	0.367	0.361	
	Stage3(Med._Var.)	0.548	8.963	0.000			
Economic Feasibility/ Brand Image/ Purchase Intention	Stage 1	0.312	4.774	0.000	0.097	0.093	complete mediation
	Stage 2	0.270	4.066	0.000	0.073	0.068	
	Stage 3 (Ind._Var.)	0.092	1.588	0.114	0.365	0.359	
	Stage 3(Med._Var.)	0.569	9.824	0.000			
Design/ Brand Image/ Purchase Intention	Stage 1	0.601	10.919	0.000	0.361	0.358	complete mediation
	Stage 2	0.416	6.639	0.000	0.173	00169	
	Stage 3 (Ind._Var.)	0.089	1.286	0.200	0.362	0.356	
	Stage 3(Med._Var.)	0.544	7.893	0.000			
Safety/ Brand Image/ Purchase Intention	Stage 1	0.561	9.854	0.000	0.315	0.312	Partial mediation
	Stage 2	0.530	9.088	0.000	0.281	0.278	
	Stage 3 (Ind._Var.)	0.285	4.454	0.000	0.413	0.407	
	Stage 3(Med._Var.)	0.438	6.848	0.000			

According to Table 10, in the case of functionality, the first stage regression coefficient is 0.232, which has a positive (+) effect, it is 0.354 in the second stage, 0.238 in the independent variable in the third stage, and 0.501 in the parameter. The t-values and p-values that can measure the significance level show significant results at all stages. In addition, the effect of the independent variable in step two is greater than that of the independent variable in step three. That is, the 'partial mediation effect' can be confirmed. Economic feasibility, design, and safety are all the same, and a partial mediating effect can be confirmed. Therefore, hypothesis H8 was adopted.

Table 10. Mediating Effect of Consumer Attitude

Independent/ Parameter/ Dependent Variable	Stage	β	T	P	R^2	Adj. R^2	Result
Functionality/ Consumer Attitudes/ Purchase Intention	Stage 1	0.232	3.461	0.001	0.054	0.049	Partial mediation
	Stage 2	0.354	5.498	0.000	0.125	0.121	
	Stage 3(Ind._Var.)	0.238	4.201	0.000	0.363	0.357	
	Stage 3(Med._Var.)	0.501	8.851	0.000			
Economic Feasibility/ Consumer Attitudes/ Purchase Intention	Stage 1	0.273	4.124	0.000	0.075	0.070	Partial mediation
	Stage 2	0.270	4.066	0.000	0.073	0.068	
	Stage 3 (Ind._Var.)	0.127	2.156	0.032	0.324	0.318	
	Stage 3(Med._Var.)	0.522	8.845	0.000			
Design/ Consumer Attitudes/ Purchase Intention	Stage 1	0.431	6.942	0.000	0.186	0.182	Partial mediation
	Stage 2	0.416	6.639	0.000	0.169	0.173	
	Stage 3 (Ind._Var.)	0.216	3.495	0.001	0.347	0.341	
	Stage 3(Med._Var.)	0.463	7.496	0.000			
Safety/ Consumer Attitudes/ Purchase Intention	Stage 1	0.404	6.411	0.000	0.163	0.159	Partial mediation
	Stage 2	0.530	9.088	0.000	0.281	0.278	
	Stage 3 (Ind._Var.)	0.365	6.366	0.000	0.421	0.416	
	Stage 3(Med._Var.)	0.409	7.123	0.000			

Table 11 shows the results of verifying the moderating effect of ESG management between the attributes of electrical motors and brand images compared to Model 1 (R^2 = 0.193. Adjusted R^2 = 0.189), Model 2 (R^2 = 0.376, Adjusted R^2 = 0.370), and the interaction (R^2 = 0.409, Adjusted R^2 = 0.400). In addition, in Model 3, the interaction term was statistically significant. ESG management showed a positive moderating effect between functionality and brand image, but ESG management did not show a positive moderating effect between economic feasibility, design, safety, and brand image. Therefore, hypotheses H9-1 were adopted, and H9-2, H9-3, and H9-4 were rejected.

Table 11. Moderating Effect of ESG Management

		Model 1			Model 2			Model 3		
		β	t	p	β	t	p	β	t	p
Independent Variable	Functionality	0.440	7.110	0.000	0.362	6.528	0.000	-0.316	-1.537	0.126
Adjustment Variable	ESG Management				0.434	7.835	0.000	-0.142	-0.802	0.423
Interaction Term	Functionality*ESG Management							0.998	3.148	0.001
	R^2		0.193			0.376			0.409	
	Adj. R^2		0.189			0.370			0.400	
Sig. F Change			50.546			61.380			11.681	
Independent Variable	Economic Feasibility	0.312	4.774	0.000	0.183	2.999	0.003	0.306	1.482	0.140
Adjustment Variable	ESG Management				0.446	7.293	0.000	0.600	2.352	0.020
Interaction Term	Economic Feasibility*ESG Management							-0.225	-0.621	0.535
	R^2		0.097			0.280			0.281	
	Adj. R^2		0.093			0.273			0.271	
Sig. F Change			22.790			53.194			0.385	
Independent Variable	Design	0.601	10.919	0.000	0.471	7.996	0.000	0.670	3.456	0.001
Adjustment Variable	ESG Management				0.283	4.805	0.000	0.468	2.575	0.011
Interaction Term	Design*ESG Management							-0.332	-1.076	0.283
	R^2		0.361			0.424			0.427	
	Adj. R^2		0.358			0.419			0.419	
Sig. F Change			119.220			23.086			1.157	
Independent Variable	Safety	0.561	9.854	0.000	0.457	8.493	0.000	0.287	1.375	0.171
Adjustment Variable	ESG Management				0.370	6.877	0.000	0.227	1.277	0.203
Interaction Term	Safety*ESG Management							0.255	0.846	0.399
	R^2		0.315			0.441			0.443	
	Adj. R^2		0.312			0.436			0.436	
Sig. F Change			97.092			47.291			0.715	

V. Conclusions

This study aims to examine the effects of electric vehicle attributes on the purchase intention of electric vehicle users by deriving functionality, economic feasibility, design, and safety sub-factors based on previous studies on the attributes of electric vehicles. In particular, it was checked whether brand image and consumer attitude were mediated. ESG management attempted to study the moderating effect between the attributes of electric vehicles and brand image. Focusing on existing studies, research models and hypotheses were established, and a survey was conducted on Chinese electric vehicle users. Focusing on the empirical results, the summary and implications are as follows.

First, the four factors of functionality, economic feasibility, design, and safety of electric vehicles had a positive effect on brand image. In other words, the more positive the functionality, economic feasibility, design, and safety, the better the brand image of consumers. In particular, design was the most important factor. In the case of Kim (2018), it was analyzed that design was becoming more important than the technical elements of electric vehicles.

Second, the effect of the attributes of electric vehicles on consumer attitudes was verified. As a result, three factors, economic feasibility, design, and safety, had a positive effect on consumer attitudes. On the other hand, functionality did not affect consumer attitudes. Electric vehicles are among new energy vehicles, and their machine performance and noise suppression are superior to traditional vehicles, but it was determined that there is no statistically significant effect on changing consumer preferences yet. Above all, it is thought that electric vehicles are in the early stages of development, and related infrastructure is not properly ready. For example, the lack of public charging stations for electric vehicles, long charging times, and low driving distances are thought to be the main reasons.

Third, four factors for the attributes of electric vehicles (functionality, economic feasibility, design, and safety) showed a positive effect on consumer purchase intention. In other words, the higher the functionality, economic feasibility, design, and safety, the higher the intention to purchase electric vehicles. In particular, safety was the most important determinant. Safety, such as the robustness of the vehicle body, the possibility of an accident, and the safety factor, seems to be the most important factors to consider when purchasing an electric vehicle (Lim & Jung, 2017).

Fourth, it is judged that the brand image has a positive mediating effect between the attributes of electric vehicles and purchase intention. Functionality and safety showed a partial mediating effect, and economic feasibility and design showed a complete mediating effect. Therefore, since the economic feasibility and design of electric vehicles mainly affect the purchase intention through brand image alone, a differential strategy is required. In addition, in the case of consumer attitude, both the attributes of electric vehicles and purchase intention were found to have a partial mediating effect. Therefore, it is judged that various strategic processes are possible accordingly.

Finally, ESG management has a positive moderating effect between functionality and brand image. On the other hand, there was no positive moderating effect between economic feasibility, design, safety, and brand image. Why is this difference between functionality and other attributes occurring? In addition, various efforts are expected to be possible to create synergy between functionality and ESG management.

Next, some implications derived through this study are presented. First, automobile producers need to more actively promote the improvement of the ‘functionality’ and ‘infrastructure’ of vehicles. For example, it is necessary to build many charging stations and connect these to the navigation of cars through the Internet. When a car runs out of battery power, it is required to improve infrastructure to allow actions such as finding a charging station on the Internet, reserving a place to charge, and charging time. Consumer charging experience and knowledge will be used to improve

services. In addition, 'economic feasibility' should be improved, and more diverse and superior 'design' should be provided to consumers. Furthermore, research on the unique design of electric vehicles is required, not the existing automobile design. In addition, electric vehicles should also be designed and produced in parallel, focusing on 'safety' compared to ordinary vehicles. Second, looking at the full mediating effect between the economic feasibility of the brand image and the purchase intention of the design, active investment in electric vehicles should be made. In order to create a positive brand image for electric vehicles for consumers, corporate marketers should establish marketing strategies that emphasize the economic feasibility and design aspects of electric vehicles. Various policies are needed to spread electric vehicles in government agencies and organizations. For example, it will be possible to develop the electric vehicle industry by supplementing financial support policies and reducing the burden on purchases. Third, this study is of academic significance in that ESG management was studied in the electric vehicle industry. In particular, empirical research on ESG management will contribute to the development of academia. It was determined that, after practicing the ESG management of an electric vehicle, carbon emissions could be innovatively reduced, and it would contribute to continuous environmental protection. A company's ESG management will be an important criterion for evaluating the brand, not only for investors but also for consumers. In addition, it is thought that practicing ESG management will have a positive effect on long-term corporate interests. Therefore, companies will be able to increase consumer purchase intention by actively practicing ESG management and conducting marketing to promote a positive image of the brand. More than any other industry, sincere ESG management in the electric vehicle industry should be steadily promoted.

This study also has the following limitations. First, since the population was limited to general consumers interested in electric vehicles in northeastern China, it has some limitations in interpreting the results. In the future, it is necessary to compare and study with all of China or other countries. Second, there may be an error in the purchase intention of electric vehicles since it is aimed at general consumers interested in the actual purchase of electric vehicles. As a follow-up study, a comparative study will be possible for actual buyers to identify clear factors. Third, in this study, four sub-factors were derived as attributes of electric vehicles. If the properties of electric vehicles are added, the scope of the study can be expanded.

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Evaluating Inventory Management Performance as Measured by Inventory Management Efficiency

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ABSTRACT

Purpose – To measure inventory management performance, we aim to develop a new indicator from which the random variation factor is eliminated. To this end, we propose *inventory management efficiency* (*IME*) as a novel metric to which technical efficiency is applied.

Design/Methodology/Approach – To properly define *IME*,we established an inventory turnover function for which the multiplicative model represents the relationship between inventory turnover and its determinants, such as gross margin, capital intensity, and sales surprise, as suggested by Gaur et al. (2005). In addition, based on empirical results and the form of the inventory turnover function, we examine in detail whether the inventory turnover function is well- defined. We then examined the validity of the research model with the inefficiency term, which is a one-sided error, and investigated whether the inventory management inefficiency term exists statistically.

Findings – The inventory turnover function suggested in this study is a well-defined function, and *IME* is an appropriately defined indicator for measuring inventory management performance. Moreover, the actual inventory turnover is determined on average at a level that is less than the maximum inventory turnover expected from the determinants of inventory turnover.

Research Implications – *IME* can be utilized as a newly applicable indicator for evaluating inventory management.

Keywords: inventory management, inventory turnover, stochastic frontier analysis, technical efficiency
JEL Classifications: C50, M11, M19

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I. Introduction

Inventory management has occupied an integral position in operations management (OM), which aims to match demand with supply (Cachon & Terwiesch, 2016; Choi & Roh, 2021; Gaur et al., 2005; Li et al., 2023; Patchimnan et al., 2022; Stephens et al., 2022; Zhou & Xing, 2022); inventory management is the management activity that responds to demand with an inventory (Stevenson, 2020). Thus, effective inventory management increases the likelihood of improvement in a firm's performance and can become a stepping stone to further strengthen a firm's competitiveness (Cannon, 2008; Capkun et al., 2009; Chen et al., 2005, 2007; Chuang et al., 2019; Eroglu & Hofer, 2011a, 2011b; Gaur et al., 2005; Isaksson & Seifert, 2014; Kolias et al., 2011; Lee, 2022).

Recognizing the importance of inventory management, many prior studies have examined the association between inventory management performance and firm performance (Cannon, 2008; Capkun et al., 2009; Chuang et al., 2019; Eroglu & Hofer, 2011a, 2011b; Isaksson & Seifert, 2014; Kim, 2022; Koumanakos, 2008). Interestingly, the existing literature shows mixed results regarding the relationship between inventory management performance and firm performance. Specifically, while many studies have confirmed the positive effect of inventory management performance on firm performance (Capkun et al., 2009; Chen et al., 2005, 2007; Isaksson & Seifert, 2014; Koumanakos, 2008; Mishra et al., 2013), some have confirmed a negative relationship (Cannon, 2008) and found an inverted U-shaped relationship between these two performance variables (Chuang et al., 2019; Eroglu & Hofer, 2011a, 2011b), whereas others have not found a significant relationship (Cannon, 2008). Eroglu and Hofer (2011b) noted that these mixed results are highly likely to originate from inaccurate measurement of inventory management performance and emphasize the necessity of developing an indicator to precisely evaluate a firm's inventory management performance or capability.

Given this necessity, we need to review two indicators: (i) *adjusted inventory turnover* (*AIT*) (Gaur et al., 2005) and (ii) *empirical leanness indicator* (*ELI*) (Eroglu & Hofer, 2011b). First, Gaur et al. (2005) suggest *AIT* is a modified version of inventory turnover. Inventory turnover, the ratio of a firm's cost of goods sold to its average inventory level, indicates how many times inventory is turned over for sale in an accounting period; because of this feature, inventory turnover is commonly used as the appropriate variable to evaluate the inventory management performance of a firm (Gaur et al., 2005; Kolias et al., 2011; Stevenson, 2020). However, there is a limitation in measuring inventory management performance when using inventory turnover per se because the effects of a firm's factors are significantly reflected in inventory turnover value (Gaur et al., 2005; Gaur & Kesavan, 2015). To address this, Gaur et al. (2005) selected a firm's certain factors, such as gross margin, capital intensity, and sales surprise, as the determinants of inventory turnover, examined their effect on inventory turnover, and developed *AIT*, which is an empirical measure to more precisely evaluate inventory management performance by controlling for the effects of gross margin, capital intensity, and sales surprise (Gaur et al., 2005; Gaur & Kesavan, 2015).

Additionally, Eroglu and Hofer (2011b) suggest *ELI*, which is often used to measure inventory management performance. *ELI* indicates the level of inventory that can be evaluated relative to competitors in the industry (Chuang et al., 2019) and is calculated by considering the relationship between the firm's scale and the inventory holding level (Eroglu & Hofer, 2011a, 2011b). Many studies have analyzed inventory management using *ELI* (Chuang et al., 2019; Eroglu & Hofer, 2014; Hofer et al., 2012; Isaksson & Seifert, 2014).

However, although these two indicators are well developed through theoretical review, they involve a problem owing to the parametric methodology with which they are practically estimated. This is because the value of the estimated indicator includes random variation. For example, the *AIT* is calculated by subtracting the predicted inventory turnover from the actual inventory turnover after regressing the actual inventory turnover on

gross margin, capital intensity, and sales surprise (Gaur et al., 2005).[1] That is, *AIT* can be seen as the difference between actual inventory turnover and inventory turnover predicted by the effects of gross margin, capital intensity, and sale surprise. Accordingly, it is reasonable to conclude that *AIT* includes random variations. Similarly, *ELI* is calculated based on the difference between the actual inventory and the predicted inventory obtained with an estimated coefficient after regressing the firm inventory level on the firm's sales level (Eroglu & Hofer, 2011b).[2] In other words, *ELI* can be seen as the difference between the actual inventory level and the inventory level explained by the sale level. Therefore, because *ELI* indicates the inventory level that is not explained by the sales level, it can be said that the random variation that affects the actual inventory level is also included in *ELI*.

Despite the advantages of these two indicators, both *AIT* and *ELI* contain random variations, which is a limitation. To overcome this limitation, this study proposes an inventory management performance indicator through a novel approach, specifically, to develop an indicator from which random variation is eliminated. To achieve this objective, borrowing the concept of technical efficiency from production economics, we define *inventory management efficiency* as a novel metric for evaluating the inventory management performance of a firm. We also establish an inventory turnover function in which the relationship between the determinants of inventory turnover—gross margin, capital intensity, and sale surprise — as suggested by Gaur et al. (2005) and inventory turnover is expressed in a multiplicative form. In addition, we carefully considered whether the inventory turnover function satisfied the conditions required to properly define *inventory management efficiency* and applied stochastic frontier analysis, a parametric approach, to estimate *inventory management efficiency*. To pursue our study, we employed a dataset from 2000 to 2018 consisting of 40 South Korean retail business firms.

Accurate measurement is the key to the improvement in inventory management performance; the more precise performance metric is ultimately required to drive competitive advantage through inventory management. In this respect, the previous studies regarding the measurement of inventory management performance have limitations as mentioned above. Thus, the newly-proposed inventory performance metric in this study can serve as a quantitative standard for efficient inventory management and, furthermore, as a starting point for new business research.

The remainder of this paper is organized as follows. Section 2 reviews the related literature, and Section 3 defines the inventory turnover function and *inventory management efficiency*. Section 4 introduces the research model and Section 5 defines the variables and describes the data used. Section 6 presents and analyzes the estimation results. Finally, section 7 discusses the implications, limitations, and extensions of future research.

II. Related Literature

1. Inventory Management Performance

Analysis of the effect of inventory management

1. The score of AIT is computed as $\ln(AIT) = \ln(IT) - \hat{b}_{GM}\ln(GM) - \hat{b}_{CI}\ln(CI) - \hat{b}_{SS}\ln(SS)$. Here, $\ln(AIT)$ represents the variable taking the natural logarithm of adjusted inventory turnover; $\ln(IT)$ denotes the variables taking the natural logarithm of actual inventory turnover; $\ln(GM)$, $\ln(CI)$, and $\ln(SS)$ are the variables obtained by taking the natural logarithms of gross margin, capital intensity, and sale surprise, respectively; and $\hat{b}_{GM}$, $\hat{b}_{CI}$, and $\hat{b}_{SS}$ are the estimated coefficients of gross margin, capital intensity, and sale surprise, respectively (Gaur et al., 2005).
2. $\hat{\epsilon} = \ln(I) - \hat{a} - \hat{b}\ln(S)$. Here, $\ln(I)$ and $\ln(S)$ denote the variables taking the natural logarithms of inventory and sale levels, respectively; $\hat{a}$ represents the estimated coefficient for a constant term; $\hat{b}$ represents the estimated coefficient for the effect of ln(S) on ln(I). Utilizing $\hat{\epsilon}$, we can obtain ELI; specifically, $\hat{\epsilon}$ is studentized and then multiplied by -1 (Eroglu & Hofer, 2011b).

on firm performance is a key research topic in the field of OM. The underlying objective of the analysis is to examine the role of inventory management in securing competitive advantage. To achieve this objective, many studies have adopted the perspective of lean practice—the approach that the lower the level of inventory held by a firm, the more effective its inventory management is—when interpreting the indicator of inventory management performance and investigating the relationship between inventory management performance and firm performance.

For example, Capkun et al. (2009) show the negative impact of inventory (as adjusted by sales) on financial performance, such as gross profit and earnings before interest and taxes (EBIT). Koumanakos (2008) found that the higher the inventory level held by a firm, the lower its financial performance, such as operating margin. Chen et al. (2005, 2007) used US firm-level data to find that an abnormal excess inventory level is negatively associated with stock price performance. By proposing *inventory resource efficiency*[3] *as a metric for inventory management performance, Modi and Mishra (2011) used a dataset from US manufacturing firms to uncover the positive effect of inventory efficiency on stock market returns. Isaksson and Seifert (2014) revealed an inverted U-shaped relationship between financial performance and ELI* but found that the maximum point of financial performance did not exist in the range of the data used and thus stressed that there was potential room for a firm to enhance performance by lowering its inventory level. Taken together, the main findings of these studies confirmed that effective inventory management, as evaluated by a low level of inventory, is positively related to firm performance, thereby implying that reducing inventory is required to enhance firm performance. In addition, numerous related studies from a lean practice perspective have found a positive impact of inventory management on firm performance (Elking et al., 2017; Elsayed, 2015; Lwiki et al., 2013; Prempeh, 2015; Swamidass, 2007).

However, some studies have reported different results. For example, Cannon (2008) examined the relationship between inventory management performance (as measured by the percentage change in inventory turnover) and financial performance, such as return on assets (ROA), return on investment (ROI), market value added (MVA), and Tobin's Q—and found that, for many firms, inventory management performance was irrelevant to financial performance, and even found that there was a negative relationship between inventory management performance and financial performance for some firms. In addition, Balakrishnan et al. (1996) find no significant relationship between inventory turnover and ROA. Moreover, some studies confirm a nonlinear relationship between inventory management and firm performance. For example, Eroglu and Hofer (2011b) investigated the association of *ELI* with return on sale (ROS) and ROA, and found an inverted U-shaped relationship in some industries. They also reviewed the relationship between the detailed ELIs—estimated by using *ELI* for raw material inventory, work-in-process inventory, and finished good inventory—and ROS and confirmed an inverted U-shaped relationship in many industries. Similarly, Chuang et al. (2019) found an inverted U-shaped association between *ELI* and technical efficiency in retailers, leading to the conclusion that a firm should maintain a proper inventory level to maximize its performance. In summary, some prior studies have identified a negative or insignificant relationship between inventory management performance and firm performance or even revealed a nonlinear relationship between these two performances.

Thus, it can be said that the existing literature showed mixed results when examining the correlation between inventory management and firm performances because the findings include positive, negative, insignificant, and nonlinear relationships. Eroglu and Hofer (2011b) argued that these mixed results might originate from

3. The inventory resource efficiency is assessed by measuring the sales-to-inventory ratio of the firm with the mean and standard deviation for this ratio across all other firms (Modi & Mishra, 2011).

a measurement error caused by the failure to measure precisely how effectively inventory is managed in a firm, emphasizing the necessity of a more sophisticated metric for evaluating inventory management. Recognizing this necessity, this study develops a novel indicator for measuring inventory management performance which can be a solution to the measurement error at evaluating inventory management performance.

With regard to the indicator development for inventory management, Gaur et al. (2005) carefully reviewed the relationship between several variables pertaining to firms, such as gross margin, capital intensity, sales surprise, and inventory turnover, and then suggested the *AIT'* a new indicator to evaluate inventory management by controlling the average effect of gross margin, capital intensity, and sales surprise, as a more sophisticated metric. Similarly, Eroglu and Hofer (2011b) developed *ELI*, a new inventory management performance indicator that considers economies of scale. However, because both *AIT* and *ELI* are estimated using parametric estimation methods, these two indicators contain a random variation factor, which is a limitation. Considering this limitation, this study is meaningful in that it is the first attempt to separate the inventory management performance indicator from a random variation factor, a problem not addressed by Gaur et al. (2005) and Eroglu and Hofer (2011b).

2. Technical Efficiency and Stochastic Frontier Analysis

Borrowing from the concept of technical efficiency, we define *inventory management efficiency* as a newly applicable indicator for evaluating inventory management performance. Technical efficiency is derived from production economics theory and is specifically defined as the ratio of the maximum output level, expected from the factor determining the output level (i.e., the inputs), to the actual output level (Kumbhakar & Lovell, 2003). Consequently, the *inventory management efficiency* newly proposed in this study is defined as the ratio of the maximum inventory management level, expected from the factor determining the inventory management level, and the actual inventory management level, which will be discussed in Sections 3 and 4.

In addition, we estimate *inventory management efficiency* using stochastic frontier analysis. Stochastic frontier analysis assumes that the dependent variable is determined by the stochastic frontier and the composed error (Kumbhakar & Lovell, 2003; Kumbhakar et al., 2015). The stochastic frontier expresses the relationship between dependent and independent variables. The composed error consists of an error term that represents random variation and a technical inefficiency that is equivalent to technical efficiency. In general, the error term is assumed to follow a normal distribution, and a nonnegative distribution, such as a half-normal, truncated normal, exponential, or gamma distribution, is assumed for the technical inefficiency term. From the assumption of the distributions of both the error and technical inefficiency terms, we can estimate these two terms separately (Kumbhakar & Lovell, 2003; Kumbhakar et al., 2015), from which we derive the concept of *inventory management efficiency* (see Section 3).

Because of these characteristics, technical efficiency and stochastic frontier analysis have been widely applied in various research areas such as firm performance analysis (Chuang et al., 2019; Lieberman & Dhawan, 2005), information technology (IT) effect analysis (Kim et al., 2015; Lin & Shao, 2006; Lin & Shao, 2000), cost and profit performance analysis (Tabak & Tecles, 2010; Tecles & Tabak, 2010), and energy- and pollutant-related analysis (Filippini & Hunt, 2011; Herrala & Goel, 2012; Yang & Lei, 2017). For example, Chuang et al. (2019) examined the relationship between *ELI* and firm performance, as measured by technical efficiency, using stochastic frontier analysis. Likewise, relying on stochastic frontier analysis, Lieberman and Dhawan (2005) analyzed the technical efficiency of both Japanese and American automobile companies by combining the resource-based view with the production economy theory. Regarding the effect of IT, Lin and Shao (2000) and Lin and Shao (2006) and applied stochastic frontier analysis to examine the effect

of IT investment on technical efficiency. Similarly, Kim et al. (2015) examined the link between IT investment and technical efficiency using Bayesian stochastic frontier analysis.

With regard to cost and profit performance, Tecles and Tabak (2010) and Tabak and Tecles (2010) analyzed the cost efficiency and profit efficiency of both the Brazilian and Indian banking sectors using Bayesian stochastic frontier analysis. As the usefulness of stochastic frontier analysis has been gradually recognized, many studies have begun to employ it to explore topics related to energy and pollutants. For example, Lin and Long (2015) analyzed the energy efficiency of the Chinese chemical industry, and Filippini and Hunt (2011) examined energy efficiency in the US residual sector. By employing a stochastic frontier analysis, Herrala and Goel (2012) to investigate the global CO2 emission efficiency of approximately 170 countries, and Yang and Lei (2017) analyzed the CO2 emission performance of Chinese provinces.

As reviewed above, technical efficiency and stochastic frontier analyses have been applied to a variety of issues. However, previous studies seldom employed them to evaluate inventory management performance. This study contributes to the literature in that it is the first to measure inventory management performance using technical efficiency and stochastic frontier analysis.

III. Inventory Turnover Function and Inventory Management Efficiency

To define *inventory management efficiency*, we assume that the inventory turnover function [$f(\cdot)$] representing the relationship between inventory turnover and the factors that determine inventory turnover as follows:

$$IT = f(X) \tag{1}$$

Here, IT represents an inventory turnover that can be regarded as the same as the output factor of the production function, and X, which can be regarded as the same as the input factor of the production function, is the vector that determines inventory turnover.

As mentioned above, the concept of technical efficiency is applied to *inventory management efficiency*, which is proposed as a new indicator in this study. Therefore, to define *inventory management efficiency*, the inventory turnover function must satisfy the same conditions as the regularity condition of the production function. Specifically, let us assume that the regularity conditions of the inventory turnover function are equal to the regularity conditions of the production function required to define technical efficiency (Kumbhakar & Lovell, 2003; Kumbhakar et al., 2015), as follows:

Condition 1: $f(\cdot)$ is finite, non-negative, real-valued, and single-valued for all nonnegative and finite X.

Condition 2: $f(0) = 0$.

Condition 3: $f(X) \geq f(X')$ for $X \geq X'$, meaning monotonicity.

Condition 4: $f(X)$ is continuous and twice differentiable.

Condition 5: $V(IT) = \{X \mid f(X) \geq y\}$, the requirement set for X, is a convex set, which implies the quasi-concavity of $f(X)$.

Condition 6: The set $V(IT)$ is closed and non-empty for any $IT > 0$.

Condition 1 is the basic definition for the inventory turnover function, and Condition 2 indicates that inventory turnover is not determined when no factor determines inventory turnover. Condition 3 indicates that more inputs lead to no lesser output, meaning that an increase in the determinant of inventory turnover should not decrease inventory turnover (i.e., the effect of the determinant on inventory turnover must be at least

nonnegative). Condition 4 is used for mathematical simplicity. In Condition 5, the statement that $V(IT)$ is a convex set is equivalent to that $f(X)$ is quasi-concave (Kumbhakar et al., 2015; Varian, 1992). Finally, Condition 6 indicates that it is always possible to determine a positive inventory turnover level (Kumbhakar et al., 2015).

The function that satisfies all six regularity conditions presented above is a well-defined production function (Kumbhakar et al., 2015). If a production function is well-defined, it is possible to use it as a stochastic frontier and formulate a stochastic frontier production function with technical efficiency (Kumbhakar et al., 2015). Therefore, if the inventory turnover function satisfies all the above six conditions, it can be concluded that the inventory turnover function is well-defined, which enables us to formulate the stochastic frontier inventory turnover function (*SFITF*) including the *inventory management efficiency* in the form of technical efficiency, as follows:

$$\text{IT} = f(X)\exp(-u),\ u \geq 0 \tag{2}$$

Where $f(X)$ is a stochastic frontier indicating the maximum inventory turnover expected at level of X. Moreover, because $u \geq 0$, $IT \leq f(X)$. Thus, u is the factor that prevents actual inventory turnover from reaching the maximum inventory turnover level and can be termed inventory management inefficiency. Furthermore, the *inventory management efficiency* (*IME*) is expressed as

$$IME = \exp(-u) \tag{3}$$

From Eq. (2) and Eq. (3), we can see that *IME* represents the ratio of the actual inventory turnover to the maximum inventory turnover levels ($IT / f(X)$). Indeed, *IME* has a value between 0 and 1, and a value closer to 1 indicates that *IME* is high. Specifically, a value of *IME* close to 1 implies that the actual inventory turnover is close to the maximum inventory turnover.

IV. Model Specification

As mentioned, Gaur et al. (2005) confirmed the significant effects of gross margin, capital intensity, and sales surprise on inventory turnover. Based on these results, this study employs gross margin, capital intensity, and sales surprise as factors that determine inventory turnover, and then assumes a multiplicative model as the specific form of the inventory turnover function, given by

$$f(X) = A \cdot IG^{\alpha_{IG}} \cdot CI^{\alpha_{CI}} \cdot SS^{\alpha_{SS}} \tag{4}$$

Where *CI* and *SS* denote capital intensity and sales surprise, respectively, and *IG* represents the inverse value of the gross margin. In particular, the reason for selecting the inverse of the gross margin instead of the gross margin is to satisfy Condition 3, that $f(X)$ should increase monotonically with respect to X. In this regard, when reviewing the results of previous studies, we found that capital intensity and sales surprise positively affect inventory turnover, but gross margin negatively affects it (Gaur et al., 2005; Gaur & Kesavan, 2015; Kolias et al., 2011). Therefore, if the gross margin is used as in previous studies, the inventory turnover function cannot satisfy Condition 3. However, when using the inverse of the gross margin, we expect a positive effect on inventory turnover. Namely, we can determine that the inverse of the gross margin is an appropriate variable to satisfy Condition 3. Indeed, our empirical results show the positive effect of the inverse of gross margin on inventory turnover ($\alpha_{IG} > 0$; see Tables 5 and 8). In addition, our empirical results confirm the positive effect of both capital intensity and sales surprise on inventory turnover ($\alpha_{CI} > 0$, $\alpha_{SS} > 0$; see Tables 5 and 8). Therefore, Eq. (4), which includes the inverse of gross margin, capital intensity, and sales surprise as determinants of inventory turnover, satisfies Condition 3. Moreover, because our empirical results indicate $A > 0$, $\alpha_{IG} > 0$, $\alpha_{CI} > 0$, $\alpha_{SS} > 0$ (see Tables 5 and 8), Eq. (4) satisfies Condition 1. Additionally, we can easily observe that Eq. (4) satisfies Conditions 2 and 4.

Meanwhile, given that all data used in this

study have positive values (see Table 2), and our empirical results show $A > 0$, $\alpha_{IG} > 0$, $\alpha_{CI} > 0$, $\alpha_{SS} > 0$ (see Tables 5 and 8), it can be said that Eq. (4) is a quasi-concave function,[4] leading to the conclusion that $V(IT)$ is a convex set. Thus, we can conclude that Eq. (4) satisfies Condition 5 based on the data and empirical results of this study. Similarly, because all data used in this study have a positive value (refer to Table 2) and our empirical results confirm $A > 0$, $\alpha_{IG} > 0$, $\alpha_{CI} > 0$, $\alpha_{SS} > 0$ (see Tables 5 and 8), Eq. (4) always produces a positive inventory turnover, implying that Condition 6 is satisfied.

Therefore, because all regularity conditions were satisfied, we can conclude that Eq. (4) is a well-defined inventory turnover function: In other words, when Eq. (4) is used as the inventory turnover function, it can be said that *IME* expressed as in Eq. (3) is adequately defined.

Following previous studies, the model was estimated by assuming a log-linear model (Gaur et al., 2005; Gaur & Kesavan, 2015; Kolias et al., 2011). Specifically, by substituting Eq. (4) into Eq. (2) and taking the natural logarithm, Eq. (5) was obtained.

$$\ln IT = \ln A + \alpha_{IG}\ln IG + \alpha_{CI}\ln CI + \alpha_{SS}\ln SS - u \tag{5}$$

We then add subscripts indicating firm (i) and time (t) to each variable in Eq. (5). By introducing terms indicating the firm-specific effect, time-specific effect, and random variation into Eq. (5), we formulate the research model to estimate *IME* as follows:

Research Model:

$$\ln IT_{it} = \alpha_0 + \alpha_{IG}\ln IG_{it} + \alpha_{CI}\ln CI_{it} + \alpha_{SS}\ln SS_{it} + F_i + c_t + v_{it} - u_{it} \tag{6}$$

Here, $\alpha_0 = \ln A_{it}$, F_i denotes the firm-specific effect, which is constant over time but varies across firms, to capture unobserved firm heterogeneity, such as managerial efficiency, marketing, location strategy, and accounting policy (Gaur et al., 2005; Gaur & Kesavan, 2015; Kolias et al., 2011); and c_t denotes the time-specific effect to capture the unobservable effects constant across firms but vary over time, such as economic condition, interest rates, and price level (Gaur et al., 2005; Gaur & Kesavan, 2015; Kolias et al., 2011). To estimate firm -and time-specific effects, we use dummy variables. In Eq. (6), the error term v_{it} denotes random variation to capture idiosyncratic disturbances that vary over time and across firms:

Meanwhile, for the estimation, we need to assume that the inefficiency term u_{it} follows a nonnegative distribution; namely, u_{it} is a one-sided error (Kumbhakar et al., 2015). Regarding the nonnegative distribution for u_{it}, we relied on a half-normal distribution as follows:

$$u_{it} \sim i.i.d.\, N^{+}(0, \sigma_u^2) \tag{7}$$

Here, u_{it} is assumed to be independent and identically distributed, σ_u^2 represents the variance of the distribution, and we assume the following for the distribution of the error term, v_{it}:

$$v_{it} \sim i.i.d.\, N(0, \sigma_v^2) \tag{8}$$

where σ_v^2 denotes the variance of the error term to be estimated, and v_{it} is assumed to be independent and identically distributed. In addition, we assumed that u_{it} and v_{it} were distributed independently.

It is noteworthy that the composed error in Eq. (6) are separated into u_{it} and v_{it}. Therefore, the estimation of Eq. (6) enables us to distinguish between u_{it} and v_{it}.

4. If $A > 0$, $IG > 0$, $CI > 0$, $SS > 0$, $\alpha_{IG} > 0$, $\alpha_{CI} > 0$, and $\alpha_{SS} > 0$, Eq. (4) satisfies $f(ax^1 + (1 - a)x^2) \geq \min[f(x^1), f(x^2)]$ for $x^1 = [IG^1, CI^1, SS^1]$ and $x^2 = [IG^2, CI^2, SS^2]$ when $a \in (0, 1)$. Our empirical results reveal $A > 0$, $\alpha_{IG} > 0$, $\alpha_{CI} > 0$, and $\alpha_{SS} > 0$, (see Tables 5 and 8) and the data on *IG*, *CI*, and *SS* are all greater than zero (see Table 2), leading to the conclusion that Eq. (4) is quasi-concave.

V. Definition of Variables and Data Description

1. Definition of Variables

Inventory turnover (IT_{it}) is defined as

$$IT_{it} = \frac{CGS_{it}}{\frac{1}{2}(INV_{it} + INV_{it-1})} \quad (9)$$

Where CGS_{it} and INV_{it} denote the cost of goods sold and the inventory of firm i in year t, respectively.

As previously explained, it is appropriate to use the inverse of the gross margin because of Condition 3. The inverse gross margin (IG_{it}) is defined as

$$IG_{it} = \frac{S_{it}}{S_{it} - CGS_{it}} \quad (10)$$

Where S_{it} denotes the sale of firm i in year t.

Next, capital intensity (CI_{it}) is defined as

$$CI_{it} = \frac{TA_{it}}{INV_{it} + TA_{it}} \quad (11)$$

Where TA_{it} denotes the tangible fixed assets of firm i in year t.

Finally, following Gaur et al. (2005), we define sales surprise (SS_{it}) as

$$SS_{it} = \frac{S_{it}}{SF_{it}} \quad (12)$$

Where SF_{it} denotes the sales forecast of firm i in year t. Because the sales forecast is not publicly reported, we need to estimate the sales forecast using historical data. Specifically, we used Holt's linear exponential smoothing method (Gaur et al., 2005; Kolias et al., 2011), as follows:

$$SF_{it} = L_{it-1} + T_{it-1} \quad (13)$$

Where L_{it} and T_{it} indicate the sales level and trend, respectively. Specifically, L_{it} and T_{it} are defined as

$$L_{it} = \lambda S_{it} + (1 - \lambda)(L_{it-1} + T_{it-1}) \quad (14)$$

$$T_{it} = \rho (L_{it} - L_{it-1}) + (1 - \rho) T_{it-1} \quad (15)$$

And λ and ρ, which lie between 0 and 1, are weighting constants.[5]

2. Data Description

We select firms in the retail industry. The reason for choosing these firms is that this study uses the gross margin, capital intensity, and sales surprise, as suggested by Gaur et al. (2005), as determinants of inventory turnover. Reviewing the characteristics and behaviors of retail firms and the results of prior related studies, Gaur et al. (2005) chose gross margin, capital intensity, and sales surprise. Thus, to utilize these three determinants in the inventory turnover function, it makes sense to choose firms in the retail industry as the target of analysis.

The dataset used in this study comprises firm-level panel data on South Korean retail firms from 2000 to 2018. Meanwhile, the inventory turnover calculated from the collected data includes substantial values (e.g., values greater than 100) and minimal values (e.g., values less than 1). We judged that the abnormal situation was reflected in these extreme values for these extreme values. Therefore, we removed the extreme values from the analysis. Specifically, firms that land above the top 5% or below the bottom 5% of the inventory turnover are excluded from the dataset. In addition, we excluded firms that had provided observations for less than five years. The final dataset used in this study was unbalanced panel data consisting of 675 observations from 40 firms

5. Based on the assumption of $\lambda = \rho$ (Gaur et al., 2005), we found the values that made the best forecasts for each firm and utilized them to calculate *Lit* and *Tit*.

for which data were available, and all data were taken from KISVALUE, known as Korea's leading credit agency (Ahn et al., 2008; Choi, 2010).

Table 1 lists the retail sector and number of firms in each sector. Tables 2 and 3 show the summary statistics of the variables and their correlation coefficients among the variables, respectively.

Table 1. Retail Sectors and the Number of Firms in Each Sector

Sector description	Number of firms	Sector description	Number of firms
General merchandizing store	14	Auto parts and interior products retailing	3
Non-store retailing	6	Retail business specializing in other merchandise	1
Textiles, apparel, footwear and leather goods retailing	7	Fuel retail business	1
Information and communication equipment Retailing	2	Commodity brokerage	6

Table 2. Summary Statistics of the Variables

Variable	Number of Observations	Mean	Standard deviation	Minimum	Maximum
IT_{it}	675	10.30	10.05	1.143	56.26
IG_{it}	675	5.941	13.78	1.002	282.9
CI_{it}	675	0.697	0.279	0.0193	0.997
SS_{it}	675	2.316	20.89	0.0739	480.5

Table 3. Correlation Matrix

Variable	IT_{it}	IG_{it}	CI_{it}
IT_{it}	1.000	•	•
IG_{it}	0.018	1.000	•
CI_{it}	0.171***	-0.013	1.000
SS_{it}	0.070*	0.078**	0.010

Note: ***p<0.01, **p<0.05, *p<0.1.

VI. Results and Analysis

1. Basic Results

To examine the appropriateness of the research model given by Eq. (6), we conducted a skewness test on the ordinary least squares (OLS) residual, following Schmidt and Lin (1984). The basic idea of this test is that if the research model with the inefficiency term as in Eq. (6) is appropriate to explain the data used, the residuals obtained through OLS estimation should show a distribution of negative skewness. This is because we assumed a nonnegative distribution for u_{it} in Eq. (6). That is, if the data used in this study conform to the research model with the inefficiency term, the distribution of residuals (ϵ_{it}) obtained through OLS estimation—after replacing the composed error $v_{it} - u_{it}$ in Eq. (6) to the error term ϵ_{it}—should show negative skewness.[6] To perform this test under the null hypothesis of no skewness, we used the following test statistic (Schmidt & Lin, 1984):

$$\sqrt{b_1} = \frac{m_3}{m_2\sqrt{m_2}}$$

Where m_2 and m_3 are the second and third sample moments of the OLS results, respectively. To examine the statistical significance of $\sqrt{b_1}$, we adopt the approach suggested by D'Agostino and Pearson (1973).

Table 4. Skewness Test Results on OLS Residuals

Variable	$\sqrt{b_1}$	p-value
$\hat{\epsilon}_{it}$	-0.214	0.010

We can observe from Table 4 that the statistic for $\sqrt{b_1}$ is –0.214 and the corresponding p-value is lower than 0.05, leading us to reject the null hypothesis of no skewness. Thus, we can conclude that the OLS residual ($\hat{\epsilon}_{it}$) shows a distribution of negative skewness. Based on this result, our research model [Eq. (6)], which includes an inefficiency term with a nonnegative distribution, can be considered appropriate.

We applied maximum likelihood estimation (MLE) after formulating a log-likelihood function from the assumption of v_{it} (please refer to Appendix A for the log-likelihood function) to estimate Eq. (6) and show the estimation results in column (b) in Table 5. As shown in this column, the estimated coefficients of α_{CI} and α_{SS} in Eq. (6) are 0.173 ($p < 0.01$) and 0.349 ($p < 0.01$), showing that inventory turnover is positively correlated with capital intensity and sales surprises, respectively. Specifically, because our model is log-linear, the estimated coefficients of CI_{it} and SS_{it} provide the elasticity of inventory turnover with respect to capital intensity and sales surprise: IT_{it} increases by 0.176% as CI_{it} increases by 1% and IT_{it} increases by 0.349 % as SS_{it} increases by 1%. These results are consistent with Gaur et al. 's (2005) findings in that they also show positive associations of capital intensity and sales surprise with inventory turnover. In addition, the estimated coefficient of α_{IG} is 0.313 ($p < 0.01$), indicating that inventory turnover is positively correlated with the inverse of gross margin. Specifically, IT_{it} increased by 0.313% as IG_{it} increased by 1%. Indeed, this result is identical to the findings of Gaur et al. (2005), who revealed a negative association between gross margin and inventory turnover; however, this study does not provide a detailed explanation of the association of inventory

6. The estimation model for obtaining OLS residuals is as follows: $\ln IT_{it} = \alpha_0 + \alpha_{IG}\ln IG_{it} + \alpha_{CI}\ln CI_{it} + \alpha_{SS}\ln SS_{it} + F_i + c_t + \varepsilon_{it}$.

turnover with gross margin, capital intensity, and sales surprise because it focuses on *inventory management efficiency* as the development of a new performance metric; please refer to Gaur et al. (2005) to understand these associations. Meanwhile, it can be observed from Column (b) of Table 5 that α_0 is significantly positive, confirming that A in Eq. (4) was greater than 0. These results for the estimated coefficients of α_{CI}, α_{SS}, α_{IG}, and α_0 support the conclusion that the inventory turnover function expressed in Eq. (4) is well-defined (see Section 4). Meanwhile, as is shown in

Table 5. Estimation Results

Parameter	Coefficient Estimate: OLS estimation Column(a)	Coefficient Estimate: Stochastic Frontier Model with half-normal distribution Column(b)
Frontier		
α_0	1.218*** (0.201)	1.789*** (0.213)
α_{IG}	0.257*** (0.048)	0.313*** (0.050)
α_{CI}	0.209*** (0.058)	0.173*** (0.055)
α_{SS}	0.293*** (0.037)	0.349*** (0.040)
Inefficiency		
σ_u^2	•	0.503*** (0.130)
σ_v^2	•	0.099*** (0.036)
Log likelihood	•	-515.4784
R-squared	0.649	•
AIC	•	1160.957
BIC	•	1454.413
LR test statistic	•	15.103***

Note: Standard errors in parentheses, ***p<0.01, **p<0.05, *p<0.1.

Column (a) of Table 5, the results of the OLS estimation are quite similar to those of our research model. This result also corroborates the conclusion that the inventory turnover function is well-defined.

To examine whether the inventory management inefficiency term (u_{it}) in Eq. (4) statistically exists, we conducted a log-likelihood ratio

(LR) test (Kumbhakar et al., 2015).[7] To do this, we establish the null hypothesis for our research model as follows:

$$H_0: \sigma_u^2 = 0$$

As shown in Table 5, the LR test statistic is statistically significant at the 1% level. Hence, we can reject H_0, leading to the conclusion that the inventory management inefficiency term exists statistically.[8] This result implies that our research model with the composed error fits well with dataset and validates the analysis of *inventory management efficiency*, which is discussed below.

Table 6. IME_{it} results

	Mean	Standard deviation	Minimum	Maximum
IME_{it}	0.619	0.171	0.056	0.912

After estimating Eq. (6), we obtain IME_{it}, which can be expressed as $\exp(-u_{it})$ [please refer to Appendix A for the estimation formula for $\exp(-u_{it})$]. Table 6 shows the IME_{it} results. It can be observed from this table that the average value of IME_{it} is 0.619. This result indicates that the actual inventory turnover was determined at around 61.9% on average, relative to the maximum inventory turnover. Namely, the actual inventory turnover level was determined on average at a level that was less than the maximum inventory turnover level expected from the current levels of the inverse of gross margin (namely, gross margin), capital intensity, and sale surprise. This result suggests room for improvement in the inventory turnover. In addition, as shown in Table 6, the standard deviation of IME_{it} was 0.171, and the maximum value was approximately 16 times larger than the minimum value.

Table 7. Test of Significance of Firm- and Time-Fixed Effects

	χ^2	p-value
Statistic	1024.75	0.000

Meanwhile, to test whether the fixed effects are jointly significant in our research model, we conducted a Wald test and obtained significant test statistic, as reported in Table 7, leading us to reject the null hypothesis that the coefficients of all firm and time dummies are jointly equal to zero.

7. The LR test statistic is $-2[L(H_0) - L(H_1)]$ where $L(H_0)$ is log-likelihood value under null hypothesis and $L(H_1)$ is log-likelihood value under alternative hypothesis. Specifically, $L(H_0)$ is calculated from OLS and $L(H_1)$ is calculated from MLE (Kumbhakar et al., 2015).
8. For the purpose of comparison, we estimated the research model with the inefficiency term following the exponential distribution; but we could not reject the null hypothesis that the inefficiency term does not statistically exist because the LR test statistic is insignificant. This result implies that the model specification with exponential distribution is not proper. Moreover, we attempted to estimate the research model equipped with truncated normal distribution and did not obtain the estimation results because the MLE was not convergent. Taken together, we decided that the model specification with half-normal distribution fits well with our dataset.

Based on these results, it can be concluded that Eq. (6) with firm -and time-specific effects is an appropriate model specification.

2. The Effect of Firm Size on Inventory Management Efficiency

This section also analyzes the effect of firm size on IME_{it}. To this end, we rely on Caudill and Ford (1993), Caudill et al. (1995), and Hadri (1999), where an inefficiency term, such as u_{it} in Eq. (6) is assumed to follow a half-normal distribution with heteroscedasticity to examine the effect of the explanatory variable on technical efficiency. They proposed that the variance of the half-normal distribution can be parameterized by a vector of observable variables and associated parameters, thereby allowing for the inefficiency's heteroscedasticity (Kumbhakar et al., 2015). Following their model, we explore the effect of firm size on IME_{it}. Specifically, we modified the variance of the half-normal distribution (Eq. 7); we parameterize the variance by firm size ($FirmSize_{it}$), given by

$$\sigma_{u,it}^2 = \exp(\beta_0 + \beta_{FS} FirmSize_{it}) \quad (16)$$

Where β_0 is the constant; β_{FS}—the sign that reveals the direction of the effect of firm size on inventory management inefficiency (u_{it})—is the coefficient of firm size (Caudill & Ford, 1993; Caudill et al., 1995; Hadri, 1999).

Table 8. Estimation Results When Assuming Half-Normal Distribution with The Heteroscedasticity

	Coefficient	Standard Error
Frontier		
α_0	1.8469**	0.224
α_{IG}	0.346***	0.052
α_{CI}	0.178***	0.058
α_{SS}	0.337***	0.040
Inefficiency		
β_0	0.551	0.378
β_{FS}	-0.169***	0.052
σ_v^2	0.0588*	0.058
Log likelihood	-510.618	
AIC	1153.23	
BIC	1441.21	
LR test statistic	23.823***	

Note: ***p<0.01, **p<0.05, *p<0.1.

We used the natural logarithm of the number of employees with a 1-year lag as the proxy for a firm's size (Angelini & Generale, 2008; Chuang et al., 2019; Gligor, 2016; Laeven & Woodruff, 2007). Formulating the log-likelihood function with Eq. (16), we estimated the research model by applying MLE. Table 8 shows the estimation results. It can be readily observed from this table that the estimated coefficient of β_{FS} is -0.169 ($p < 0.01$). This result indicates that firm size is positively

correlated with IME_{it}; the estimated sign of β_{FS} presents the direction of the effect of firm size on u_{it} (Caudill & Ford, 1993; Caudill et al., 1995; Hadri, 1999). Moreover, as shown in this table, the estimated coefficients of α_{CI}, α_{SS}, α_{IG}, and α_0 are all significantly positive, supporting a well-defined inventory turnover function. Also, it can be concluded that u_{it} statistically exists because the LR test statistic is statistically significant at the 1% level. Thus, we can analyze *inventory management efficiency* by estimating IME_{it}, as reported in Table 9.

Table 9. IME_{it} Results When Assuming the Half-Normal Distribution with Heteroscedasticity

	Mean	Standard deviation	Minimum	Maximum
IME_{it}	0.588	0.204	0.026	0.927

As shown in this table, the average value of IME_{it} is 0.588. That is, the actual inventory turnover is determined at around 58.8% on average relative to the maximum inventory turnover. This result reconfirms that there is room for improvement in inventory turnover.

VII. Discussion and Conclusions

Prior studies that analyzed the relationship between inventory management and firm performance showed mixed results; some found a positive relationship, others uncovered a negative relationship, while other studies revealed an insignificant or even nonlinear relationship. These mixed results are highly likely to originate from the measurement problem embedded in the indicators used in previous studies (Eroglu & Hofer, 2011b). Accordingly, it was necessary to develop an indicator to evaluate inventory management performance more accurately. In the context of such a necessity, Gaur et al. (2005) and Eroglu and Hofer (2011b) suggested newly developed indicators called *adjusted inventory turnover* (*AIT*) and the *empirical leanness indicator* (*ELI*), by applying the parametric method. However, the parametric method with which they developed the indicators has a built-in limitation: it includes a random variation factor. To overcome this limitation, we aimed to develop a new applicable indicator in which the random variation factor was removed. To achieve this, we proposed *inventory management efficiency* (IME_{it}) as a novel indicator to which the concept of technical efficiency was applied, and then estimated IME_{it} with stochastic frontier analysis.

Specifically, to properly define IME_{it}, we established an inventory turnover function for which the multiplicative model was used to represent the relationship between inventory turnover and its determinants, such as gross margin, capital intensity, and sales surprise, as suggested by Gaur et al. (2005). In addition, based on the empirical results and the form of the inventory turnover function, we inquired minutely into whether the inventory turnover function is well-defined. We then examined the validity of the research model with the inefficiency term, which is a one-sided error, and investigated whether the inventory management inefficiency term exists statistically.

The main findings of this study are as follows: First, the inventory turnover function suggested in this study is a well-defined function, and IME_{it} is an appropriately defined indicator. With our empirical results and the form of the inventory turnover function as specified by a multiplicative model, we revealed that the inventory turnover function satisfies all six regularity conditions. Second, we statistically confirmed the existence of IME_{it}; our empirical evidence revealed that the research model with the inventory management inefficiency term fits well with our dataset

and showed that the inventory management inefficiency term statistically exists. These results make it possible to evaluate inventory management performance while excluding random variations. Third, we found that the actual inventory turnover is determined on average at a level that is less than the maximum inventory turnover expected from the determinants of inventory turnover: the average IME_{it} is 0.619, and the average IME_{it} is 0.588 when assuming a half-normal distribution with heteroscedasticity. These results imply that there is room for improvement in the inventory turnover. Finally, IME_{it} is positively related to firm size; the estimated coefficient of firm size on inventory management inefficiency (u_{it}) is significantly negative.

This study is in line with Gaur et al. (2005), who suggest a newly developed indicator for measuring inventory management performance. However, this study attempts to overcome the inherent limitation that random variation is contained in their indicator by employing the concepts of technical efficiency and stochastic frontier analysis, thereby proposing a more sophisticated metric for measuring inventory management performance. This is an academic implication of the present study. Moreover, applying the methodology with IME_{it} as proposed in this study, retail managers can evaluate their (or their firms') capability or productivity in managing inventory relative to their competitors and may unearth other firms that they can use as benchmarks to improve inventory management. The indicator developed in this study can be utilized as a basic quantitative metric to establish strategies for improving inventory turnover, which is a managerial implication of the current study.

Despite these implications, this study has several limitations that suggest areas for future research. First, although we started by recognizing the limitations inherent in both *AIT* and *ELI*, we did not address *ELI*'s problem; we focused only on *AIT* to distinguish between inventory management performance indicators and random variation. Thus, future research should devise a strategy to separate the random variation from *ELI* effectively. Second, we did not consider factors other than firm size, such as firm- and industry-specific variables, that may affect *inventory management efficiency*. To obtain more practical implications, the association of both firm- and industry-specific variables with *inventory management efficiency* must be explored. A consideration of typical firm characteristics, such as vertical integration and growth options, and typical industry characteristics, such as industry concentration and demand uncertainty, could be a significant starting point for finding practical implications in terms of inventory management. Third, the inventory turnover function proposed in this study may not be suitable for manufacturing firms; this study selected, as the determinants of inventory turnover, gross margin, capital intensity, and sale surprise, all of which Gaur et al. (2005) suggested through a careful review of retail firms' behavior. Hence, to analyze the *inventory management efficiency* of manufacturing firms in future research, it is necessary to review the determinants of inventory turnover systematically and carefully for manufacturing firms, differentiated from those for retail firms.

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How Does Corporate Intelligence Level Affect Corporate Sustainability? Evidence from China

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ABSTRACT

Purpose – Facing the backdrop of the digital economy and industrial transformation, China is interested in smart manufacturing to promote transformation, economic growth, and development. Executive characteristics when employing smart technology play an important role. This study aims to explore the relationship between various qualities and the sustainable development of enterprises.

Design/Methodology/Approach – This study investigates the impact of corporate intelligence level on corporate sustainability in the digital economy era using a fixed-effects model with Chinese A-share listed companies from 2011 to 2020. It also explores the moderating roles of executive technical backgrounds, overseas backgrounds, and age on the impact of corporate intelligence level on corporate sustainability.

Findings – The findings show that corporate intelligence level can contribute to sustainable development. Executive technical backgrounds, overseas backgrounds, and age have positive moderating effects on corporate intelligence level, which can contribute to sustainable development.

Research Implications – This study indicates that enterprises will promote sustainable development if they place value on the qualities our findings have highlighted. Our study thus enriches the relevant research on smart manufacturing and sustainable development.

Keywords: corporate intelligence level, corporate sustainable development, digital economy, executive characteristics, governance policy

JEL Classifications: G30, G34, G38

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I. Introduction

The advanced development of the digital economy has ushered in a period of high-speed growth. This includes cloud computing, big data, the Internet of Things, mobile Internet, and artificial intelligence, which have become key forces driving national economic growth and development (Ren, 2022). However, this vast amount of data requires the human skills of analysis and insight in order to apply them effectively. The integration of these digital knowledge networks, information, and technology innovation are key factors accelerating the restructuring of traditional economic development and government governance models (Shan et al., 2023). Against the backdrop of the digital economy, where new-generation information technologies, such as big data, communication networks and artificial intelligence, are constantly breaking through, intelligent production methods and digital lifestyles are rapidly emerging (Li & Pang, 2022). The growing global interest in sustainability is driving companies to rethink business models and seek new ways to address this challenge (Rocha et al., 2022). The ongoing era of Industry 4.0 and Smart Manufacturing are terms widely used today in industry, academia, and consultancy to describe the major industrial transformation taking place (Belhadi et al., 2021). Moreover, digitalization, as a central component of the fourth industrial revolution, has a dominant impact on the development of economic agents (Tikhonov et al., 2022). Intelligent manufacturing refers to the integrated application of a new generation of information technology in the context of the development of the current digital economy. Digital information products, such as terminal equipment, intelligent equipment, electronic components, and integrated circuits, are the material basis of the digital economy, combined with the traditional manufacturing industry, blockchain, and artificial intelligence (Cao et al., 2022). Artificial Intelligence (AI), the core technology of the digital economy, is leading the transition to a sustainable economic growth pathway under the Chinese-style system of environmental decentralization (Fang et al., 2022). The relationship between smart manufacturing and sustainability has yet to be demonstrated, despite the fact that innovation and sustainability can be balanced in a way that makes "corporate sustainability" and "smart manufacturing" a broad dimension issue (Kim & Kim, 2021; Piccarozzi et al., 2022).

Existing research implies that the full introduction of tools related to the digital economy in high-tech enterprises, including artificial intelligence, is necessary as it allows for a qualitative leap in the production process and facilitates the improvement of product quality (Tikhonov et al., 2022). Companies tend to adopt smart manufacturing to improve manufacturing productivity, efficiency, and reduce costs (Pech-Rodríguez et al., 2022). The production process becomes "smart", which accelerates the production process, improves production efficiency and finished product quality, reduces delivery costs, and tracks the production chain. (Piunko & Tolkacheva, 2021). This process simplifies the data used to improve and optimize products and processes, and the desire to enhance connectivity and communication has led many organizations in the developed world to invest heavily in implementing smart technologies for manufacturing. These technologies are expected to increase global manufacturing capabilities while sustaining demand for future production systems by integrating equipment and frameworks from advanced economies (Atieh et al., 2022). Intelligent manufacturing provides a powerful means for enterprises to realize agility, virtualization, integration, and synergy, and can bring efficient, reliable, and safe effects to the manufacturing process of enterprises (Yue & Zeng, 2021). A series of multiple shop floor management methods, such as lean manufacturing, logistics, the Internet of Things, intelligent manufacturing, information physical systems, and artificial intelligence, also significantly improves production management efficiency and operational performance, and improves financial conditions, thus improving productivity (Tripathi et al., 2022). For companies

in the digital transformation phase of Industry 4.0, supply chain relational capital positively influences corporate green management, whichenhances financial performance and sustainability. Supply chain relational capital also indirectly enhances corporate sustainability by leveraging corporate green management initiatives (Jung et al., 2022; Yu et al., 2021).

With the deepening of the digital transformation of the industry, the demand for digital skills in various industries is increasing rapidly, and the talent shortage has become a key factor affecting the development of the digital economy (Li, S. et al., 2022). In an intelligent manufacturing system, people play a central role, which is manifested in two aspects. First, their knowledge is indispensable for the creation and improvement of intelligent manufacturing systems. Second, their initiative is very important in identifying and addressing the causes of possible problems in order to prevent future problems (Stadnicka et al., 2019). There is a strong correlation between executive team characteristics and firm performance (Dhifi & Zouari, 2022; Garcia-Blandon et al., 2019). Heterogeneity in executive team characteristics may improve subsidiary performance, and this effect is stronger in subsidiaries that have been in operation for a longer period of time (Gong, 2006).

Compared to other industrialized countries, China-wide manufacturing still faces challenges, such as low productivity, uneven development, and low quality (Zhou et al., 2015). New digital economies, such as big data, artificial intelligence, and digital empowerment, have a positive effect on improving technological tools and reducing operational costs, but the digital economy also forces companies to rapidly improve strategies (Sun & Wang, 2022). Consequently, the Chinese government strategically proposed the "Made in China 2025" approach to promote smart manufacturing (Lin et al., 2018). The 21st century has seen the rapid development of information and advanced manufacturing technologies in the context of the digital economy, and the rapid development of smart manufacturing in China. With this, China has greatly increased its investment in research on smart manufacturing and has established research projects in this area, which marks the moment when smart manufacturing in China reached deeper development (Tan, 2021). As such, Chinese enterprises are selected as the target of this study. The world is facing a major challenge regarding sustainability (Horne et al., 2020). Many researchers are using artificial intelligence (AI) and machine learning to achieve sustainable development goals and develop an effective mechanism to promote a circular economy (Kar et al., 2022).

Based on previous literature and the analysis of the research background, we not only focus on the impact of executive characteristics on enhancing enterprise intelligence level but also on the enhancing effect of enterprise intelligence level on enterprise sustainable development, thus constructing a study with Chinese listed companies on the Shanghai and Shenzhen stock markets from 2011 to 2020. The impact of enterprise intelligence level on enterprise sustainable development was empirically tested, and the results show that enterprise intelligence level has a facilitating effect on enterprise sustainable development. This study further adopts the moderating effect to explore the interaction mechanism between enterprise intelligence level and sustainable development. The empirical study shows that executive technology background, executive overseas background, and executive age can positively moderate the effect of enterprise intelligence level on sustainable development. This provides a theoretical basis for enterprises promoting sustainable development by improving intelligence level. The introduction of the moderating effect of executive characteristics also provides a reference for the restructuring of the enterprise executive team, as well as a theoretical reference for executives to explore paths to enhance sustainable enterprise development capability.

This study enriches the research on enterprise intelligence level. Few domestic and foreign researchers have analyzed the relationship between enterprise intelligence level and enterprise sustainable development, and explored its

influence mechanism and mechanism of action. The theoretical and empirical tests also confirm whether intelligence level becomes a new engine of sustainable enterprise development, enriching the study of the economic consequences of enterprise intelligence level. This study also incorporates enterprise intelligence transformation as a strategic choice into the research field of upper echelons theory, conducts research on executive characteristics in the Chinese context, and improves the strategic response capability of enterprises to external market changes, thereby also enriching the research of upper echelons theory in the context of emerging business model practice. It also provides an opportunity for enterprises to carry out intelligence transformation and be more effective in the future. It provides theoretical and empirical support for the intelligent transformation of enterprises, and how to find endogenous power in the "new track" of digital economy in the future, which is of great practical significance.

Compared with previous studies, the contribution points of this study are as follows. First, most previous studies on enterprise intelligence level are at a macro level, examining data at the provincial level. This study examines the development of intelligence from the micro enterprise level and introduces the role of executive characteristics on the impact of enterprise intelligence level on enterprise sustainable development, which provides an empirical basis for relevant theoretical development. It also provides a decision basis for enterprises to promote enterprise sustainable development. Second, it expands the scope of research on enterprise intelligent transformation, executive characteristics, and sustainable enterprise development, enriches the relevant research literature, reveals the positive regulating effect of executive background on enterprise intelligence and green innovation level on enterprise development, and provides a theoretical basis for the government to introduce relevant policies to better promote enterprise intelligent transformation.

II. Theoretical Background and Hypotheses

1. Intelligence Level and Enterprise Sustainable Development

The application of smart manufacturing (AI enhanced) has become a compelling topic for researchers and industry worldwide (Wang et al., 2021). However, smart manufacturing, as an evolving concept, can be divided into three basic paradigms: digital manufacturing, digitally networked manufacturing, and next-generation smart manufacturing. The new generation of smart manufacturing involves the deep integration of artificial intelligence technologies and advanced manufacturing technologies throughout the entire life cycle of design, production, products, and services. Such a concept also involves the optimal integration of the corresponding systems; the continuous improvement of product quality, performance, and service levels of enterprises; and the reduction of resource consumption (Zhou et al., 2018). The digital economy can significantly increase productivity by reducing transaction costs. It can be seen that smart manufacturing, smart agriculture, smart cities, and smart contracts are all new technologies that can significantly improve efficiency by reducing transaction costs and eliminating intermediaries from the value chain (Morozova et al., 2022). Many countries apply technologies, such as the Internet of Things, machine learning, and artificial intelligence (AI), to optimize supply chains, improve factory efficiency, accelerate product innovation, and enhance value services (Hang, 2022). As an inherent requirement for the development of China's traditional manufacturing industry, intelligent transformation has gradually become the main goal of transforming China's regional manufacturing industry (Zhou & Wen, 2021).

While humanity faces major sustainability challenges that require immediate action (Horne, 2020), sustainable development has emerged as a new engine driving economic growth (Li, X. et al., 2022). In this context, the growing prominence

of long-term corporate sustainability goals, global resource scarcity, and increased demand heterogeneity in markets, along with industrial value creation supported by emerging information and communication technologies have triggered a transformation in manufacturing (Baik et al., 2022; Li et al., 2020). The transformation of industries from third to fourth generation has had a significant impact on sustainable development. In view of this, different industries have adopted Industry 4.0 technologies to smooth out processes. The implementation of Industry 4.0 technologies in the manufacturing sector will not only increase productivity in manufacturing but also lead to sustainable growth (Alsaadi, 2022). Therefore, the rapid development of artificial intelligence and other technologies can help enterprises achieve sustainable development (Vinuesa, 2020). An increasing consensus is that digital technology can support enterprises in implementing a circular economy, and that there is a strong positive correlation between the implementation of digital technology and the sustainable development of enterprises (Schöggl, 2023). A correlation exists between corporate sustainability and profitability (Skiter, 2022). Corporate digital transformation significantly contributes to corporate sustainable development (Ji et al., 2023). Owing to the smart and digital transformation of manufacturing activities, companies have access to more data, which will help improve performance and sustainability (Jamwal, 2022).

Based on the above discussion, the level of smart manufacturing can promote the sustainable development of enterprises by improving production efficiency, and enterprises with high smart manufacturing levels will have better sustainable development abilities. Therefore, the following hypothesis is proposed in this study.

H1: A firm's smart manufacturing level exerts a positive impact on enhancing sustainability.

2. Moderating Effect of Executive Technical Backgrounds

Executives are the soul of the firm, and are critical for increasing the levels of innovation, enterprise value, and thus core competitiveness (Bsoul et al., 2022). The upper echelons theory, proposed by Hambrick and Mason in 1984, argues that the age, educational background, and career experience of senior executives influence the strategic decisions and operational decisions of the firm (Hambrick & Mason, 1984). Previous studies have mostly focused on the normative characteristics of senior executives, ignoring the unique needs of intelligent transformation in terms of talent that distinguish it from other corporate decisions and the trait factors that fit with the executives themselves.

A series of business practices push toward an unsustainable world, where business leaders (CEOs, top managers, and boards) are at the heart of the solution to corporate sustainability issues. Companies need "heroic" executives to lead innovative changes (Walls et al., 2021), such as digital and intelligent transformation. The knowledge gap between business owners, executive teams, and employees is one of the reasons for the sustainability gap (Aguilera et al., 2021).

The technology economy continues to develop, and methods such as artificial intelligence, the Internet of Things, big data, and cloud computing are becoming increasingly sophisticated. Economic development cannot be achieved without empowering technology (Zhou, 2022). Enterprises have begun to apply various advanced technological practices related to artificial intelligence. Human-machine interaction has a significant impact on cognitive absorption, and executives with a technical background are increasingly important (Balakrishnan & Dwivedi, 2021). Many small and medium-sized enterprises (SMEs) in developing countries are experiencing delays in introducing smart manufacturing and factory digitization owing to a lack of knowledge and communication issues (Atieh et al., 2022). There is a positive correlation between executive competence and environmental, social, and economic sustainability performance (Khan et al., 2022). Executives with an engineering or science-

related degree positively influence the relationship between corporate sustainability and corporate performance (Ghardallou, 2022).

Based on the above discussion, executives with technical backgrounds are important factors driving enterprise innovation and transformation, providing technical support for the improvement of enterprise intelligence level to promote the sustainable development of enterprises.

The following hypotheses are proposed in this study.

H2: Executive technical backgrounds have a positive moderating effect on smart manufacturing levels and will improve corporate sustainability.

3. Moderating Effect of Executive Overseas Backgrounds

According to the upper echelons theory, director values, characteristics, and experiences influence perceptions, which in turn influence decision-making behaviors and the strategic placement of a company (Bsoul et al., 2022). For successful organizations, a key component of corporate strategy is sustainability, and promoting sustainability is also an opportunity for companies to make changes and drive innovation (Cooney et al., 2022). At the same time, the competence of executives as "sustainability change agents" is positively related to corporate sustainability [49]. As stakeholders, executive continuity affects the sustainability and long-term profitability of a company (Aksoy et al., 2022).

According to upper echelons theory, corporate executives with experience of studying, working, and living abroad will also exhibit different cognitive abilities, personality qualities, and professional qualities from other executives, which will have a significant impact on corporate R&D decisions, resource allocation, and innovation management (Hambrick & Mason, 1984). According to imprinting theory, the overseas experience of executives is a kind of "imprinting", which will have an important influence on decision-making behaviors in the company, and it is difficult to change with the environment (Ye et al., 2022). Specifically, the mature operation mode of overseas enterprises and the advanced management concepts and practices of western companies influence the thinking and behavior of overseas executives while abroad. This influence will be brought to the new organization with the migration of overseas executives and reflected in the company's decision-making, such as having a more rigorous attitude, strengthening the corporate governance model, attaching importance to innovation and investment, and focusing on the optimal allocation of corporate resources. (Bai et al., 2022). We surmise that the international experiences of senior management teams will influence the success of their enterprises. Corporate digital transformation and regional digital economy development both positively moderate the overseas experience of senior management teams, helping managers better organize TMT decision-makers and increasing attention to the importance of the digital economy and sustainable development (Meng et al., 2022). By receiving scientific and technical training abroad, returning executives can master advanced technologies and keep abreast of the latest trends in technological development. This knowledge can effectively narrow the technological gap between Chinese companies and a foreign country (Zheng, 2019). Internationalization and the age of the executive team can increase company innovation (Michaela, & Tobias, 2020). Enterprises led by senior executives with overseas experience can provide higher-quality sustainability reports (Lopatta et al., 2022).

We surmise, based on the above studies, that executives with international backgrounds may be better suited to bring smart technology and sustainable development to firms.

Therefore, the following hypothesis is proposed.

H3: Executive international backgrounds have a positive moderating effect on smart technology level, and will improve corporate sustainability.

4. Moderating Effect of Executive Age

Behavioral financial theory suggests that the decision-making behavior of the general public is influenced by individual psychological factors, and changes in the social environment under environmental uncertainty and values and cognitive preferences shift over time (Alexiev et al., 2010). The characteristics of senior executives, such as age, are positively correlated with corporate performance, especially with capital investment decisions. That is, the more mature the senior executives, the better the corporate performance and capital investment decisions (Ali et al., 2021).

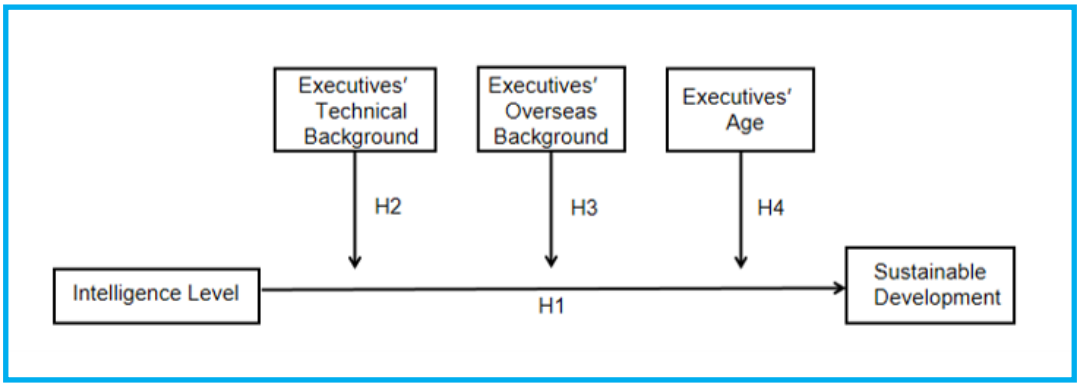
The age and educational composition of senior executives promotes IT adoption in SMEs (Chuang et al., 2009). The age of executives and backgrounds in more than two languages are important factors in improving financial performance (Rodríguez-Fernández et al., 2020). Executive team characteristics, based on age, education level, educational background, gender, and functional background, have a positive and significant impact on firm performance (Tulung & Ramdani, 2017). Older executives have greater predictive power to explain the likelihood of sustainability initiatives and promote corporate sustainability and organizational change (Tacheva et al., 2020). We surmise that a more mature employee will promote the smart technology level of a firm.

Therefore, the following hypothesis is proposed.

H4: Executive maturity has a positive moderating effect on a firm's smart technology level and will improve corporate sustainability.

The theoretical framework of this study is depicted in Fig. 1.

Fig. 1. Study Model



III. Research Methodology and Design

1. Data and Samples

In this study, Chinese A-share listed enterprises from to 2011–2020 were selected as the research object, and the data were processed as follows: (1) special treatment (ST) enterprises with obvious abnormal financial data were excluded; (2) sample data from the financial industry were excluded; and (3) the outliers were subjected to an upper and lower 1% tailing process, resulting in 29,999 observed values. The financial data of the enterprises in this study were obtained from the China Economic and Financial Research Database

(CSMAR), and the data of smart manufacturing pilot enterprises were obtained from the official website of the Ministry of Industry and Information Technology of China.

2. Definition and Measurement of Variables

2.1. Explained Variables

Enterprise Sustainable Development (SGR): With the progress of science and technology, people have a new understanding of development issues and have begun to question the traditional development model. Corporate growth is a complex process that requires constant adaptation to the external environment and changes in response to changes in the external environment (Ji et al., 2023; Wang & Jin, 2023). SGR measures the long-term performance of a company's financial sustainability, which reflects the profitability of stakeholder value creation and long-term growth.

The most representative research on the sustainable growth model of listed companies is the model proposed by Robert C. Higgins and James C. Van Horne, who applied the sustainable growth rate to judge whether a company achieved sustainable growth (Higgins, 1977; Van Home, 1998). Higgins (1977) after introducing the concept, developed a static model to represent the relationship between various financial factors and a firm's sustainable growth. The advantage of this model is that it is easy to understand and operate. The Van Horne sustainable growth model studies the growth of a firm from a dynamic perspective and relaxes the assumptions of the Higgins model, emphasizing its use for planning decisions. However, its model is too complex, so this study relies on Higgins' model to determine the sustainable growth rate of Chinese listed companies (Chen et al., 2017).

2.2. Explanatory Variables

Intelligence Level (INT): The Chinese industry and information technology sector explores new paths of smart transformation by conducting smart manufacturing pilot projects (Yin et al., 2018). With reference to the elemental conditions of the Chinese industry and information technology sector for smart manufacturing pilot demonstration projects, four main evaluation criteria were proposed for Artificial Intelligence companies: Artificial Intelligence technology, characteristics possessed by key links, requirements for achieving significant improvements in multifaceted performance and intelligence levels, and the evaluation of the remoteness, replicability, and scalability of the technology (Sun et al., 2020). Based on the viewpoint of signal theory, being selected as a pilot demonstration project can send positive signals of an advanced manufacturing technology to the outside of the organization, weakening information asymmetry inside and outside the organization, enhancing stakeholder awareness and goodwill toward the company, and attracting high-tech talent (Sun et al.,2023). In this study, we reference the research method of Yang et al. and set the dummy variable as smart manufacturing pilot demonstration enterprises, and then assign a value of 1; otherwise 0.

2.3. Moderating Variables

China has of late been improving the ability of companies to sustain economic development, and the top management team (TMT) has played an increasingly prominent role in companies (Yang et al., 2021). After Dhifi and Zouari, (2022), Garcia-Blandon et al. (2019), Sannino et al. (2020) and Wang et al. (2022), this study selected executive technical background, executive overseas background, and executive age as moderating variables.

Executive Technical Background (TECH): The main objective is to clarify whether the technical backgrounds of executives of listed companies can have a significant impact on intelligence level for enterprise sustainable development, thus drawing on the previous study's portrayal of the characteristics of corporate executives, and sets the dummy variable to a value of 1 if the company's executives have a technical background; otherwise,

it is 0 (Ener, 2022).

Executive International Background (OVERSEA): A value of 1 is assigned if at least one of the company's board members, supervisory board members, and executive team members has worked or studied overseas in the current year, and the company's executives have international backgrounds; otherwise, 0 (Azam et al., 2018; Zheng, 2019).

Executive Maturity (AGE): Executive maturity is grouped at the median, and greater than the median is assigned a value of 1 for the high age group; it is 0 otherwise (Huang, 2015; Tacheva et al., 2020).

2.4. Control Variables

This study controls for the following firm-side variables to determine the effects of other factors on the financial sustainability of the firm (Liu et al., 2022): firm size (SIZE), gearing ratio (LEV), current ratio (CUR), firm growth (GROWTH), and nature of equity (SOE). Year and industry fixed effects are controlled for considering that the effects of time and industry cannot be ignored.

Table 1 presents the study variables and definitions.

Table 1. Variables and Definitions

Variable	Name	Symbol	Definition
Explained Variables	Sustainable Development	SGR	Net sales interest rate × total asset turnover × equity multiplier ×income retention rate
Explanatory Variables	Intelligence/Smart technology Level	INT	Whether it is a pilot demonstration enterprise for smart manufacturing, dummy variable: treat =1, yes; treat =0, no
Moderator Variable	Executive Technical Background	TECH	A value of 1 is assigned to company executives with a technical background, otherwise a value of 0 is assigned
	Executive Overseas Background	OVERSEA	A value of 1 is assigned to company executives with overseas background, otherwise a value of 0 is assigned
	Executive Age	AGE	The age of executives is grouped at the median, with a value of 1 for the higher age group above the median, and 0 otherwise.
Control Variable	Company Size	SIZE	Natural logarithm of the company's total assets
	Asset–Liability Ratio	LEV	Total liabilities/total assets
	Liquidity Ratio	CUR	Current assets/current liabilities
	Enterprise Growth	GROWTH	Growth rate of operating income
	Nature of Stock Rights	SOE	Dummy variable: treat =1, state-owned holding company; treat =0, non-state-owned holding company
	Year	year	Time dummy variable, belonging to the corresponding year = 1, otherwise = 0
	Industry	ind	Industry dummy variable, belonging to the corresponding year = 1, otherwise = 0

3. Model Design

To test Hypothesis 1, that the level of smart technology has a positive impact on improving the sustainable development of enterprises, the following model was constructed:

$$SGR = \beta 0 + \beta 1INT + \beta 2\,SIZE + \beta 3LEV + \beta 4CUR + \beta 5GROWTH + \beta 6SOE + \sum ind + \sum year + \varepsilon \quad (1)$$

Where, β_0 is a constant, β_1 is a coefficient term representing the coefficient of the effect of the explanatory or control variable on the explanatory variable, which can imply the direction of the effect of the variable, ε represents the random error term, *ind* represents the industry effect, and *year* represents the time effect. This study controls for industry and time effects on the explanatory variables, which can render the model results more precisely. Hypothesis 1 can be proved to be valid if the regression coefficient of the variable INT is significantly positive.

To verify Hypotheses 2 to 4, adjustment variables are added on the basis of Model (1) to construct Models (2) to (4):

$$SGR = \beta 0 + \beta 1INT + \beta 2TECH + \beta 3TECH * INT + \beta 4\,SIZE + \beta 6TECH + \beta 6LEV + \beta 5CUR + \beta 6GROWTH + \beta 7\,SOE + \sum ind + \sum year + \varepsilon \quad (2)$$

$$SGR = \beta 0 + \beta 1INT + \beta 2OVERSEA + \beta 3OVERSEA * INT + \beta 4\,SIZE + \beta 6TECH + \beta 6LEV + \beta 5CUR + \beta 6GROWTH + \beta 7\,SOE + \sum ind + \sum year + \varepsilon \quad (3)$$

$$SGR = \beta 0 + \beta 1INT + \beta 2AGE + \beta 3AGE * INT + \beta 4\,SIZE + \beta 6TECH + \beta 6LEV + \beta 5CUR + \beta 6GROWTH + \beta 7\,SOE + \sum ind + \sum year + \varepsilon \quad (4)$$

Based on Model (1), the moderating variables (*TECH*) and interaction terms are added to Model (2), and the remaining variables are the same as in Model (1). If *TECH* * *INT* 's regression coefficient β_3 is significantly positive, "it indicates that the technical background of senior executives has a positive moderating effect on the promotion of the smart technology and the sustainable development of enterprises". Based on Model (1), adjusting variables such as *OVERSEA* background and the interaction term *OVERSEA* * *INT* are added in Model (3), and other variables are the same as in Model (1). If the regression coefficient β_3 of *OVERSEA* * *INT* is significantly positive, it indicates that executive overseas background has a positive moderating effect on the level of smart manufacturing for sustainable corporate development. Model (4) adds the moderating variable Executive Age (*AGE*) and the interaction term *AGE* * *INT* to Model (1), and the remaining variables are the same as in Model (1). If the regression coefficient β_3 of *AGE* * *INT* is significantly positive, it indicates that a higher executive age has a positive moderating effect on the level of intelligence for corporate sustainable development.

IV. Results of the Empirical Analysis

1. Descriptive Statistics

Table 2 shows the descriptive statistics of the main variables. The mean value of corporate sustainability (*SGR*) is 0.3995, and the standard deviation is 1.5636. The standard deviation is large compared to the mean and the ratio is greater than 1, indicating that *SGR* is volatile, with a minimum value of -9.4069 and a maximum value of 4.5243, which is a large fluctuation range. It can be seen that there are great differences in the level of sustainable development of enterprises in the samples. The mean value of enterprise smart technology/intelligence level *(INT*) is 0.0151, and the standard deviation is 0.1221, indicating that only 1.51% of the sample enterprises have a smart technology/intelligence level, and that of Chinese enterprises is generally low. The mean value for executive technical background (*TECH*) was 0.6805 with a standard deviation of 0.4663, indicating that 68.05% of the sample were companies with executives with a technical background, and the mean value for executive overseas background (*OVERSEA*) was 0.2329 with a standard deviation of 0.4227, indicating that 23.29% of the sample were companies with executives with an overseas background. The mean and standard deviation of dummy variable of *AGE* of executives is 50.23% and 0.50, indicating that there are more senior executives over 50 years old in the sample enterprises. In addition, the mean value for state-owned enterprises (*SOE*) was 0.3537 with a standard deviation of 0.4781, indicating the presence of 35.37% of the sample being *SOE*s. The results of the descriptive statistics show that there is a wide variation in the characteristics of the sample enterprises, the variables selected for the sample have an appropriate range of values, and there are no significant outliers that contradict the hypotheses. Therefore, the selected sample met the criteria of the study.

Table 2. Results of the Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
SGR	29999	0.3995	1.5636	-9.4069	4.5243
INT	29999	0.0151	0.1221	0.0000	1.0000
TECH	29999	0.6805	0.4663	0.0000	1.0000
OVERSEA	29999	0.2329	0.4227	0.0000	1.0000
AGE	29999	0.5023	0.5000	0.0000	1.0000
SIZE	29999	22.0874	1.3107	19.5033	26.1015
LEV	29999	0.4260	0.2162	0.0510	0.9733
CUR	29999	2.5588	2.7171	0.2732	17.4506
GROWTH	29999	0.1351	0.3471	-0.6388	1.8960
SOE	29999	0.3537	0.4781	0.0000	1.0000

2. Correlations

Table 3 shows an analytical table of correlations between the variables tested using the PEARSON correlation coefficient matrix. The results show that the correlation coefficient between smart technology/intelligence level and enterprise sustainable development is 0.2186, showing a significant positive correlation. As the correlation analysis is only between two variables, it is also necessary to verify that the variables are independent of each other, and that there is no multicollinearity before a formal regression analysis can be performed. A more precise way to determine cointegration is to conduct a VIF test. The VIF values for all variables in this study's regression model were less than 2, and therefore there was no high degree of multicollinearity, indicating a negligible effect on the main results.

Table 3. Results of the Correlation Analysis

Variable	SGR	INT	TECH	OVERSEA	AGEDUM	SIZE	LEV	CUR	GROWTH	SOE
SGR	1									
INT	0.2186***	1								
TECH	0.0568***	0.0047	1							
OVERSEA	0.0291***	0.0325***	0.1166***	1						
AGE	0.0003	0.0169***	0.0560***	-0.0314***	1					
SIZE	0.0772***	0.0876***	0.0189***	0.0577***	0.2244***	1				
LEV	-0.1809***	0.0368***	-0.0892***	-0.0543***	0.0894***	0.4569***	1			
CUR	0.0775***	-0.0275***	0.0822***	0.0500***	-0.1058***	-0.3387***	-0.6365***	1		
GROWTH	0.2476***	0.0181***	0.0260***	0.0472***	-0.0847***	0.0045	-0.0252***	-0.0113**	1	
SOE	-0.0102*	-0.0009	-0.0036	-0.1414***	0.2336***	0.3260***	0.2509***	-0.1890***	-0.0770***	1

3. Analysis of Empirical Results

From Table 4, according to the estimation results of Model (1), the R-squared of the model is 0.1848, the adjusted R-squared is 0.1840, the goodness of fit is 18.40%, and the F-test value is 212.3445, which is significant at the 1% level of significance. This means that the whole model passes the significance test, and the effect of the explanatory variable *INT* on *SGR* is significant at the 1% significance level, with the coefficient of influence of *INT* being 2.8036. That is, there is a significant positive effect and the sustainable growth rate of companies with *INT* is higher. Hypothesis 1 holds.

The coefficient of *INT* in Model (2) is 0.9320, which means that the effect of *INT* on *SGR* is significant at a 0.01 level of significance, that is, there is a significant positive effect. The coefficient of *INT*TECH* is 2.6899, meaning that the positive effect of *INT* on *SGR* is higher for firms with an executive technology background. Moreover, we can see from the increase in adjusted R2 from 0.1840 in Model (1) to 0.1941 after adding the

Table 4. Results of the Regression Analysis

Variable	(1) SGR	(2) SGR	(3) SGR	4) SGR
INT	2.8036*** (41.551)	0.9320*** (7.686)	2.4153*** (29.171)	2.4013*** (23.509)
TECH		0.0685*** (3.698)		
OVERSEA			-0.0265 (-1.324)	
AGE				0.0227 (1.298)
INT*TECH		2.6899*** (18.559)		
INT*OVERSEA			1.1391*** (8.082)	
INT*AGE				0.7103*** (5.258)
SIZE	0.2215*** (29.031)	0.2125*** (27.936)	0.2203*** (28.659)	0.2183*** (28.393)
LEV	-2.3869*** (-43.734)	-2.3459*** (-43.194)	-2.3867*** (-43.764)	-2.3851*** (-43.694)
CUR	-0.0334*** (-8.388)	-0.0335*** (-8.468)	-0.0333*** (-8.379)	-0.0334*** (-8.392)
GROWTH	1.0366*** (43.184)	1.0396*** (43.558)	1.0388*** (43.288)	1.0399*** (43.259)
SOE	0.0155 (0.821)	0.0097 (0.518)	0.0148 (0.776)	0.0092 (0.477)
Constant	-3.3624*** (-19.217)	-3.1944*** (-18.348)	-3.3296*** (-18.950)	-3.2998*** (-18.803)
Year	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes
Observations	29,999	29,999	29,999	29,999
R-squared	0.1848	0.1950	0.1866	0.1857
r2_a	0.1840	0.1941	0.1857	0.1848
F	212.3445***	213.4959***	202.1990***	200.9672***

interaction term that the moderating effect of executive technology background on the level of firm intelligence is strong. Hypothesis 2 holds.

The coefficient of *INT* in Model (3) is 2.4153, which means that the effect of *INT* on *SGR* is significant at a 0.01 level of significance; there is a significant positive effect. The coefficient of *INT*OVERSEA* is 1.1391, indicating that the positive effect of *INT* on *SGR* is higher for companies with an executive overseas background, verifying Hypothesis 3.

In Model (4), the coefficient of *INT* is 2.4013, which means that the effect of *INT* on *SGR* is significant at a 0.01 level of significance. There is a significant positive effect, and the coefficient of *INT*AGE* is 0.7013. This result indicates that the higher the age of the executive, the higher the positive effect of *INT* on *SGR*, which confirms Hypothesis 4.

4. Endogeneity Test

If there is a significant difference between samples with and without smart technology/intelligent manufacturing, it may not be due to the difference in the value of enterprise SGR brought about by smart technology/intelligent manufacturing, but the sample selection itself. In this study, to prevent the possible adverse effects of omission of information, PSM matching is carried out to find samples that are more identical to smart manufacturing among those that do not exist, thus eliminating the selective bias of the samples, followed by PSM matching, which is based on the principle of logit or probit regression. In this study, the nearest neighbor matching method was used to predict a propensity score value, and the score value closest to the intelligent manufacturing score was found in samples without smart technology/intelligent manufacturing, so as to obtain the matched samples.

From Table 5, it can be seen that there is a significant effect at the 1% level for all variables except CUR, which does not affect whether a company is a smart manufacturing company.

Table 5. Results of the Logit Regression

Treat	Coef.	Std. Err.	z	P>z
SIZE	0.1090***	0.0116	9.3700	0.0000
LEV	0.5370***	0.0917	5.8600	0.0000
CUR	-0.0032	0.0090	-0.3600	0.7220
GROWTH	0.1126***	0.0402	2.8000	0.0050
SOE	-0.1355***	0.0333	-4.0700	0.0000
_cons	-4.5396***	0.2567	-17.6800	0.0000

Note: ***p< 0.01, **p< 0.05, and *p< 0.1.

Next, we observed whether there were significant differences in the characteristic variables after matching propensity scores.

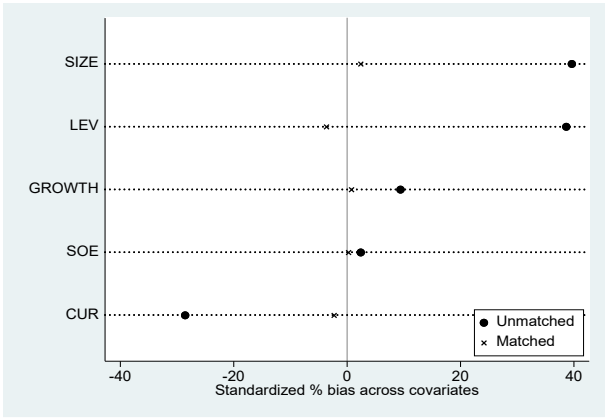
From Table 6, U is before unmatched and M is after matching, and it can be seen that the p-values after matching are all greater than 0.1; therefore, there is no significant difference between the variables of both groups of samples after matching. The test was met and the samples were matched to be more similar.

Table 6. Balance Test

	Unmatched	Mean		% Reduced				V(T)/V(C)
Variable	Matched	Treated	Control	% Bias	Bias	t	p	
SIZE	U	22.6700	22.0700	39.6000		13.3100	0.0000	1.74*
	M	22.6700	22.6340	2.4000	94.0000	0.4800	0.6330	1.39*
LEV	U	0.5080	0.4236	38.6000		11.3500	0.0000	1.0500
	M	0.5080	0.5159	-3.7000	90.6000	-0.7600	0.4480	1.0400
CUR	U	1.9209	2.5778	-28.6000		-7.0200	0.0000	0.41*
	M	1.9209	1.9739	-2.3000	91.9000	-0.5600	0.5740	0.66*
GROWTH	U	0.1693	0.1340	9.4000		2.9500	0.0030	1.36*
	M	0.1693	0.1665	0.8000	91.9000	0.1500	0.8780	1.17*
SOE	U	0.3649	0.3534	2.4000		0.7000	0.4850	.
	M	0.3649	0.3637	0.2000	90.0000	0.0500	0.9600	.

As shown in Fig. 2, the dots are the samples before matching, and the deviation from 0 is relatively high, whereas the samples after matching are all around 0, indicating that there is no large deviation after matching.

Fig. 2. Matching Chart



As can be seen from Table 7, the impact coefficient of the level of intelligence (INT) of the firm is 2.8680, and there is a significant positive contribution at the 1% significance level, which is consistent with the previous results. Therefore, the main model results are reasonable. Further, the coefficient of interaction item of INT*TECH is 2.8180, which is significant under the significance level of 1%. The coefficient of interaction item of INT*OVERSEA is 1.2799, which is also significant under the significance level of 1%. The coefficient on the INT and AGE interaction term is 0.7504, which is significant at the 1% level of significance. The three moderating effects still hold.

Table 7. Results of PSM Regression

Variable	(1) SGR	(2) SGR	(3) SGR	(4) SGR
INT	2.8680*** (26.944)	0.9481*** (5.830)	2.4382*** (19.782)	2.4572*** (16.618)
TECH		0.0231 (0.236)		
INT*TECH		2.8180*** (15.191)		
OVERSEA			-0.0913 (-0.825)	
INT*OVERSEA			1.2799*** (6.494)	
AGE				-0.0647 (-0.645)
INT*AGE				0.7504*** (4.012)
SIZE	0.1433*** (4.761)	0.0844*** (2.996)	0.1200*** (3.930)	0.1263*** (4.130)
LEV	-1.7920*** (-6.801)	-1.5734*** (-6.450)	-1.8411*** (-7.088)	-1.8373*** (-6.994)***
CUR	-0.0429 (-1.533)	-0.0471* (-1.825)	-0.0474* (-1.714)	-0.0460* (-1.648)
GROWTH	0.8113*** (7.530)	0.8477*** (8.536)	0.8120*** (7.646)	0.8220*** (7.659)
SOE	0.1864** (2.009)	0.1575* (1.835)	0.2304** (2.500)	0.1594* (1.688)
Constant	-1.9244*** (-2.626)	-0.5231 (-0.768)	-1.3346* (-1.812)	-1.4718** (-1.993)
Year	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes
Observations	1,715	1,715	1,715	1,715
R-squared	0.3941	0.4861	0.4123	0.4006
r2_a	0.3833	0.4763	0.4012	0.3892
F	36.5088***	49.7186***	36.8813***	35.1227***

Table 8. Robustness Test: Regression Results of the Adjusted Sample Interval

Variable	(1) SGR	(2) SGR	(3) SGR	(4) SGR
INT	2.7919*** (37.490)	0.9041*** (6.876)	2.4226*** (26.507)	2.3889*** (21.476)
TECH		0.0648*** (3.329)		
INT*TECH		2.7564*** (17.404)		
OVERSEA			-0.0078 (-0.366)	
INT*OVERSEA			1.0806*** (6.946)	
AGE				0.0197 (1.068)
INT*AGE				0.7264*** (4.887)
SIZE	0.2163*** (26.753)	0.2076*** (25.740)	0.2144*** (26.310)	0.2133*** (26.185)
LEV	-2.2582*** (-39.256)	-2.2190*** (-38.771)	-2.2565*** (-39.250)	-2.2564*** (-39.228)
CUR	-0.0313*** (-7.497)	-0.0315*** (-7.572)	-0.0314*** (-7.509)	-0.0314*** (-7.521)
GROWTH	0.9533*** (37.493)	0.9575*** (37.877)	0.9545*** (37.545)	0.9554*** (37.518)
SOE	0.0030 (0.152)	-0.0036 (-0.183)	0.0040 (0.202)	-0.0029 (-0.144)
Constant	-3.2669*** (-17.693)	-3.1006*** (-16.877)	-3.2214*** (-17.370)	-3.2069*** (-17.319)
Year	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes
Observations	25,893	25,893	25,893	25,893
R-squared	0.1732	0.1836	0.1747	0.1740
r2_a	0.1722	0.1825	0.1737	0.1729
F	174.7060***	176.2119***	165.8843***	165.0733***

Note: t-statistics are in parentheses, ***p<0.01, **p<0.05, and *p<0.1.

5. Robustness Test

In 2019, COVID-19 brought enormous challenges to the development of the economy and society, as well as unprecedented difficulties for businesses, particularly in 2020, when production and operations were affected and limited by the COVID-19 prevention policy.

Therefore, to prevent the epidemic from impacting the model results, there was a bias in the estimation. After removing samples for 2020, a robustness test was again conducted. If the model results are consistent, this indicates that the model results in this study were relatively stable.

Table 8 shows the regression results of enterprise smart technology/intelligence level on enterprise sustainable development after removing samples in 2020. As can be seen from Model (1) in Table 8, the influence coefficient of smart technology/enterprise intelligence is 2.7919, which has a significant positive impact, consistent with the regression analysis results in Table 4. As can be seen from Models (2)-(4) in Table 8, the coefficients of the three interaction terms are 2.7564, 1.0806, and 0.7264, respectively, all of which are significant at the 1% level of significance. Moreover, the corrected R2 also improved, and the results were still consistent with the regression results in Table 4. The results of this study indicate that executive technical background, executive overseas background, and executive age have a positive moderating effect on the impact of the corporate smart technology/intelligence level on corporate sustainability; therefore, the results of this study have been tested for robustness.

V. Discussion

In the digital economy era, artificial intelligence and other information are the main technologies of the digital economy used to promote the smart/intelligent digital transformation of enterprises. At the same time, the academic community not only focuses on the financial performance of enterprises but also the sustainable development ability. Some scholars have argued that smart manufacturing can improve a firm's production processes (Huang & Wei, 2022; Yue & Zeng, 2021). Various shop floor level management methods, such as smart manufacturing and artificial intelligence, have also significantly improved production management efficiency, operational performance, and financial performance, thus increasing the productivity of the company (Tripathi et al., 2022). For some enterprises in the smart technology /intelligent transition period, supply chain relational capital has a positive impact on corporate green management and improves financial performance (Yu et al., 2021). Digital economy technologies, such as artificial intelligence, have great potential for increasing the productivity of industrial systems (Mo et al., 2023). Other scholars have also focused on the relationship between the level of smart technology/corporate intelligence and financial performance, where the impact of the level of smart technology/corporate intelligence on economic performance is significant (Liu et al., 2021). Many companies use smart technology/business intelligence and big data to mechanize tasks such as analysis, decision making, and strategy formulation, thereby improving the financial performance of the company (Mallamaci & Ferrara, 2022). However, this still requires skilled human interfacing to implement, apply, and make appropriate decisions. There is a significant positive relationship between artificial intelligence and corporate financial performance, and the development of artificial intelligence strategies can effectively improve the financial performance of companies (Xu & Xu, 2022). Firms require managers that are able to oversee this process.

Against the backdrop of the continuous development of the digital economy, enterprises should not only pay attention to financial performance but also place smart technology/intelligence level and sustainable development in the future corporate strategy. As far as current research is concerned, the moderating factors of the smart technology/corporate intelligence level on corporate sustainability are unclear. Therefore, we believed it was relevant to examine the

relationship between the level of smart technology/ corporate intelligence and corporate sustainability in the context of the digital economy, as well as what role employee characteristics play in this process.

We proposed that executive characteristics (technology background, overseas background, and age/ maturity) had a positive impact on the smart technology/intelligence levels of a company in its sustainable development. This study provides a basis for enterprises to promote sustainable development by improving intelligence levels.

VI. Conclusion

Considering China's A-share listed enterprises from 2011 to 2020 as the research object, this study empirically analyzed the relationship between enterprise smart technology/ intelligence levels and enterprise sustainable development. This was in the context of the digital economy and was based on a fixed regression model.

We also examined the moderating effect of executive characteristics (technical background, overseas background, and age). The empirical results show that (1) the corporate intelligence level significantly contributes to corporate sustainability; (2) the technical background of executives positively regulates the impact of corporate intelligence level on corporate sustainability; (3) the overseas background of executives positively regulates the impact of corporate intelligence level on corporate sustainability; and (4) the age of executives positively regulates the impact of corporate intelligence level on corporate sustainability.

1. Limitations and Future Research

In the future, China can seize the opportunity for digital economic development, intelligent transformation, sustainability, and the upgrading of enterprises.

It is necessary to optimize the regional development pattern of the digital economy, facilitate the scientific layout of regional digital productivity, strengthen the interconnection and interoperability of digital infrastructure, and the common construction and sharing of information resources between urban and rural areas and between central and western regions, and promote the orderly flow of digital elements across regions, sectors, and industries. Second, the national government plays a leading role. Specialized bodies can issue strategic policies, make laws and regulations to promote the development of intelligent manufacturing standards, improve data-related legislation, and strengthen risk monitoring. Fourth, rising labor costs may inhibit R&D investment in intelligent manufacturing technology. Government R&D subsidy policies can focus on innovation in intelligent manufacturing technology in areas with high labor costs and provide appropriate subsidy intensity on the premise of a necessary technical audit to avoid excessive labor substitution demand, forcing enterprises to substitute external introduction for independent R&D of intelligent manufacturing technology. Fifth, it is neccesary to continue to set up pilot demonstration projects for smart manufacturing in various industries, emphasizing openness and sharing, and to form intelligent technology routes that can be replicated and promoted. These aim at expanding domestic demand for smart manufacturing technology in the context of the "double cycle" while promoting advanced models of smart transformation in foreign markets, using a demand-pull mechanism complemented by direct R&D funding to promote technological innovation in smart manufacturing with joint efforts at both ends. Finally, focusing on major technologies and key industry needs, such as artificial intelligence and industrial Internet, collaborative innovation of industry, universities, and research in intelligent manufacturing can be carried out, and advanced intelligent manufacturing enterprises can be encouraged to carry out professional consulting services to promote the development of intelligent manufacturing.

2. Accelerated Digitalization and Intelligent Transformation of Enterprises

First, there is a need to strengthen the digitalization of enterprise production execution, encourage implement network monitoring, and use information management systems to monitor the production process in real time. Digital equipment should be used to collect various data indicators on the production process, based on the analysis and mining of production data, to provide a scientific basis for decision making to optimize production processes, quality control, reduce energy consumption, and management. Second, it is vital to promote the digitization of enterprise resource allocation, support qualified Chinese enterprises to carry out digital projects to promote enterprise informatization construction to achieve effective integration of logistics, capital flow, information flow, and workflow, and improve the level of collaboration in R&D, manufacturing, and service. Enterprises should be encouraged to use the Internet platform to optimize the allocation of idle resources, develop an industry sharing economy, and improve the efficiency of resource utilization. Third, they should promote the digitalization of enterprise operational decision-making and encourage enterprises to build operational decision-making support systems. Relevant enterprises should build enterprise intelligent analysis and decision-making platforms based on the use of big data, artificial intelligence, expert systems, and management information systems to conduct multi-dimensional gap analysis and improve modern enterprise management. Finally, digital workshops and smart factories should be promoted. Relying on industrial parks, industrial parks, industrial bases, and other advanced manufacturing clusters, smart manufacturing demonstration bases and smart factories and digital workshops should be built in the fields of energy, chemical industry, aerospace, automobile manufacturing, electronic information, high-end equipment, medicine, and the processing of special agricultural products.

3. Increased Proportion of Highly Qualified Personnel

First, it is important to increase efforts in skill training for employed workers and improve the workforce's adaptability to the digital and intelligent transformation. The digital economy helps cultivate talent and can greatly broaden access to learning information, improve human capital in the manufacturing industry, target various forms of transferable skills training through online classes, online education, and online exams, and establish a lifelong learning vocational education system for the workforce in manufacturing sectors that are more easily replaced by robots to help workers achieve skills upgrading, employment, and job upgrading. Second, deepening education reform, especially higher education reform, establishing a digital talent training guarantee system, and accurately positioning the direction of digital talent training in vocational education, on the basis of continuing to expand the scale of higher education and increase investment in higher education, paying close attention to the frontier of international technological development, accelerating the adjustment of the structure of higher education disciplines, establishing a system of intelligent manufacturing disciplines, and actively training professionals related to artificial intelligence and multi-skilled composite talents with more flexible problem-solving abilities should be undertaken. Third, we will continue to promote talent introduction programs. Compared to the development of international technical fields, many industries and fields in China still lack core technical talent. The government can continue to promote preferential employment policies for overseas students or professionals with core skills, and encourage more talent to return to China to work. Finally, when assigning senior management teams, listed enterprises can consider providing more support to overseas and technical backgrounds to help enterprises build a talent base for intelligent development and improve the diversification of senior management teams.

4. Limitations

In addition, some limitations of this study should not be ignored. (1) There are differences in the degree of implementation of smart manufacturing and the transformation and improvement paths of enterprises in different industries, and this study does not distinguish between industry types for further research. (2) Different technologies in intelligent manufacturing may have different effects on enterprise performance. Some technologies have a positive impact, whereas others have a negative impact. This study does not further distinguish the technologies that may affect the quasi-certainty of the results. (3) At present, China mainly implements a government-driven intelligent demonstration enterprise model, and we cannot judge the degree of enterprise intelligent implementation using public data. Therefore, limitations in data availability may also affect the research results. These issues can be further discussed in future research.

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Multiple User Switching Intention of Simple Payment Service (SPS): Focusing on Korean Generation Z

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ABSTRACT

Purpose – Previous research on SPS (Simple Payment Service) includes studies focusing on the intention to adopt or to continue use. Therefore, there is a limitation in explaining the motivation of multiple users among Generation Z that have already adopted SPS. This study focuses on examining the factors affecting the switching intention of multiple users among Generation Z from one SPS to another based on the PPM (push, pull and mooring) model.

Design/Methodology/Approach – This study applied the PPM model to explain the switching intention of multiple users. A total of 235 university students in their 20s with experience using two or more simple payment services were collected and analyzed.

Findings – All three factors of the PPM model were found to have a statistically significant effect on switching intention. That is, intention to switch to other SPS was high, even though the consumers habitually used it or were reluctant to change.

Research Implications – SPS providers need an effective PPM strategy to retain customers by providing benefits in terms of ease of use, versatility (online and offline payment), and price to prevent deviation from the service. It is also important to ensure the relative advantage and reliability of the service, and to implement favorable marketing tailored to the 20s.

Keywords: mooring factors, multiple user, pull factors, push factors, simple payment service, switching intention

JEL Classifications: M31, N70, O33

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I. Introduction

Simple payment service (SPS) belongs to one of the most competitive fintech services in Korea. It is the most preferred payment method among 'Generation Z' in Korea. It accounts for 35.8% of the total payment market. The SPS mainly used by Korean Generation Z includes Naver Pay, Kakao Pay, Tos Pay, and Payco. Generation MZ is a term that encompasses the Millennial Generation, and Generation Z born between the mid-90s and early 2010s. According to *Generation Z Trend Report 2021*, Millennials had a relatively high preference for Samsung Galaxy, and Generation Z for Apple iPhone (Bae, 2021). As Apple Pay enters the Korean market, it is expected that large numbers of users in their 20s are likely to switch to Apple Pay. The landscape of the Korean SPS market will change with the entry of Apple Pay. Generation Z is active in consumption and investment, although they have few assets and little income. As Generation Z is expected to become the main axis of the fintech industry, it is worthwhile to investigate behavioral patterns related to SPS adoption.

Existing studies on a mobile SPS can be largely classified into two streams.

One stream includes research on factors in adopting a service. This trend is dominated by studies based on the technology acceptance model (Davis, 1989). These studies explain SPS adoption behavior utilizing logic in the technology acceptance model. The majority of studies focus on those sectors of service users that switch from traditional card payment methods to SPSs. The main explaining variables include such concepts as ease of use, convenience, or the usefulness of the service, which are key explanatory factors in the technology acceptance model. For example, Son (2021) showed that new users accept SPS due to the convenience and usefulness of the mobile simple payment system.

Another stream is studies examining continuous users' intentions of the SPS. These studies attempt to explain which factors affect the intention to continue using the adopted service. A representative study, for example, is to explore how perceived value and perceived risk affect the intention to continue using.

Existing research, which has been classified into two streams, has the following fundamental limitations.

First, these studies focus on the intention of a new user that has adopted a specific SPS for the first time. Therefore, these studies are unable to explain the motivation of old users that have already adopted a SPS, but are going to switch to others.

Second, existing studies have the premise that service users adopt only one SPS. However, in reality, it is common to use multiple SPS at same time. Prabowo and Kurnia (2021) analyzed the switching intention and switching behavior of Indonesian e-wallet users. According to this study, in Indonesia, 21% of users use only one digital wallet, 28% of users use two or more, and 47% or more of users use three or more electronic wallets.

Therefore, this study focuses on users with experience using SPS along with multiple services. In addition, it tries to examine the factors affecting the user switching intention from one SPS to another.

The reason this study paid attention to the switching intention of multiple users is that there is no strong player in the Korean SPS market. There is no dominant SPS such as WeChat Pay in China or Apple Pay in the US. Thus, it is hard to say that one dominant SPS is largely used in Korea, and quite differently, many people use two or more SPSs at the same time. For example, a person can use Samsung Pay through a Galaxy smartphone offline. In an online transaction, remittances or gifts are sent via Kakao Pay. Furthermore, Naver Pay is used when purchasing products at the Naver online shopping mall. As such, most Korean SPS users show multiple use patterns adopting two or more SPSs.

Previous studies focused on one payment service only, and tried to examine the continuous use intention. This study, unlike these trends, aims to examine multiple user switching intentions observed frequently in the multiple use context,

like in Korea. A new conceptual model will be suggested by extending the PPM model. The relevant hypotheses will be developed and tested empirically by the survey data collected in Korea. In this context, the first research question is (1) what factors make multiple users switch to other payment service? This is important in the field of marketing and consumer behavior, which emphasizes the importance of maintaining existing users and engaging potential future customers. Previous studies argue that customer satisfaction can lower switching intention. Recent studies, however, have suggested new factors affecting switching intention rather than satisfaction. They include such factors as the relative attractiveness of different products and propensity to pursue variety (Bansal & Taylor, 2015). Therefore, this study tries to find factors influencing switching intention in the multiple use context. The second research question is (2) how do the different components of the PPM model influence the switching intention of multiple users? By introducing the PPM model and continuing use intention, this study seeks to address this issue and make the first step toward advancing the body of knowledge on the topic.

II. Literature Review

1. Simple Payment Service and Continuous Use Intention

Most previous research about the SPS (simple payment service) focuses on identifying antecedent variables that affect continuous use intention (Lee & Yi, 2021). Representative studies are as follows. Son (2021) adopted variables such as perceived value, trust, resistance, and flow for innovative technologies to identify the motivational determinants that affect the continuous use of an SPS. It was analyzed that the cost-benefit from using an SPS, trust in the SPS provider, individual user resistance to the adoption of SPS, and enjoyment of using SPS affect continuous use intention.

Another study found that brand image and brand attitude were important for mobile easy payment services to be used continuously, like regular products (Kim & Chong, 2020). The reason why a specific payment service was selected among various simple payment services perhaps that the brand is recognized as differentiated and has established an image as a distinct brand (Kim, 2022). Building a differentiated brand can have a positive effect on brand attitude or continuous use intention.

In a study on intention to use SPS, Yu et al. (2021) conducted a study focusing on WeChat *Hongbao*, which is used in social media in China. *Hongbao* means red paper bag. It was a means of Chinese culture to wish for blessings in Chinese, or to convey the meaning of gratitude. In the past, *Hongbao* was an act of giving and receiving through direct meetings (off-line), in the sense of gratitude or wishing for the blessings of the other person, such as New Year's money, or congratulations and condolences. Currently, it is being done online with the use of SNS. Based on the Unified Technology Acceptance Theory (UTAUT) model, this study believes that the continued use of WeChat *Hongbao* is determined by three factors. The effect of functional demand, psychological demand, and social demand on WeChat's performance expectations and use intention is examined.

In another study on WeChat Pay, Lee and Chae (2020) focused on benefits and sacrifice factors of the value-based adoption model (VAM). It is believed that the perceived usefulness and perceived risk of WeChat Pay affect the perceived value (functional value, social value, emotional value, cognitive value, situational value), and ultimately affect the continuous use intention.

In most of the existing studies related to SPS, studies that focus on continuous use intention are dominant. They focus on technology acceptance models such as ease of use and usefulness (Gao & Jin, 2022). Perceived risk factors for hesitation in using SPS include concerns about security and stability, and there are also studies focusing on user resistance to innovation, habits, and switching costs.

2. Push-Pull-Mooring Model and Switching Intention

The push-pull-mooring (PPM) theory is a theory developed to explain factors that affect human migration behavior. It has been introduced in many studies that explain the switching intention of consumers. In particular, it has been used to verify the intention to switch to a new information technology or service in the IT technology or service field (Ban & Lee, 2021; Cao et al., 2020; Hsieh, 2021; Kim & Park, 2018; Park & Kim, 2021; Seo, 2022).

Regarding the switching intention of smart appliances, Kim and Park (2018) also utilized the push-pull-mooring theory, which is a migration theory. The low usefulness and ease of use of existing home appliances were selected as push factors. The attractiveness of alternatives and subjective norms are regarded as pull factors. The status quo bias is adopted as a mooring factor to explain the intention to switch to smart home appliances. An empirical analysis was conducted on TV, air purifier, washing machine, and dryer users. All three factors were found to have a significant effect on switching intention. In the group with low status quo bias, all three factors were found to have a significant effect on switching intention.

Seo (2022) applied the PPM model to study the conversion intention of airline users. Push factors consist of low service quality, low satisfaction, and low reliability. Pull factors include the attractiveness of alternatives and subjective norms. Mooring factors are seen as low diversity pursuit and low conversion experience. It is believed that there is a difference in conversion intention according to the status quo bias as a moderating variable.

Ban and Lee (2021), who analyzed the determinants of exhibitor conversion intentions, applied the PPM factor, a migration theory. The push factor is attributed to failed exhibition service, poor participation performance, and exhibition price problem. As a pull factor, they saw the attractiveness of competitive exhibitions and the price benefits of competitive exhibitions. Mooring factors such as high switching costs and low pursuit of change are believed to affect the switching intention of exhibitors. 273 exhibitors participating in Mega Show and the International Food Industry Exhibition were analyzed, and PPM factors affecting conversion intention were derived.

Park and Kim (2021) analyzed PPM factors that affect the intention to switch to Over The Top (OTT) service. The push factors were regarded as low satisfaction and low pleasure, and the pull factors consist of the attractiveness of alternatives and the richness of content. Mooring factors as moderating variables were low switching costs and pursuit of diversity, and they were found to affect the intention to switch to OTT services. PPM factors affecting conversion intention were derived for users of OTT services such as Wave, Netflix, Watcha, and YouTube.

PPM theory was also used in a study by Jin and Rha (2020) that analyzed consumer intention to use technology-based self-service (TBSS) for food service companies. For the push factor, it regarded low availability and low service quality for the service of restaurant employees. It was found that awareness of the convenience and enjoyment of using the kiosk were pull factors, and technostress and communication avoidance as mooring factors affect intention to use. As a result of the analysis, it was found that privacy concerns did not affect intention to use.

In particular, it is used to explain the intention to switch from an IT product or service to another service. However, although the factors constituting PPM are different depending on the subject of analysis, sub-factors constituting the mooring factor are almost the same.

3. Influencing Factors of Switching Intention

Switching intention, in contrast to repurchase intention, can be defined as the intention to switch the product or service currently in use to another product or service. It is an important factor that can predict switching behavior, but it is difficult to predict because it promotes rapid conversion to other products or services (Jeong & Cho, 2021).

Studies that did not apply the PPM model in analyzing the influencing factors of switching intention are as follows. There is a study that applies the Value-based Adoption Model (VAM), which analyzes factors influencing user conversion intention by dividing it into benefits and costs. First, there is a study that explains the conversion intention from the perspective of perceived risk at the expense of the user. Perceived risk by buyers of Airbnb accommodations could influence hesitancy. Perceived risk is adopted as a factor influencing the behavior of purchasing other hotel products, or the intention to switch to other accommodation products. Major perceptual risks include psychological risks (tension), physical risks (security risks such as hidden cameras), and economic risks (additional fees) (Jeong & Cho, 2021).

Second, as a study that explains switching intention in terms of benefits, a study by Cho (2018) that identified the conversion intention in the social commerce fashion apparel product market. In this study, the effect of attractiveness of alternatives perceived by university students that purchased products in the social commerce market on their conversion intention was analyzed. It was analyzed that relational benefits (social benefit, certainty benefit, economic benefit, special treatment benefit) affected it as a moderating variable. In addition to product sales, social benefits such as community activities among consumers, special benefits such as mileage service for regular customers, certain benefits related to hacking and security, and economic benefits such as discounts should be strengthened to lower conversion intention.

A study by Prabowo and Kurnia (2021) examined the conversion intention and behavior of multiple users of electronic wallets in Indonesia. According to the World Bank, the e-wallet market accounts for 10% of the total payment market in Indonesia. There are 38 e-wallet mobile apps in Indonesia. Among these, only 21% of users use one e-wallet, and the remaining 79% use two to three e-wallets. The purpose of this study was to identify reasons why conversion behavior frequently occurs in Indonesia. Quality, emotional, social, and cognitive values, which are the perceived values of electronic wallets, are considered to have an impact on conversion intention or customer satisfaction. Most respondents are consumers with upper-middle incomes.

A study by Prabowo and Kurina (2021) was also conducted in a similar context, and the effect of perceived value on conversion intention and conversion behavior was analyzed based on the preceding study by Lin and Wang (2017). The components of perceptual value referred to a study by Sweeney and Soutar (2001). Survey subjects were college graduates aged 26 to 40, accounting for 82.7% of total survey subjects, and most were self-employed; self-employed people would adopt all electronic payment services used by electronic payment users. In their study, perceived value consisted of four categories: quality/performance value (convenience of function and performance), emotional value (feeling good, fun), social value (enhancing image, looks different), and emotional value (uniqueness, novelty).

Zhu and Hwang (2019) studied the intention of switching to Alipay. Emotional immersion and the perceived usefulness of existing payment services are believed to have a negative effect on the intention to switch to Alipay. It was seen that service quality and social impact had a positive effect on the intention to switch to Alipay. Perceived switching costs and individual resistance to innovation were found to have a negative effect on the switching intention of Alipay as a moderating effect, but the moderating effect was rejected as a result of the analysis.

Hsieh (2021) used the PPM theory to identify the intention of medical customers to pay for medical expenses through mobile payment apps. In switching from cash payment to mobile payment app, it was found that low satisfaction, perceived risk, and social influence as push factors, and relative advantage, compatibility, test usability, and image as pull factors had a positive effect on conversion intention. On the other hand, sunk cost, status quo propensity, and switching cost had a negative effect on user conversion intention. 1,020 Taiwanese medical customers were analyzed.

The results of existing studies can be summarized as follows. First, most studies explain conversion intention through the main variables of the PPM model. Second, there some studies used the value-based acceptance model (VAN), which assumes that conversion intention is lowered or increased due to the perceived risk or benefit. Third, the study on the conversion intention of simple payment service focuses on the conversion intention of credit card users. There are not many studies on the intention to switch to other SPS.

This study investigates the switching intention of multiple users focusing on Korean Generation Z, who are in their 20s and account for 35.8% of the total Korean payment market. In Indonesia, electronic payment service users are close to early adopters, but in Korea, the electronic payment service is in the stage of transition from growth to maturity, and multi-use is already becoming a trend among Generation Z. Second, there are many studies on the effect of perceived value on customer satisfaction, and many opinions support that customer satisfaction can lower switching intention. This study, however, examines the impact factors other than satisfaction. Recent studies suggest new factors as determinants of switching intention, such as the relative attractiveness of different products, or propensity to pursue variety (Bansal & Taylor, 2014).

III. Research Model and Hypotheses

1. Research Model

In this research model, a push factor causes users to switch to other simple payment services as the performance of core services expected from simple payment services falls short of user expectations. In previous studies, the pushing factors for switching from credit card payment service to simple payment service resulted in two things. The inconvenience of a payment processing method and inefficient payment processing methods are considered major push factors.

First, it focuses on how conveniently payment can be made. It is said that ease of use means easy to pay, but if the level of convenience is low compared to other simple payment services, it can make people switch to other simple payment services. In this study, the ease of use of a simple payment service means the degree to which it is easy to use something. It can be used without discomfort or difficulty. If it is inconvenient every time you use the simple payment service, the frequency of use will inevitably decrease. This means that if the most core service desired by users of the simple payment service is not met, they will switch to other simple payment services.

Second, the focus is on whether payments can be made anywhere. The versatility of the simple payment service means the degree to which payment can be made without problems when making a payment at an online shopping mall or an offline shopping mall. If the payment is rejected, or the user cannot use the simple payment service, the user has no choice but to switch to a simple payment service with versatility.

Third concerns whether the simple payment service currently in use provides price benefits. There are not many studies on this factor. Various simple payment service providers focus on ease of use and versatility rather than providing price benefits to users. However, many competitors are currently entering the simple payment service market. If the demand level of the MZ generation to use a simple payment service that gives price benefits in a high price situation is not met, a user can switch to another simple payment service. If a price benefit is given for use through promotion, for example, if a price benefit such as cashback or discount is given, the user may not switch to another simple payment service. However, simple payment services without price benefits can promote conversion to other simple payment services (Lee & Kim, 2017).

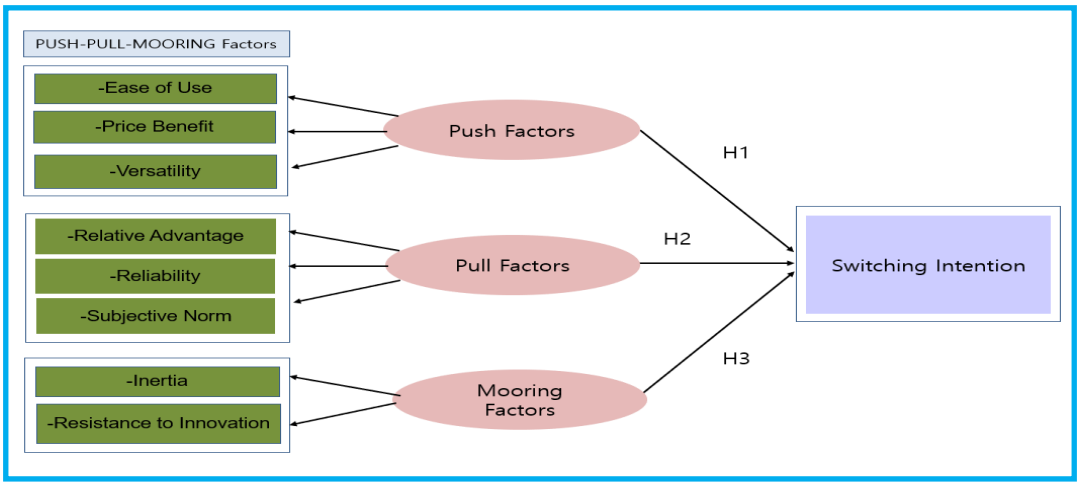
A pull factor composes the attractiveness of other simple payment services. First, for relative advantage, do other simple payment services provide more convenient functions? Second, is it a reliable simple payment service provider?

Third, do close acquaintances respond positively to the company? As such, subjective norms were included because the positive thoughts peers can influence decision-making.

Existing studies have suggested the attractiveness of alternatives and subjective norms, but this study included relative advantage, reliability, and subjective norms as sub-factors that constitute the attractiveness of other simple payment services. In a situation where various simple payment services have already been introduced, it is important that the relative advantages are clear. In addition, due to the nature of financial services, if the reliability of other simple payment service providers is high, conversion will occur. Like subjective norms, positive reactions from others promote conversion to other simple payment services.

The mooring factor is a social and psychological factor introduced due to limitations in explaining cultural-geographical movement only with the interaction of pull and push (Moon, 1995). Status quo bias refers to the tendency to maintain the current decision rather than to try something new, even when new and better alternatives exist (Samuelson & Zeckhauser, 1988). The mooring factor does not migrate and stays in the current position. In this study, status quo bias (habit) and resistance to innovation are considered as mooring factors. If there is a high tendency to habitually use the existing simple payment service, there is a high possibility that it will be moored to the current simple payment service. If one dislikes changing the current situation or accepts it as an annoyance, he will not be able to switch to other simple payment services.

Fig. 1. Research Model



2. Hypotheses

2.1. Push Factors and Switching Intention

Most intention to switch is due to dissatisfaction with the current service (Sun et al., 2017). Dissatisfaction is the opposite of satisfaction, and dissatisfaction refers to a psychological state that induces users to switch to other services. As a result, the degree of dissatisfaction with the current SPS affects the intention to switch, and the following hypotheses can be presented based on existing studies.

Acceptance of a simple payment service is due to the convenience of not having to carry a physical wallet, which is a key attribute of simple payment

service. All existing SPS replace physical wallets and provide the benefit of simplicity. However, if convenience is not guaranteed, one can switch to another SPS. As a result, it is necessary to improve the ease of use in payment methods (Liao et al., 2009).

Ease of use refers to the extent to which a target service can be expected to be used without effort. If payment is made easily due to the nature of the system, users will be satisfied with the ease of use. If users believe that a particular technology can be used without mental stress and effort, it will have a decisive effect on the acceptance of the technology (Foroughi et al., 2019). As a result, the lower the ease of use of the current SPS, the more it affects the intention to switch.

If convenience of use cannot be provided due to a lack of affiliated stores, the simple payment service will not be able to meet user expectations for universality, which is a core benefit. Lack of versatility will be a factor that forces a switch from the simple payment service they are currently using. Lee and Kim (2017) saw limitations of versatility due to a lack of merchants, payment cancellation, and errors as key reasons for not using a current simple payment service. Versatility is the most important factor in the spread of simple payment service, and it is determined by how many member stores are secured. Jung and Lee (2019) also derived versatility as a key factor that determines the degree of user spread of simple payment services. As a result, if the current simple payment service is not used in various transactions as expected by users, it will affect the intention to switch to other simple payment services.

In the case of simple payment service, unlike the US or Chinese market, Korea uses a card registration method. In addition, Naver Pay, Kakao Pay, Zero Pay, and credit card apps are competing fiercely as simple payment services in online commerce, and Samsung Pay has a relatively high proportion offline. However, if price benefits such as discounts or accumulated points become insufficient, the offline market led by Samsung Pay will also be divided into Kakao Pay, Naver Pay, and Apple Pay. If Apple Pay's pending availability causes iPhone users to switch to Apple Pay, competition will intensify. Even in the case of similar simple payment services, providing economic benefits such as points or discounts, or special treatment benefits such as customized products, are important for the intention to continue use of a simple payment service. As a result, if the simple payment service does not provide price benefits, it can be an important factor in switching to other simple payment services (Cho, 2018).

H1: Push factors (ease of use, versatility, and price benefit) will positively affect switching intention.

2.2. Pull Factors and Switching Intention

Pull factors make a destination attractive with a positive image of the destination. Among pull factors, the relative advantage of competing alternatives means the degree to which a new alternative is perceived as better (Davis, 1989). Rogers saw that among the five characteristics of innovative technology, relative advantage played an important role in explaining the acceptance rate of innovation.

Park et al. (2022) believed that user satisfaction would increase if consumers recognized that innovative products have superior functions or performance compared to existing products. It is believed that the relative advantage of the 3D digital fashion show affects the intention to continue use. In addition, it is expected that user satisfaction will be high if the degree of differentiation or relative advantage of the financial services provided by Internet banks is higher than that of existing commercial banks. As a result, the relative advantage of other simple payment services affects switching intention.

According to Lee and Kang (2015), reliability among pull factors occurs when companies that provide services or products are perceived as having a sense of responsibility. In other words, it is the belief that a product or service will meet the buyer's expectations. In the case of services with high intangibility, trust between users and

providers acts as an essential factor. Even in situations where decision-making uncertainty is high, or accurate information about products or services is not provided, it is believed that if users have high trust in a product or service provider, they will have purchase intentions.

Anderson and Sullivan (1993) presented a similar view on reliability. Reliability is viewed as the buyer's belief that the company doing business with the buyer will not only refrain from taking actions that could lead to negative consequences but it will also strive to deliver positive results. In addition, there is a view that trust in a company is regarded as the reputation of the company, and the degree of trust and professionalism that consumers have toward the company (Fombrun, 1996).

As a result, the higher the reliability of other simple payment services, the more it affects conversion intention.

A subjective norm is a belief that a reference person or reference group will support a behavior. A behavior is influenced by normative trust in a group, and it can be seen as the extent to which one tries to follow the will of the reference group (Flowers et al., 2017). A reference group is a group of people that influence behavior (Tran & Kim, 2022). Through this group, social norms and values or ideologies become a reference point for an individual. It can be seen as the extent to which the thoughts or opinions of the reference group about new alternative products and services affect decision-making. Subjective norms have been studied as an important factor included in the technological acceptance model and as a variable influencing conversion intention (Kim & Park, 2018). A group's opinions or thoughts can positively influence behavior to switch to other services, and Sun et al. (2017) revealed that subjective norms can have a positive effect on service switching intention.

H2: Push factors (relative advantage, reliability, and subjective norm) will positively affect switching intention.

2.3. Mooring Factors and Switching Intention

'Mooring factors' can be defined as factors that play a role in hindering migration to competitive products or services. It is facilitated by the tendency to maintain the status quo and switching costs. The mooring factor was introduced as it was argued that the complexity of the migration decision process could not be explained only with push factors or pull factors in the PPM model. This is because even if push or pull factors are adopted as factors that promote migration, and migration may be prevented due to individual circumstances or circumstances (Hsieh et al., 2012). Mooring factors such as tendency to maintain the status quo and resistance to innovation have been examined to see whether they play an important role in hindering migration.

Lee and Jung (2021) also saw the status quo bias as a concept similar to 'inertia' that tries to continuously maintain the current state. There are two explanations for avoiding change. First, when the tendency to avoid loss becomes strong, a cognitive error in thinking the loss is greater occurs. Therefore, we try to keep the current situation as it is. Second, it is believed that people are reluctant to change due to the annoyance of changing the product or service they are currently using (Kleijnen et al., 2009). As a result, habit and resistance to innovation, which are personal inclinations, were regarded as major components of the status quo bias, and the following hypothesis was developed.

H3: Mooring factors (inertia and resistance to innovation) will negatively affect switching intention.

IV. Methodology

The questionnaire items and construct concepts for this study were developed through a preliminary survey targeting college students. For statistical processing, SPSS 26.0 and AMOS 27.0 were used (Lee & Kim, 2022). The survey was conducted from March 10 to March 26, 2023, targeting university students in their 20s

(Z-generation) with experience using two or more simple payment services. Generation Z were born after 1995, and are referred to as digital natives. As digital natives from birth, they grew up in a media environment where the boundaries between online and offline were unclear (Kim & Chang, 2022). Generation Z has different subjective characteristics from the past generations (Cheong et al., 2023). Therefore, little is known about fintech styles unique to Generation Z, which differentiate Generation Z from Millennials.

Convenience sampling was used as a survey method, and a total of 254 questionnaires were collected. Among the collected questionnaires, 235 questionnaires were used for the final analysis, excluding 19 questionnaires with many missing values and insincere responses.

The demographic characteristics of the respondents are shown in Table 1. By gender, there were 128 females (54.5%) and 107 males (45.5%). SPSs used most are Kakao Pay (102 participants, 43.4%), Naver Pay (65 participants, 27.7%), Tos Pay 33 (14%), Samsung Pay (25 participants, 10.6%), Payco (5 participants, 2.1%), KB Pay (1 participant, 0.4%), and NH Pay (1 participant, 0.4%).

Table 1. Demographic Profiles of Respondents

Variable (N=235)	Characteristic	Frequency	Percent (%)
Name of SPS	Kakao Pay	102	43.4
	Naver Pay	65	27.7
	Tos Pay	33	14
	Samsung Pay	25	10.6
	Payco	5	2.1
	NHPay	1	0.4
	KB pay	1	0.4
Gender	Male	107	45.5
	Female	128	54.5
Frequency of Use (based 10 times)	10 times	35	14.9
	9 times	19	8.1
	8 times	45	19.1
	7 times	31	13.2
	6 times	16	6.8
	5 times	38	16.2
	4 times	8	3.4
	3 times	12	5.1
	2 times	4	1.7
	1 times	3	1.3
Place of Use	Online shopping mall	176	74.9
	Convenience store	31	13.2
	Restaurant	19	8.1
	Other	9	3.8

The number of times respondents used SPS was measured based on how many times a service was used. 45 people has 8 uses (19.1%), 38 had 5 uses (16.2%), 35 people had 10 uses (14.9%), 31 had 7 uses (13.2%), 19 had 9 uses (8.1%), 16 had 6 uses (6.8%), 12 had 3 uses (5.1%), 8 had 4 uses (3.4%), 4 had 2 uses (1.7%), 3 had a single use (1.3%), and 1 showed no response. It was found that most used SPS more than once.

Table 2. Survey Questionnaire Items

Variable		No.	Items	Related Research
Push Factors	Ease of Use	EU1	The SPS mainly used is not easy to operate.	Davis (1989), Moore and Benbasat (1991)
		EU2	The SPS mainly used takes a lot of time to use.	
		EU3	The SPS mainly used is inconvenient.	
		EU4	The SPS mainly used is difficult to use	
	Price Benefit	PB1	The SPS mainly used does not accumulate many points.	Foroughi et al. (2019)
		PB2	The SPS mainly used does not provide discount benefits.	
		PB3	The SPS mainly used does not provide benefits such as cashback	
		PB4	The SPS mainly used is not financially advantageous.	
	Versatility	VS1	Payment can be made anytime, anywhere using the SPS that is mainly used.	Lee and Kim (2017), Jung and Lee (2019)
		VS2	There are times when payment fails while using the SPS which is mainly used.	
		VS3	There have been cases of payment cancellations or errors while using the simple payment service that is mainly used.	
Pull Factors	Relative Advantage	RA1	I know of other SPS that provide superior service.	Moore and Benbasat (1991)
		RA2	I know of other SPS that offer more benefits.	
		RA3	I know of other SPS that make it easier to pay.	
	Reliability	RE1	Other SPS will give greater reliability.	Lee and Kang (2015)
		RE2	Other SPS will be more honest.	
		RE3	Other SPS will do a good job of fulfilling promises.	
		RE4	Other SPS will be more reliable.	
	Subjective Norm	SN1	My acquaintances respond favorably to other SPS.	Venkatesh et al. (2003), Rejon-Guardia et al. (2020)
		SN2	My acquaintances are very interested in other SPS.	
		SN3	My acquaintances take a friendly attitude toward other SPS.	
Mooring Factors	Inertia	IN1	The main SPS is used habitually.	Hsieh et al. (2012), Lee and Jung (2021)
		IN2	The main SPS is used unconsciously.	
		IN3	The main SPS used is automatically used.	
	Innovation Resistance	IR1	It is troublesome to change SPS which is mainly used.	Kleijnen et al. (2009)
		IR2	I am reluctant to change the SPS which is mainly used.	
		IR3	It is not easy to change the SPS which is mainly used.	
Switching Intention		SI1	I want to switch to other payment service that gives me greater satisfaction.	Fishbein and Ajzen (1975), Kang et al. (2015)
		SI2	I want to switch to other SPS that offer more discounts.	
		SI3	I want to use a new SPS.	
		SI4	Other SPS is more suitable for my taste.	

Responses to the main place of use of simple payment service include online shopping malls by 176 persons (74.9%), convenience stores by 31 (13.2%), restaurants by 19 (8.1%), and other places by 9 (3.8%). It was found that they overwhelmingly used simple payment services in online shopping malls. The variables used in this study are measurement items whose reliability and validity have been verified in previous studies, and some questionnaire items were changed to fit SPS. According to the empirical results of the exploratory factor analysis, the scale of this questionnaire was determined to be 28 items for nine dimensions of all variables.

More specifically, items of all constructs were measured on a 7-point Likert rating scale from "Completely disagree = 1" and "Completely agree = 7". There were nine items for push factors as ease of use (three items), price benefit (four items), and versatility (two items). There were ten items for pull factors as relative advantage (three items), reliability (four items), and subjective norms (three items). There were six items for mooring factors with inertia (three items) and innovation resistance (three items). Based on various previous studies, questions were modified and constructed according to the topic and subject of this study. The survey questionnaire items are shown in Table 2.

V. Results and Discussion

In this study, factor analysis using the principal component analysis method was conducted to verify the validity of the measurement items, and the rotation method of the factors was the Varimax rotation method. Push consisted of ease of use, price benefit, and versatility. Pull, includes relative advantage, reliability, subjective norm. Prior to factor analysis, the KMO (Kaiser-Meyer-Olkin) value, an index to verify whether the data is suitable for factor analysis, was 0.789, and the Bartlett value was 3,926.270, with a significance probability p = 0.0000, indicating that the selection of variables for factor analysis was appropriate and was able to verify. In the process of factor analysis, the standard factor loading values for 'The SPS mainly used is not easy to operate', 'Payment can be made anytime, anywhere using the SPS mainly used', and 'I want to switch to other SPS that offers more discounts' were set to less than 0.6. The results are shown in Table 3.

Three questions were removed because they were not satisfied, and the three pull factors, three push factors, two mooring factors, and switching intention were measured with a total of 28 questions. As a result of the reliability analysis, the Cronbach α values were all above 0.6, confirming that they had internal consistency. The results are shown in Table 3.

Discriminant validity verifies whether one latent factor is statistically significantly distinguished from other latent factors. By comparing the correlation square and average variance extraction value (AVE) of the two latent factors, discriminant validity can be secured if the correlation square value is lower than the average variance extraction value (Fornell & Larcher, 1981).

As a result of this study, it was found that the average variance extraction (AVE) of all measurement factors exceeded the standard of 0.5, and the value of the correlation square of each factor was smaller than the average variance extraction (AVE), indicating that discriminant validity could be verified in Table 4.

Prior to hypothesis testing between the measured factors, the goodness of fit for the research model was verified. As a result of the verification, x^2 = 557.220, degrees of freedom (df) = 339, p = 0.000, and absolute agreement was verified with CMIN/DF = 1.676, GFI = 0.859, and RMSEA = 0.052. In addition, NFI=0.845, IFI=0.942, TLI=0.934, and CFI=0.941, which are intermediate fit measurement scales, were derived. It indicates that the model fit was good overall. In this study, a total of three hypotheses were set and analyzed to examine the influence relationship of Push, Pull, and Mooring Factors on conversion intention, and the effect relationship is shown in Tables 5 and 6.

Table 3. Confirmatory Factor Analysis and Reliability Analysis

Variable	No.	Exploratory Factor Analysis			Cronbach's α	Confirmatory Factor Analysis	
		Factor Loading	Eigen Value	Cumulative %		AVE	CR
Ease of Use	EU2	.795	1.529	65.955	.871	.730	.888
	EU3	.917					
	EU4	.900					
Price Benefit	PB1	.787	3.747	35.708	.831	.558	.833
	PB2	.842					
	PB3	.847					
	PB4	.759					
Versatility	VS2	.862	1.006	78.718	.782	.646	.784
	VS3	.870					
Relative Advantage	RA1	.881	3.174	47.045	.887	.724	.887
	RA2	.850					
	RA3	.835					
Reliability	RE1	.705	6.252	22.327	.900	.698	.902
	RE2	.851					
	RE3	.829					
	RE4	.810					
Subjective Norm	SN1	.836	1.648	60.494	.889	.729	.890
	SN2	.871					
	SN3	.865					
Inertia	IN1	.858	2.118	54.609	.884	.722	.886
	IN2	.897					
	IN3	.835					
Innovation Resistance	IR1	.751	1.190	75.125	.813	.611	.822
	IR2	.849					
	IR3	.862					
Switching Intention	SI1	.831	1.378	70.876	.811	.615	.825
	SI3	.807					
	SI4	.748					
KMO(Kaiser-Meyer-Olkin)						.789	
Bartlett' Test of Sphericity				Chi-Square		3926.270	
				df(p)		378(.000)	

Notes: 1. Criteria: AVE>0.5, CR>0.7.
2. AVE: Average Variance Extracted, CR: Composite Reliability.

Table 4. Discriminant Validity and Correlation Matrix

Factor	1	2	3	4	5	6	7	8	9
1. EU	.854								
2. PB	.148*	.747							
3. VS	.407	.218	.803						
4. RA	.118	-.030	.156	.851					
5. RE	.223	.048	.288	.536**	.835				
6. SN	-.026	.032	.117	.390	.481	.854			
7. IN	.291	-.035	.130	-.107	.039	-252	.849		
8. IR	.033	-.148	-.009	.103	.102	.040	.490	.781	
9. SI	.197	.124	.224	.408*	.571**	.389	.017	.203	.783

Notes: 1. *p*-value: *<0.05 and **<0.01.
2. Diagonals (in bold) reflect the square root of AVE.

Table 5. Model Fit Results

Index	CMIN(χ^2)	CMIN(χ^2)/df	RMSEA	GFI	AGFI	NFI	IFI	TLI	CFI
Results	557.220 (.000)	1.702	0.052	0.859	0.831	0.845	0.942	0.934	0.941
Criteria	p≦0.05	1.0≦χ^2/df≦2.0	≦0.05	≧0.8-0.9	≧0.8	≧0.8	≧0.9	≧0.9	≧0.9

Hypothesis 1, "Push factor will have a significant effect on switching intention", was adopted as β=.677 and p=0.033. In other words, the more negatively evaluated ease of use, price benefit, and versatility, which are push factors, the more the switching intention was statistically significant.

Hypothesis 2, "Pull factors will have a significant effect on switching intention", was adopted as β=.977 and p=0.000. It was found that the higher the 'alternative attractiveness', 'reliability', and 'subjective norm', the sub-factors of the pull factor, the more the switching intention was statistically significant.

Hypothesis 3, "Mooring factor will have a significant effect on switching intention", was adopted as β = .318 and p = 0.026. In other words, the higher the mooring factors (high inertia and high innovation resistance), the greater the switching intention, statistically. The results of the analysis showed that the more habitually used and the more reluctant to change, the higher the conversion intention. Statistically, the results of the analysis were significant, but contrary to the expected hypothesis.

Table 6. Structural Analysis Results

Hypothesis	Path			Path Coefficient	S.E.	C.R.	p-Value	Result
H1-1	PULL	→	SI	.677	.318	2.129	.033**	Supported
H1-2	PUSH	→	SI	.972	.150	6.488	***	Supported
H1-3	MOORING	→	SI	.318	.143	2.227	.026*	Supported

Notes: 1. *p*-value = *** < 0.001.
2. S.E.: Standard Error; C.R.: Critical Ratio.

VI. Conclusion

This study was conducted to analyze the factors influencing the switching intention of multiple users among Generation Z for SPS. In particular, in this study, when Apple Pay enters the already competitive SPS market, we try to understand why and how users will switch to a new simple payment service. In addition, by analyzing the influencing factors, we intend to present effective research results and implications for the SPS market, which is forming a fierce competition.

The results obtained through hypothesis testing are as follows. First, the factors of the PPM model (Push, Pull, Mooring) were all found to have a statistically significant effect on switching intention. Specifically, the push factor was found to have a positive (+) effect on switching intention. It was found that the intention to switch to other SPS is increasing. The pull factor also appeared to have a positive (+) effect on switching intention. In other words, if the relative advantage of other SPS is high, if other simple payment services give greater reliability and trust, and if people respond favorably to other SPS, there is a high willingness to switch. Finally, the mooring factor was shown to have a positive (-) effect on switching intention. In other words, it was found that the intention to switch to other SPS was high, even though consumers habitually used it or were reluctant to change.

These results show that users in their twenties habitually use SPS, but have high intentions to switch to other SPS, even if they feel the change to other SPS is cumbersome. It is interesting to note that the analysis results showed that, even if it is cumbersome and reluctant, they will switch to other SPS because their satisfaction with the current SPS is low and the attractiveness of other SPS is high.

Second, the academic implications are as follows. The PPM (Push-Pull-Mooring) model is a migration model that is effective in identifying the antecedent factors of switching intention and is used in many studies. Although it is partially used in studies that reveal the switching intention from physical card use to SPS use, this study identifies sub-components of the PPM model for multiple users of SPS. There is a lack of studies analyzing the influencing factors for switching from one SPS to another. Therefore, this study is meaningful in that it applied the PPM model to multi-users of SPS and verified the relationship between major influencing factors and switching intention. Existing studies have moved away from using variables in the technology acceptance model, such as ease of use and usefulness, and this research adopted price benefits and versatility as new major constituent concepts in addition to ease of use in the push factor. In addition, it has academic significance in conducting a study by introducing the reliability of payment institutions, in addition to relative advantages and subjective norms, in the pull factor.

Third, the practical implications are as follows. In this study, the pull factor had a greater influence

on conversion intention than the push factor. It was found that the reliability of other SPS, relative advantages, and favorability of acquaintances affected the intention to switch. Interpreting these analysis results, there are many Apple phone users in the case of multi-users in their 20s, and the ease of use, price benefits, and versatility of the previously used Kakao Pay or Naver Pay were not high. They did not use SPS offline. If Apple Pay enters the market, it is expected that even if they think that it is a cumbersome to change a habitually used SPS, they are highly likely to switch to Apple Pay. In addition, it is said that versatility that enables convenient offline payment is secured, and it is highly likely that Kakao Pay or Naver Pay will be converted to Apple Pay. Confidence in Apple in their 20s, relative attractiveness, and the favorability of people around them are expected to have a direct impact on intention to switch. Accordingly, SPS providers need to provide convenience, versatility that can be used offline, and price benefits to prevent deviation from their service. It is also important to ensure the credibility of the payment institution.

On the other hand, the limitations that appeared in the process of conducting this study are as follows. First, since the survey was conducted only for college students in their 20s that used more than one SPS through the online survey, it is judged that there is a limit to generalization of the data. Therefore, in future studies, it is necessary to supplement the validity of the generalization of the model targeting respondents of various ages. In addition, in order for the model to have theoretical validity, it provide be a more meaningful analysis if the theoretical validity is established through comparison between Korea and China by comparing the analysis results to Chinese college students in their 20s at a future time.

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New Trade Protectionism Response to COVID-19: An Investigation on Firm Export Performance in an Emerging Country*

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ABSTRACT

Purpose – Given the significance of concerns raised about the global shift toward protectionism under trade policy uncertainty context, and echoed by requests to contribute to issues that concern a wider variety of stakeholders, this study aims to review new trade protection measures in response to the pandemic crisis and their effects on export performance from an emerging country's exporters.

Design/Methodology/Approach – Research data were gathered by surveying 613 export managers of different types of exporters in Vietnam from a list of exporters provided by Ministry of Industry and Trade, and then applied a regression model for analysis.

Findings – The study demonstrated a negative relationship between firm export performance and six trade protectionism measures, including industrial subsidies, public-procurement restrictions, FDI restrictions, standards protectionism, green protectionism, and regional integration. Only restrictions on migrant workers had no appreciable impact on firm export performance. Additionally, only employee number, out of the three control factors, significantly and positively affected how well firms succeed in exporting.

Research Implications – The study's findings have significant ramifications and contributions to theory and practice in international trade for an emerging country to overcome new trade protectionism measures. To support firms in expanding export markets, the government of an emerging country should concentrate on establishing and developing policies to support exporters, especially small and medium enterprises. Firms should pursue a sustainable export strategy in light of the emergence of new trade protectionism in significant import markets.

Keywords: emerging country, export performance, new trade protectionism, pandemic crisis, Vietnam
JEL Classifications: F13, F23, F68

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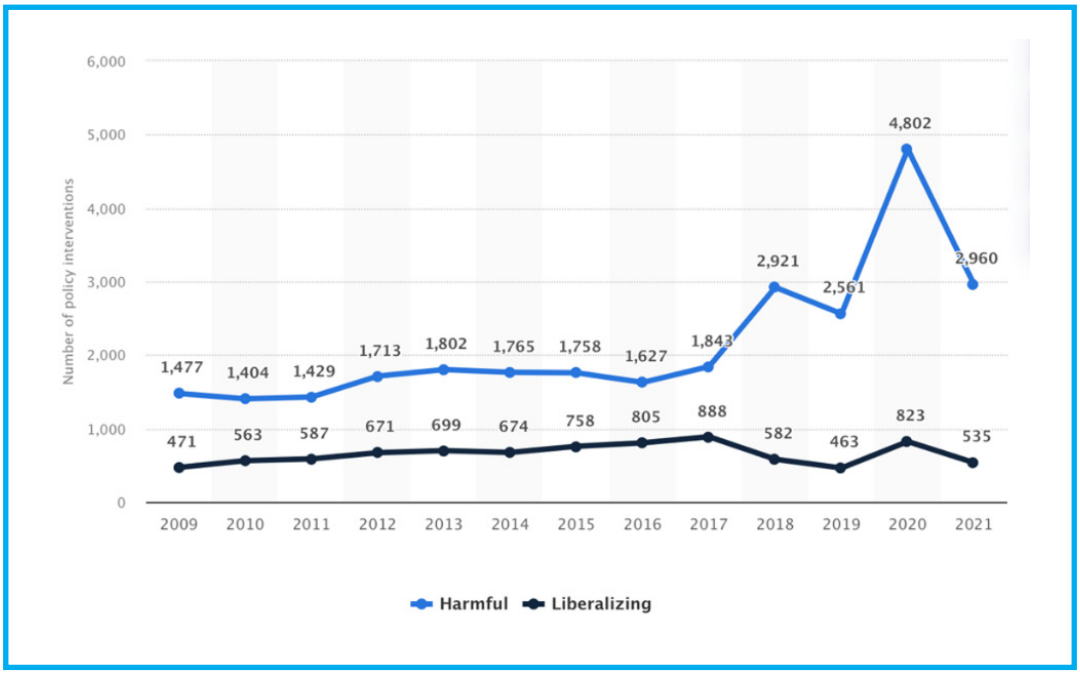
I. Introduction

Protectionism and anti-globalization sentiments have risen over the past few years (Hatzigeorgiou et al., 2021), especially after COVID-19 (Qin et al., 2020). However, trade liberalization, such as trade agreements and frameworks, is intended to abolish tariffs and border checks to facilitate seamless, efficient, and free trade (Tam, 2019). The number of policy interventions enacted globally has increased dramatically from 2009 to 2021 compared to the number of liberalizing trade policies, which has caused a considerable shift in the global economy toward more extraordinary protectionism measures. Notably, during the pandemic crisis from 2019 to 2021, the gap between harmful and liberalizing policy intervention was maximized (Fig. 1). With 7,376 policies enacted during this period, the United States led China with 5,915 identical policies. These policies were deemed harmful to the liberalization of international trade (Statista, 2022). The most commonly used protectionism measures included subsidies (excluding export subsidies), export-related measures, tariff measures, contingent trade-protective measures, and trade-related investment measures (Statista, 2022).

Fig. 1. Number of Harmful and Liberalizing Intervention Policies in International Trade from 2009 to 2021



Source: Statista (2022).

These new restriction measures, which are increasing, more complex, lack transparency, and are arbitrary to apply, have a significant and negative impact on global trade, especially in times of crisis (Erixon & Sally, 2010; Ghibuţiu, 2014). This is further illustrated by global trade data in the two most recent crises: the global financial crisis and the COVID-19 pandemic. UNCTAD (2015) stated that world trade rebounded substantially after the global financial crisis in

2010 and 2011. However, since 2012, global trade growth has lagged behind GWP growth, and has been even more anaemic. Also, WTO (2016) assessed that "*the ratio of merchandise trade to GDP [...] in 2012-2014 declined gradually, before falling significantly in 2015*". Similarly, as a result of the COVID-19 pandemic, the value of worldwide merchandise exports decreased by 8% in 2020, while trade in services decreased by 21% (WTO, 2021b).

Furthermore, trade protectionism has expanded worldwide, and will continue to do so in developed and developing nations (Sica & Durusoy, 2015). In EU member countries, foreign exporters still struggle to enter this market due to barriers such as local partner requirements, entry restrictions, licensing procedures, and technical licenses. Since 2018, the USA has undertaken a variety of protectionist trade policies that have strained relations with other major economies and sparked a "trade war" with China (Steinberg & Tan, 2022). New trade protectionism has also emerged in critical Asian markets. In Japan, new trade protection measures have been introduced, such as administrative procedures for importers, abuse of customs procedures, product standards, and inspection and certification regulations unique to Japan. Additionally, South Korea regulated and staged the exporting of some goods, including rice and steel. On the other hand, the South Korean government supported domestic production by lowering taxes and providing funds and low-interest loans to help small and medium-sized firms, R&D, and environmental protection. Thailand, Singapore, and Indonesia also implemented non-tariff trade protection measures in the ASEAN region, such as import restrictions on specific industries, export bans on minerals, and increases in the authority and responsibility of ministers by enabling them to influence and manage trade policies.

Concerns have been raised about the future viability of trade liberalization due to the global shift toward protectionism (Steinberg & Tan, 2022), particularly in trade policy uncertainty context (Liu et al., 2022). Thus, recent studies have gradually emphasized trade protectionism research. The extant literature on trade protectionism is diverse, with one camp concentrating on its political economy (Nkemgha et al., 2022), and the other on the effects of trade protectionism. The latter camp has examined the impact of trade protectionism not only from macroeconomic effects (Barattieri et al., 2021), like its impact on the country's economy (Ahmad et al., 2021; Fajgelbaum et al., 2020; Potrafke et al., 2022), on foreign direct investment (Luo et al. 2019), or the administration's policies (Astrid & Soto, 2018; Kee et al., 2013; Smith & King, 2020), but also from industry effects (Ahmad et al., 2021). Furthermore, different aspects of trade protectionism, like digital protectionism (Aaronson, 2018) or green protectionism (Scientific et al., 2014), have also been studied. The extant literature assumes that trade protectionism has a significant and negative impact on macroeconomic growth, and implies specific policies for different countries without considering the trade protectionism measures themselves and their effects on export performance of exporters. Remarkably, this line of investigation has ignored firm responses to trade protectionism in a crisis (Evenett, 2019; Sica & Durusoy, 2015), especially in emerging economies (Luo et al., 2019).

Exports play a significant role in an emerging country like Vietnam. Thanks to the progress of global economic integration over the last two decades (Nguyen, 2016), Vietnam has doubled its exports over the past several years. The expansion of trade protection measures, thus, has a significant impact on Vietnam's economic development, and requires studies to prove this effect on Vietnam's export performance. Furthermore, since the 2008-2009 global financial crisis, new trade protectionism has emerged and has more influence on an export-oriented and emerging country like Vietnam. However, foreign trade suffered less during COVID-19 and bounced back more quickly than during the global financial crisis (Stephens et al., 2022; WTO, 2021a). How firm export performance responds to new trade protectionism and the pandemic crisis is still a question for all

Vietnamese exporter managers and policymakers.

Hence, by reviewing new trade protection measures in response to the pandemic crisis and their impacts on export performance from an emerging country's exporters, this study addresses contemporary issues in international trade and establishes future research and practice implications for policymakers, practitioners, and academic scholars. By doing this, this study echoes requests of contributing to issues that concern a wider variety of stakeholders, from international business and trade scholars (Rammal et al., 2022).

The study is organized as follows. Section 2 provides a conceptual framework of new trade protectionism and hypotheses development. Section 3 presents the research methodology. Section 4 reviews the empirical research results. Section 5 discusses the research contributions and implications, and the last section contains the conclusion, limitations, and future research.

II. Literature Review and Hypotheses

1. Trade Protectionism

Import restrictions or, more generally, trade restrictions, are commonly linked to the concept of protectionism. Irwin (1996) asserted that protectionism was both a political philosophy and a legal policy, while Evenett (2019) considered protectionism from several aspects, trade restrictions in goods, import restrictions in goods, and governmental intervention, namely, taxing imports.

Trade protectionism is seen from two different angles in the literature. The first alleges that trade protection reduces the competitiveness of imported goods and leverages national resources (Rammal et al., 2022). Due to the potential for internalization and competition, domestic firms may profit by bolstering and increasing market positions at home. Nevertheless, from a different angle, several countries note that the advantages of imports do not seem to balance the harms they produce to domestic productivity (Gandolfo, 2014). Increasing trade protection can lead to severe consequences, such as imbalances in the market. In the long term, this can lead to high costs, especially for countries applying protection measures. Supporting domestic industries, including direct or relief assistance, does not reduce costs for enterprises. At the same time, efforts on tariffs or anti-dumping duties and anti-subsidy taxes boost the prices of goods and services compared with those gained by liberalizing trade. It has been noted by (Ottaviano et al., 2009) that domestic protection measures will only be helpful temporarily. In the long term, they will hinder the self-shifting of resources, leading to high long-term costs in improving production efficiency and boosting international competition. Protecting firms will reduce product richness, increase market power, and sacrifice consumer interests.

Rising trade barriers have historically influenced all countries, but have especially affected those that have protectionist policies in place. Hence, in recent decades, governments have moved to promote global trade to promote economic integration. Traditional trade protection measures like tariffs and import quotas have dramatically decreased in recent decades because of the growth of bilateral and multinational free trade agreements (Gandolfo, 2014). However, since the world economic recession of 2008-2009, new trade protectionism has emerged, especially in developed countries and important import markets; the frequency of trade investigations on this issue is increasing quarter by quarter (Erixon & Sally, 2010). Additionally, in 2018, the United States implemented numerous waves of tariff increases after more than 50 years of spearheading efforts to remove international trade barriers. Because of the sizes of the involved countries, the magnitude of the tariff increases (Fajgelbaum et al., 2020) especially in this time of new trade protectionism. Since new trade protection measures frequently lack transparency, it is challenging to determine their effectiveness. The developed and/or significant importing nations emphasize once more that the purpose of applying trade restrictions

is to safeguard domestic goods producers and consumers. As a result, they frequently introduce additional trade protection measures like industrial subsidies, public procurement, FDI restrictions, and standards for quality, hygienic conditions, workplace safety, and environmental protection. Industrial subsidies, public-procurement or "buy-national" restrictions, migrant worker restrictions, FDI limits, standards protectionism, green protectionism, and regional integration as trade protectionism are well-known new trade protection instruments (Erixon & Sally, 2010; Ghibuţiu, 2014).

2. Industrial Subsidies

Local governments utilize the "industrial subsidies" measure most commonly when determining trade policy. Subsidies, tax breaks, lowered interest rates, investments, or export credits can all be used as assistance. Local governments specifically employ tax and non-tax measures, such as tariffs, the domestic tax system, import and export licenses, quotas, and technical measures to restrict the import of products. Export taxes, sales taxes, income taxes, domestic currency exchange rates, and export subsidies are all reduced or waived for domestic producers. These industrial subsidies are frequently implemented in response to international competition (Gandolfo, 2014).

Although governments frequently state justifiable goals when putting support programs into place, these initiatives can give domestic firms a competitive edge. Due to the destruction of fair competition in free trade, industrial subsidies are viewed in these situations as trade obstacles for foreign companies (Bajona & Kelly, 2012; Erixon & Sally, 2010). Domestic firms have two options; they can speculate by manipulating the pricing of their goods (or services) in a way that benefits them most, or they can take no action and have little incentive to raise the quality and cost of their products. Based on the previous study, we suggest the following first hypothesis regarding the effects of industrial subsidies on exporters, even though consumers sustained the most long-term harm (Bajona & Kelly, 2012).

H1: The industrial subsidies of the host country have a considerable and detrimental impact on the export performance of foreign firms.

3. Public Procurement or "Buy National" Restrictions

Public procurement, or the systematic purchase of goods and services by the public sector, is a significant driver of market demand, and often contributes significantly to government spending and GDP (Dai et al. 2021). When the government gives special privileges to domestic suppliers, this implies a "buy local policy" (Mougeot & Naegelen, 2005). Such a policy might take many forms, including local content restrictions, the exclusion of international providers, and preferential pricing for domestic producers. The "Buy American Act", regarded as a component of the US fiscal stimulus strategy, is a typical example of this trade protection. Similarly, China has adopted the phrase "Buy Chinese Act" to promote domestic economic growth throughout its provinces. Therefore, we support the idea that a host country's public procurement policy can limit its import of goods and services from foreign partners, despite potential adverse effects.

H2: The policy on public-procurement restrictions of host country influences has a considerable and detrimental impact on the export performance of foreign firms.

4. Restrictions on Migrant Workers

Despite the incredible improvement over the past few decades, millions remain in abject poverty. About 25% of people wish to relocate permanently (Chiswick & Miller, 2015). As a result, many nations have implemented restrictive policies for migrant workers to preserve domestic worker employment (Erixon & Sally, 2010). For instance, the US government restricts H1B visas

granted to foreign nationals employed by relief banks. The European government controls and oversees foreign laborers by issuing rigorous work licenses. Therefore, constraints on migrant worker policies give domestic employees job opportunities. It also results in fewer opportunities to attract highly-qualified foreign workers, which can be a crucial human resource for R&D and domestic economic development. The primary link between migrant workers and exports may be related to the consumption of items produced by the host country. This may be relatively limited, but we propose that restrictions on migrant workers can influence domestic imports.

H3: Restrictions on migrant workers in host countries have a considerable and detrimental impact on the export performance of foreign firms.

5. FDI Restrictions

As indicated by FDI deregulation, strong financial investment incentives, and the ratification of international agreements, countries have been increasingly able to access FDI (Pandya, 2016). However, FDI can negatively influence national security, indigenous industries, and labor, even if governments still seek to attract it for economic and technical development (Thangavelu et al., 2021). Regarding imports, FDI may involve importing equipment, products, and services from the foreign nation serving as the FDI host country. Therefore, FDI restrictions can be seen as adequate safeguards for domestic manufacturing and limiting the import of related goods, services, and machinery. Governments are increasingly tightening these regulations in light of recent crisis recovery and the emergence of environmental protection (Erixon & Sally, 2010). The new foreign investment limit is most prevalent in the energy industry. South America, Europe, and Australia are currently concerned about sovereign wealth funds in developing countries and the internalization of their SOEs, notably those in China. Restrictions on FDI from China have been tightened in recent years in several countries, including the US, Japan, and established EU countries (Ghebrihiwet & Motchenkova, 2017). Hence, we can propose that:

H4: The FDI restrictions of the host country have a considerable and detrimental impact on the export performance of foreign firms.

6. Standards Protectionism

Importing nations frequently impose restrictions on imported products and services, such as regulations for a specified percentage of domestic raw materials to be used in the manufacture of commodities, or safety, marketing, labeling, and packing requirements (Gandolfo, 2014). These standards negatively impact imported goods and services, whereas those domestic are not affected. Although these standards are established for social benefit, importing nations frequently make a difference by applying restrictions to imported goods and services more stringently and more difficultly than those indigenous. Standards protectionism is anticipated to grow and become more sophisticated as technology, living standards, social forces, and environmental conditions improve and evolve rapidly (Erixon & Sally, 2010). Trade protection measures based on technical and food safety requirements have been implemented since the global financial crisis started. Certain agricultural items from Europe are forbidden in China. India has imposed stricter standards on imported goods, including iron, steel, fiber, soybean oil, and aluminum.

On the other hand, the EU and US also forbid the entry of Chinese toys, phones, and cattle. Over 500 commodities are subject to pre-shipment censorship procedures in Indonesia, and only six seaports and international airports are authorized to import these items. The WTO has underlined that since the global financial crisis and COVID–19 pandemic, there have been considerable increases in technical trade obstacles (WTO, 2021b). According to the WTO, this measure will restrict imports more frequently as the economy weakens. Thus, we assume that:

H5: Standards protectionism has a considerable and detrimental impact on the export performance of foreign firms.

7. Green or Environmental Protectionism

Many people in highly industrialized nations are concerned about the damaging effects of increased free trade on the environment (Bechtel et al., 2012). Hence, green or environmental protection has recently become popular (Lottici et al., 2014). Many nations went through a time of both rapid economic growth and ecological pollution before an era of environmental protection. The process of "moving to a green economy" begins as the nation becomes wealthier and has the appropriate material, technological, and financial circumstances for investing in wastewater treatment systems, enhancing regulations, and taking other pollution control measures. Countries tend to focus more on enhancing the quality of life when living standards rise, such as by improving clean air and water. As levels of education rise, they will start to demand more and put pressure on industries and governments to clean up the environment (Levinson, 2017). The green protectionism of importing nations is used against exporting countries that pollute while producing their goods. Despite several nuanced arguments, importers contend that the environment of producing and consuming nations must be safeguarded from the destruction of natural resources and the environment caused by the manufacturing of commodities in the host nations and/or by the consumption of imported goods (Levinson, 2017; Ritzel & Kohler, 2017). Environmental protectionism has two advantages; it is more legal in the eyes of the community, and it can be applied flexibly (Bajona & Kelly, 2012; Lottici et al., 2014). However, environmental protectionism is an export barrier (Isip et al., 2022; Kahiya, 2018), and it may slow economic growth (Peng et al., 2020). Hence, we hypothesize that:

H6: Green or environmental protectionism has a considerable and detrimental impact on the export performance of foreign firms.

8. Regional Integration as Trade Protectionism

Previous research cited several reasons for regional integration (Schneider, 2017). Regional trade agreements are another tool that enables nations to protect regional trade. These actions appear to be the only legal means for countries to build their local brands without opening markets to outside competition. This also complies with international export promotion regulations while assisting indigenous industries.

Regional integration-based trade protectionism can have various adverse effects on global commerce. Regional integration policy might increase the danger of trade disputes with third-party countries by establishing preferential regulations incompatible with the norms of the WTO. When the members of the regional integration adopt the principle of discrimination, third nations, especially developing countries, risk greater marginalization (Abida, 2013). Regional integration policies also increase the distance between various regions geographically. Economic nationalism and protectionism pose risks to the multilateral trading system. Therefore, we believe that trade protection regulations by a regional integration may negatively affect imports into member countries, particularly those originating from countries outside the region.

H7: The regional integration of the host country has a considerable and detrimental impact on the export performance of foreign firms outside the region.

III. Research Methodology

1. Variable Measurement

Export performance (*EXP*) is a dependent variable that is determined by how satisfied

Vietnamese export firms are with their performance in key international markets like the US, EU, Japan, South Korea, China, and ASEAN. Seven new trade protection measures identified in the theoretical framework are independent variables in this study: industrial subsidies (*INS*), public procurement restrictions (*PPR*), restrictions on migrant workers (*RMW*), FDI restrictions (*FDIR*), standards protectionism (*STR*), green protectionism (*GRP*), and regional integration (*RIN*) (Table 1).

Table 1. Measurements of Independent Variables

Variable	Items
Industrial Subsidies (INS) (Bajona & Kelly, 2012)	• Direct subsidies (INS1) • Indirect financial subsidies (INS2) • Tax exemption and reduction (INS3)
Public Procurement or "Buy National" Restrictions (PPR) (Mougeot & Naegelen, 2005)	• Policies and programs encouraging domestic consumption (PPR1) • Policies and programs against foreign goods (PPR2) • Priority legislation and monopoly for domestic actors (PPR3) • Financial priority policies for domestic actors (PPR4)
Restrictions on Migrant Workers (RMW) (Chiswick & Miller, 2015; Erixon & Sally, 2010)	• Immigration restrictions (RMW1) • Restrictions on migrant workers (RMW2) • Restrictions on foreign workers (RMW3)
FDI Restrictions (FDIR) (Erixon & Sally, 2010; Thangavelu et al., 2021)	• FDI Restrictions in industries of export products (FDIR1) • FDI Restrictions in input and output industries of export products (FDIR2) • FDI legislation on tax, fee on revenue, and profit of foreign investors (FDIR3)
Standards Protectionism (STR) (Erixon & Sally, 2010)	• Biosafety standards (STR1) • Chemical safety standards (STR2) • Standards on conditions of production, farming, and fishing areas (STR3) • Labeling and packaging standards (STR4)
Green Protectionism (GRP) (Bajona & Kelly, 2012; Levinson, 2017; Lottici et al., 2014; Ritzel & Kohle, 2017)	• Rules on environmental protections (GRP1) • Rules on waste and pollution treatment (GRP2) • Rules on ecological balance (GRP3) • Rules on exploitation and usage of natural resources (GRP4)
Regional Integration (RIN) (Abida, 2013; Goff, 2019; Sally, 2006)	• Impact of FTAs in economic zones (RIN1) • Impact of FTAs in the geographic zone (RIN2) • Impact of traditional and neighborhood partnership (RIN3) • Result of similar behavior, consumption habits, and culture (RIN4)
Export Performance (EXP) (Do & Nguyen, 2020; Nadkarni & Narayanan, 2007)	• Financial export performance (EXP1) • Market export performance (EXP2) • Strategic export performance (EXP3) • Product export performance (EXP4)

To fully capture the characteristics of export firms, we also include three control variables in our regression model: firm age (*AGE*), substantial revenue (*RVN*), and employee number (EMN). All scales were evaluated using a continuous 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

2. Pre-testing and Translation

The survey questionnaire for this research was initially created in English, and then backward translated into Vietnamese (Mcgorry, 2000). An in-depth pre-test of the survey questionnaire was undertaken with five export managers from five exporters before the official survey. The pre-test's main goal was to evaluate the items' appropriateness, clarity, and understandability. In general, participants said they deeply understood the items' meanings. The researchers slightly modified the survey questionnaire's phrasing. Questions about the respondents, their firms, and items assessing the constructs make up the two primary components of the final survey questionnaire.

3. Collection of Data and Research Sample

The American Psychological Association's "Ethical Guidelines for Research with Human Subjects" and the Declaration of Helsinki's ethical precepts were strictly adhered to in this research. We surveyed Vietnamese exporters in significant international markets to test the proposed hypotheses. A mixed mode of paper and online data gathering approach was used to guarantee that the most important possible target sample could participate in the survey. The Ministry of Industry and Trade (MoIT) provides a list of Vietnamese exporters. It was filtered to only retain those with export activities in the US, EU, China, Japan, South Korea, and ASEAN markets. These are significant and critical markets in which Vietnamese exporters face new trade protectionism.

The researchers were able to reach out to these exporters with the assistance of Vietnam MoIT officers to engage them in the survey and learn more about their preferred method of questionnaire distribution. Through MoIT, questionnaires on paper were given out to participants. Respondents that chose the online approach received surveys via email. No financial incentives were offered, and participation in the study was voluntary. The survey's completion was regarded as "informed consent".

The respondents were made aware that the survey was only utilized for academic purposes, and their anonymity and confidentiality were guaranteed to lessen the common method bias (Podsakoff et al., 2003). Additionally, the researchers altered the survey questionnaire for various respondents by rearranging the constructs and survey items, which may have clouded respondent impressions of any direct connections between the constructs (Podsakoff et al., 2003).

656 responses were received over 6 months of surveys, from September 10, 2021, to March 10, 2022, including 289 paper-based and 367 online answers. 43 responses were disqualified based on the standards established by Hair et al. (2016) because they contained unresolved issues. Therefore, 613 responses in all were valid. The profile of surveyed exporters and respondents are displayed in Table 2.

Most export firms in the research sample range in age from 3 to 10 years. At 39.64 percent, joint stock companies (JSC) made up the most considerable portion, followed by private firms, FDI, state-owned enterprises, and other types. Exporters in the survey were typical of average size, with numbers of employees ranging from 50 to 299, accounting for 58.4% of the surveyed firms. Additionally, 56.77 percent of revenue falls within the range of 50 and 300 billion VND. This suggests that SMEs are the leading Vietnamese exporters in significant markets.

Table 2. Surveyed Firm Characteristics

	Freq.	%		Freq.	%
Firm Age	613	100%	Firm Type	613	100%
≤ 3 years	83	13.54%	State-owned	57	9.30%
3 to ≤ 5 years	210	34.26%	JSC	243	39.64%
5 to ≤ 10 years	162	26.43%	Private	136	22.19%
10 to ≤ 20 years	96	15.66%	FDI	67	10.93%
≥ 20 years	62	10.11%	Others	110	17.94%
Revenue	613	100%	Employees	613	100%
VND 5 billion	53	8.65%	≤ 50 persons	114	18.60%
5 to ≤ 50 billion VND	119	19.41%	50 - 99 persons	137	22.35%
50 to ≤ 100 billion VND	201	32.79%	100 -299 persons	221	36.05%
100 to ≤ 300 billion VND	147	23.98%	300-999 persons	112	18.27%
≥ 300 billion VND	93	15.17%	≥1000 persons	29	4.73%

4. The Regression Model

Concerning the regression model, it is formulated as:

$$Y = a_0 + a_1X_1 + a_2X_2 + ... + a_{10}X_{10} + \varepsilon$$

Of which, Y is the export performance (*EXP*) of the export firm in primary markets, including the US, EU, China, Japan, South Korea, and ASEAN markets.

$a_0, a_1, ..., a_{10}$ are coefficients to estimate.

$X_1, X_2..., X_7$ are new trade protection measures such as Industrial Subsidies (*INS*), Public Procurement Restrictions (*PPR*), Restrictions on Migrant Workers (*RMW*), FDI Restrictions (*FDIR*), Standards Protectionism (*STR*), Green Protectionism (*GRP*), and Regional Integration (*RIN*).

X_8, X_9, and X_{10} present firm characteristics such as firm age (*AGE*), revenue (*RVN*), and employee number (EMN).

ε is the error term.

IV. Results

All Cronbach's alpha coefficients are higher than 0.7 regarding variable measurement validity. Additionally, all KMO and Bartlett's Test results are significant at a 95% confidence level (Table 3). The created variables (first component) for all independent variables can explain more than 60% of the data. As a result, the research's variable measurement is valid.

The new protectionism against Vietnamese exporters in primary markets is the dependent variable in the model, according to the regression results in Table 4. Ten independent variables can influence the new protectionism against Vietnamese exporters in significant markets.

Table 3. Variable Measurement Validity

Variable	No. of Items	Cronbach's Alpha	KMO and Bartlett's Test		Total Variance Explained by first component (%)
			Kaiser-Meyer-Olkin Measure	Sig.	
INS	3	0.884	0.713	0.000	81.771
PPR	4	0.846	0.805	0.000	68.486
RMW	3	0.905	0.715	0.000	85.525
FDIR	3	0.929	0.759	0.000	88.312
STR	4	0.793	0.729	0.000	61.874
GRP	4	0.931	0.722	0.000	82.972
RIN	4	0.918	0.811	0.000	80.513
EXP	4	0.883	0.782	0.000	74.055

Table 4. Regression Results

	Unstandardized Coefficients		t	Sig.	Collinearity Statistics	
	B	Std. Error			Tolerance	VIF
(Constant)	-0.243**	0.086	-2.827	0.005		
INS	-0.270***	0.024	-11.433	0.000	0.604	1.656
PPR	-0.147***	0.027	-5.518	0.000	0.477	2.095
RMW	-0.023	0.019	-1.200	0.231	0.908	1.101
FDIR	-0.147***	0.025	-5.945	0.000	0.549	1.821
STR	-0.083***	0.019	-4.330	0.000	0.914	1.095
GRP	-0.212***	0.027	-7.944	0.000	0.472	2.121
RIN	-0.345***	0.026	-13.197	0.000	0.493	2.028
AGE	0.001	0.016	0.093	0.926	0.947	1.056
EMN	0.075***	0.019	3.885	0.000	0.913	1.095
RVN	0.014	0.016	0.844	0.399	0.941	1.063

R: 0.893 R Square: 0.797 Adjusted R Square: 0.794 Durbin-Watson: 1.687
Std. Error of the Estimate: 0.454 F: 236.497 Sig.: 0.000

Note: *Significant at $p<.05$; **Significant at $p<.01$; ***Significant at $p<.001$.

With a confidence level of 99%, the regression findings for industrial subsidies (*INS*) show a significant and adverse influence of this factor on the export performance of Vietnamese exporters in key international markets (β = -0.270 and Sig = 0.000). This supports the first hypothesis that export performance declines as protection policies are tightened and raised. In practice, many countries formulate protection policies to promote the expansion of domestic firms. These protection policies, in turn, make the market more competitive. As a result, Vietnamese exporters will experience more significant challenges in market competition, notably in the struggle over prices, while exporting to a country with strict protection measures. Recently, certain nations, including Japan, have implemented measures to help domestic firms, including currency devaluation and tax subsidies.

Additionally, several nations, like the US, South Korea, the UK, and others, introduced many new policies that impacted and decreased Vietnam's exports. By issuing two decrees, including an anti-unfair trade and an anti-dumping order, the US took decisive action to identify the root of trade deficits and alter its policy. Due to subsidized or unlawful subsidies, these two decisions have sped up the collection of anti-dumping duties and promoted high taxes on imported goods. Due to this, exporting items to the US market is now more challenging. Some challenges remain and inflict a significant burden on Vietnamese exporters, even though national policies and strategies have been implemented to manage and foster favorable conditions for firms.

With a confidence level of 99%, the regression results also show that public procurement or "buy national" restrictions (*PPR*) have a significant and adverse effect on the export performance of Vietnamese exporters (β = -0.147; Sig = 0.000). As a result, when governments enact policies that limit public procurement, export performance falls. This outcome aligns with Erixon and Sally (2010). The second hypothesis is therefore confirmed. Some nations enforce regulations that limit public procurement by promoting citizen use of domestically manufactured items. For instance, one of the provisions in the US fiscal policy during the economic slump of 2008–2009 was the "Buy American Act". China also uses the tagline "Buy Chinese Act", which is similar. All provinces of China have been instructed to adopt this motto. The government procurement agency is discouraged by this clause from purchasing foreign goods that China's indigenous industry might be able to produce. An internal audit must be set up to evaluate the procurement dossiers for items when central authorities want to buy a sizable quantity of imported goods. As a result, the need for imported goods is greatly diminished.

The regression results do not validate the third hypothesis concerning the restrictions on migrant workers (*RMW*). There is an insignificant impact of this factor on firm export performance with a confidence level of 95% (β = -0.023; Sig = 0.231). In fact, in important export markets such as China, South Korea, and Japan, policies on migrants are open. Japan and China even make favorable conditions for foreign workers. Contrary to some Asian markets, the EU and the US adopt a strict policy of restrictions on migrant workers. For instance, the US mandates domestic contractors to be engaged in projects and tightened visa requirements for skilled international workers. Even though different countries have different restrictions on migrant workers, this study proved that they do not affect the exporting activities of Vietnamese export firms to certain important markets.

At a confidence level of 99%, we discovered that FDI restrictions (*FDIR*) considerably and negatively affect the export performance of Vietnamese exporters (β = -0.147; Sig = 0.000). The fourth hypothesis is therefore confirmed. This result fully supports Erixon and Sally's (2010) findings. Accordingly, firm export performance declines significantly when foreign investment restriction policies of import nations are tightened. When countries impose restrictions on foreign investment, they lessen local firm chances to reach foreign exporter markets. Additionally, foreign investment restrictions impede the ability

to acquire knowledge for foreign exporters about the local export market, new technologies, and new business areas (Ghebrihiwet & Motchenkova, 2017).

According to the regression results for standards protectionism (*STR*), with a confidence level of 99%, standards protectionism has a significant and adverse effect on the export performance of exporters (β = -0.083; Sig = 0.000). The fifth hypothesis was proved; firm export performance declines when governments tighten protectionism standards. The truth is that exporters from transition countries like Vietnam have lower manufacturing conditions and product quality than developed countries. Therefore, it will be harder for these exporters to adequately meet all of the commodity standards set by the importing countries when these standard regulations rise in the export markets.

Green protectionism (*GRP*) influences significantly and negatively the export performance of Vietnamese exporters at the confidence level of 99% (β = -0.212; Sig = 0.000). This result confirms the sixth hypothesis and conforms to Levinson's (2017) and Ritzel and Kohler's (2017) findings. Investment in green production technology is also rather costly. Therefore, to meet the standards of green protectionism, firms in transition countries like Vietnam need enormous capital resources to renovate, improve production, and shift to environmental strategies (Do, 2022; Do et al., 2022).

Regional integration (*RIN*) also significantly and negatively influences Vietnamese export performance at the confidence level of 99% (β = -0.345; Sig = 0.000). This result validates the seventh hypothesis. Regional cooperation enables export firms from regional member countries to have more opportunities to access new markets in the region, mainly because of the removal or reduction of tariff barriers. However, the regional integration process affects the multidirectional trading system between the member country and the others outside its region.

Finally, among the three control variables, only employee number (*EMN*) has a significant and positive impact on the export performance of firms at a 99% confidence level (β = 0.075; Sig = 0.000). This implies that export performance will be higher if the exporter has a larger workforce. Vietnam is currently a transitional country with a young demographic structure and an abundance of working-age human resources. This makes it easier for companies to expand their product lines and raise the technical skill of their workers, ultimately improving the quality of export goods.

V. Research Contributions and Implications

Given the significance of concerns raised about the global shift toward protectionism under the trade policy uncertainty context (Liu et al., 2022; Steinberg & Tan, 2022) and echoed by the requests of Do (2022) and Rammal et al. (2022), this study aims to review new trade protection measures in response to the pandemic crisis and their effects on export performance from an emerging country's exporters. The study's findings have significant ramifications and contributions to theory and practice.

1. Theoretical Implications and Contributions

The extant literature has examined the effects of trade protectionism from various angles, including macroeconomic effects (Barattieri et al., 2021; Smith & King, 2020) and industry effects (Ahmad et al., 2021), but there is currently no research on firm effects. It has also examined trade protectionism from different aspects as digital protectionism (Aaronson, 2018) and green protectionism (Scientific et al., 2014), but only looked at a single measure of trade protectionism. The current research fills gaps in the existing literature by investigating comprehensive new trade protectionism measures as well as examining their effects at the firm level, particularly the impact on exporter performance. As a result, this study offers a thorough understanding of new

trade protectionism measures. The results of this research should be of interest to scholars that seek to comprehend the measures of new trade protectionism and the links of these measures to export performance.

By outlining various measures of new trade protectionism that affect export performance, this paper contributes to the literature on trade protectionism. The results demonstrate a negative relationship between export performance and six trade protectionism measures, including industrial subsidies, public-procurement restrictions, FDI restrictions, standards protectionism, green protectionism, and regional integration. Only restrictions on migrant workers had no significant influence on the export performance of firms. The results of this study highlight the significance of considering various new trade protectionism measures and their effects on export performance in future trade protectionism research.

Furthermore, nations that want to mitigate the adverse economic effects of a crisis have implemented both traditional and modern protectionist measures, but research on how businesses react to trade protectionism during a crisis is still limited (Evenett, 2019; Sica & Durusoy, 2015; Yoon & Ko, 2022). Therefore, this research sheds new light on the trade protectionism research stream by investigating the firm export performance response to recent trade protectionism during the pandemic, particularly in transition economies (Luo et al., 2019), which still lacks attention.

2. Practical Implications

2.1. Governmental Implications

In response to COVID-19 pandemic, developed countries are enacting new trade restrictions to restrict imports from other countries, though mainly from emerging countries. Therefore, the governments of emerging countries like Vietnam must take the necessary steps to protect their interests. One of the most effective strategies is participating in international forums and actively joining bilateral and multilateral free trade agreements (FTAs). When participating in FTAs on technical barriers, countries will receive necessary protection and assistance from all stakeholders to ensure fairness in international trade.

New trade protectionism exists in a variety of forms that are complex and challenging to identify and frequently change. Firms in transition countries often find it difficult to update and understand the new trade protections of importing countries. Therefore, emerging governments must provide them with sufficient information on export markets through specialized agencies on import protection. These agencies are tasked with collecting data related to trading protectionism rules that exporters impose on imported goods, especially for key markets and strategic export items.

To support firms in expanding their export markets, the government of an emerging country should concentrate on establishing and developing policies to support their exporters, especially small and medium enterprises. At the same time, the government should promote agreements and negotiations with developed countries to transfer technology to enable their firms to improve product quality and equipment to meet increasing quality requirements. This is an opportunity for export firms not only to improve production efficiency but also to reach out to foreign businesses, creating export cooperation in the future.

Integrating and aligning national quality standards with international standards is another essential development in the time of internationalization. Emerging countries are working to align new national standard systems with international standards for products to be accepted and consumed in every market in the world without the technical hurdles of trade protection.

Before exporting products, the governments of emerging nations should also set up quality control and technical requirements organizations. Export goods lack strict quality control which could result in returns, which damage the reputation of the exporting nation's products. To prevent items from being rejected, it is crucial to thoroughly check

export shipments to make sure they adhere to the quality, hygienic, and quarantine criteria of the import market.

2.2. Managerial Implications

The research results also highlight several managerial for managers. First, they should pursue a sustainable export strategy in light of the emergence of new trade protectionism in significant import markets. The aim of such a strategy is improving export quality and efficiency based on renovating modern technical equipment and applying advanced quality management measures, environmental standards, and international social responsibility in the production and export process. Second, to be aware of the trade obstacles, managers should thoroughly research and understand the import control policies of difficult export markets. The majority of exporters are those most adversely affected by challenges in import markets. Therefore, to address worries about increasing trade protectionism, such businesses must continuously learn about and completely comprehend the needs of export markets. Third, conducting market research and engaging in trade promotion activities will assist managers in deepening market penetration, combating new trade protectionism in import markets, and choosing the most promising export markets in accordance with prospective strengths. Additionally, employing distribution networks in foreign markets is a fantastic way to combat rising trade protectionism because distributors will be aware of the local market dynamics and offer practical answers for export-oriented businesses. Fourth, managers should actively invest in expanding technological capability, managing in accordance with international standards, and improving production. This mandates that exporters swiftly develop technical control systems in accordance with global norms and conform to accepted practices like ISO 9001: 2000, ISO 14001: 2000, and SA 8000. Fifth, the fact that a country's export markets frequently concentrate on a few key markets is one factor contributing to excessive trade protectionism. The overemphasis on these markets causes trade friction between export and import countries, which in turn forces import countries to impose stricter technical regulations to control the import of goods. In order to avoid needless trade friction and establish trade links with other nations to find development space for export activities, exporters should diversify and develop other markets in addition to major markets. Sixth, improving and expanding linkages, collaboration, and practical cooperation between domestic exporters and foreign exporters in export partners or import partners also helps combat new trade protectionism. It will be more advantageous for businesses to join alliances to overcome obstacles than it will be to engage in sporadic conflict. Considering collaborative ventures with international partners for product manufacturing or export may be another option. Exporters will find it simpler to access the market as a result of lessening the threat of new trade protectionism. At the same time, the practice shows that when trade disputes are related to anti-dumping and anti-subsidy policies, final judgments will also be more profitable for those exporters if there are foreign elements on the side of the exporting countries.

VI. Conclusion

Goods exported from emerging and/or important markets are subject to an increasing number of trade barriers. Notably, other new trade protection trends have emerged, differing in complexity and volume. In this study, we investigated and identified the negative effects of all seven new trade protection measures on the performance of export firms, including industrial subsidies, public procurement restrictions, migrant worker restrictions, FDI restrictions, standards protectionism, green protectionism, and regional integration as trade protectionism.

The results of this research should be of interest to scholars that seek to comprehend the measures of new trade protectionism and the links of these measures to export performance in

the age of COVID-19. This research sheds new light on the trade protectionism research stream by investigating the firm response to recent trade protectionism during the pandemic, particularly in Vietnam, one of the most notable countries among transition economies.

We discussed and offered relevant governmental and managerial implications for overcoming emerging trade protectionism based on the research findings. To support firms in expanding export markets, the government of an emerging country should concentrate on establishing and developing policies to support exporters, especially small and medium enterprises. Firms should pursue a sustainable export strategy in light of the emergence of new trade protectionism in significant import markets.

However, the research has some limitations. First, our research field was limited to Vietnamese firms in important export markets; thus, it will be fascinating to do the research in different export markets and contexts. Secondly, we could not compare the impacts of traditional and those of new protectionism on exports in this research. Hence, employing panel data in assessing the evolution of new trade protectionism as compared to those traditional will be a future research direction. Thirdly, in this research, we focused on new protectionism on exports from an emerging country; therefore, a comparison of protectionism's impact on exports from less-developed, developing, emerging, and developed countries will be interesting for governmental and managerial implications in the future.

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The Impact of Transformational Leadership and Transactional Leadership on Voice Behavior and Creative Behavior through Job Crafting

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ABSTRACT

Purpose – In the face of an increasingly competitive business environment and the growing complexity and dynamism of work activities, employee voice and creative behaviors are essential to organizational growth and survival. Consequently, this study examines how to increase voice and creative behaviors in organizational life using transformational leadership and transactional leadership as the entry points, and selecting job crafting as the mediating variable.

Design/Methodology/Approach – A hypothesized model was developed to examine the relationship between the constructs. The sample for the study comprised 364 Chinese employees. Data were analyzed using SPSS and structural equation modelling in AMOS.

Findings – Transformational leadership and transactional leadership positively impact job crafting, voice behavior, and creative behavior, complementing the existing theory. Furthermore, this study finds that through job crafting, transformational leadership has an enhanced impact on voice and creative behaviors.

Research Implications – Transformational leadership and transactional leadership are two separate and complementary types of leadership. Therefore, organizations should develop leaders that can flexibly use both styles to improve leadership effectiveness. Furthermore , the organization should pay more attention to employee job crafting, voice behavior, and creative behavior. Organizations or supervisors should appropriately grant employees work autonomy to respond to the rapidly changing external environment.

Keywords: creative behavior, job crafting, transformational leadership, transactional leadership, voice behavior

JEL Classifications: L20, M10, M12, M50

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I. Introduction

In the face of an increasingly competitive business environment and the growing complexity and dynamism of work activities, critical voice and ideas from employees are the keys to an organization's success, and this means that employee voice and creative behaviors are essential to organizational growth and survival (Dutton & Ashford, 1993).

Wittey and Cooper (1989) explained that voice and creative behaviors are emphasized in bringing about change in an organization, and are spontaneous and constructive behaviors of organization members. Griffin et al. (2007). proposed voice and creative behaviors as change from employee actions in building creative organizations in the context of individual tasks. Therefore, this study set voice behavior and creative behavior as dependent variables.

Furthermore, previous studies show that different leadership styles can directly influence voice and creative behaviors; for example, higher levels of moral leadership are positively related to the amount of voice behavior (Islam et al., 2019). Employees subjected to a highly inclusive leadership style will be more willing to propose voice behavior (Jiang et al., 2020). Issue leadership also influences the creative and voice behaviors of organizational members (Song, 2015). Chun (2021) used teachers as respondents and found that the stronger the perceived self-leadership, the more creative behaviors they had.

In China, in addition to hard power, leadership must have soft power and leadership skills to achieve better communication and negotiation with employees. The good qualities of transformational leadership align with the expectations of Chinese employees for upper-level leaders. Thus, adopting transformational leadership behaviors in Chinese companies will profoundly impact subordinate employees. Transformational leadership may lead to an increase in employee voice and creative behaviors.

Yukl (1994) argued that transformational leadership and transactional leadership were not two independent leadership styles, and Robbins (2001) argued that transformational leadership was built on top of transactional leadership. In addition, the same leader can use both transactional leadership and transformational leadership in different situations and times to enhance member motivation in the actual operation of the organization (Bass, 1985; Howell & Avolio, 1993). Hence, this study will explore the effects of transformational leadership and transactional leadership on voice behavior and creative behavior.

Moreover, transformational leaders not only motivate employees to engage in more meaningful work suggestions, but they also motivate employees to think beyond themselves to solve problems in new ways. Transactional leadership is a quid pro quo relationship in which the leader understands an employee's needs and commits to the required rewards, while the employee works to achieve their goals. According to social exchange theory, when employees receive resources and challenges from a transformational and transactional leader, they reward the leader in the future and show more proactive behaviors (Caesens et al., 2015), such as job crafting.

Although voice behavior and creative behavior are often viewed as 'Will Do' behaviors, they are influenced by individual differences in motivation. However, voice and creative behaviors are not only a matter of 'will' but also a matter of 'ability', because making meaningful and innovative suggestions to an organization requires a deliberate process by the individual (Detert & Burris, 2007; Morrison & Milliken, 2000). In other words, both voice behavior and creative behavior require specific competencies, and job crafting is seen as a self-transformation to actively improve one's business competencies. Hence, employees are likely to improve business competencies after job crafting, and at the same time, both the voice and creative behaviors are likely to improve.

Therefore, this study enables companies to grow sustainably in a rapidly changing environment to increase employee spontaneity, proactive voice behavior, and creative behavior. Transformational leadership was chosen as the independent variable,

which can motivate employees to go beyond their own interests. Unlike other studies, this study identifies transactional leadership as a separate leadership style, but not at the same extreme as transformational leadership, which positively influences speaking and creative action, as the independent variable.

This study also argues that the reason why members do not engage in voice and creative behaviors may be due to a lack of competence, in addition to reasons for an employee's own will. Therefore, job crafting was chosen as the mediating variable. Job crafting, voice behavior, and creative behavior are all bottom-up, positive actions that change how individuals work or the organization's status quo.

The results showed that transformational leadership and transactional leadership positively influenced job crafting, voice behavior, and creative behavior, and that transformational leadership had a more significant impact than transactional leadership. Furthermore, through job crafting, the influence of transformational leadership on voice behavior and creative behavior increased, and the effect of transactional leadership on voice behavior also increased.

II. Literature Review and Hypotheses

1. Transformational Leadership, Transactional Leadership and Job Crafting

Burns (1978b) first introduced the transactional and transformational leadership concepts in his book 'Leadership'. Transformational leadership stimulates employee motivational levels and personal needs to transcend themselves and achieve their goals. That is, transformational leadership inspires employees to trust and comply with the leader through their charisma. By making them aware of their tasks' primary meanings and responsibilities, they stimulate their higher-level needs, or expand their needs and desires. Thus, they cooperate and work together for the team's goals. They take interest in the organization beyond personal interests. Moreover, transformational leadership will enhance employee work meaning, happiness, and task performance (Ji & Wang, 2014; Kaewkitipong et al., 2023).

Burns (1978b) sees transactional leadership as a means for organizations to achieve their goals, in which leaders offer their knowledge and ideas to members to meet needs through compensation or rewards, and keep them focused on the work. According to Bass and Avolio (1990), transactional leadership emphasizes 'rewards and punishments' and 'getting what you do'. Li (2010) defined transactional leadership as supervisors motivating employee stakes, appealing to selfishness, empowering with motivation, and guiding obedience through appropriate compensation. Transactional leadership positively affects job engagement, psychological capital, job enthusiasm, and job satisfaction (Lee et al., 2012; Um et al., 2023).

Job crafting refers to spontaneous and proactive employee approaches to shaping work content to suit their motivations, interests, and skills, as well as proactive behaviors to solve work difficulties, including modifying work procedures (Ghitulescu, 2007). Job crafting is a spontaneous redesign of work based on employee self-interest to enhance employee engagement, satisfaction, recovery, and development (Tims & Bakker, 2010).

From the prior study, it appears that transformational leadership encourages organizational members to think about current situations or new problems with more diverse and innovative perspectives. It creates an atmosphere wherein employees can communicate and challenge current situations (Avolio et al., 1999). In addition to expressing the organization's future goals to employees, leaders also communicate and motivate the inner needs and ideas of employees. They are also open to providing support and resources to help employees achieve goals while giving sufficient autonomy and flexibility to adjust their work content. Therefore, employees under transformational leadership are in a high-quality

social exchange relationship. Their behaviors reflect a sense of mission and obligation to go beyond and change the status quo. They show strong motivation and behaviors to change the work status quo, such as actively seeking resources, learning new knowledge, taking the initiative to challenge new projects or breakthroughs with new methods of working, taking the initiative to adjust to work content, fixing unnecessary work requirements, and working more efficiently (Hetland et al., 2018).

Robbins (2001) argued that leaders can use both transactional and transformational leadership in different situations and times to enhance member motivation in the actual operation of the organization. Moreover, transactional leadership emphasizes the transactional relationship between the leader and the employee, which is mutually beneficial. This is the same as Burns (1978a), who pointed out 'exchanging one thing for another', and it is the same in the case of elections and sports. In other words, transactional business leaders bet financial rewards on employee productivity, and do not reward employees without productivity. Therefore, employees will voluntarily change the status quo and keep learning to earn a good reward. They will show strong motivation and behaviors to change the status quo to earn a corresponding reward when they meet a transactional leader.

Based on the above inferences, this study argues that employees under transformational leadership and transactional leadership exhibit more proactive work behaviors that change the status quo (job crafting). Therefore, we formed the following hypotheses.

H1: Transformational leadership has a positive influence on employee job crafting.

H2: Transactional leadership has a positive influence on employee job crafting.

2. Transformational Leadership, Transactional Leadership and Voice Behavior

Voice behavior comprises constructive suggestions from individuals to correct an organization's existing problems so that the organization's operations, management, or practices can be positively improved (Van Dyne & LePine, 1998). Proactive employee suggestions can enhance job engagement (Rees et al., 2013), promote interdepartmental cooperation (Daymond & Rooney, 2016), increase organizational responsiveness to environmental changes (Argyris & Schön, 1996), and enhance organizational performance (MacKenzie et al., 2011).

When leaders demonstrate a higher degree of transformational leadership, employees have a higher level of respect and recognition for their leaders, and are more willing to make suggestions to supervisors (Shamir et al., 1993). The transformational leader's attention to members and his or her needs at work will make employees feel valued and supported by the leader, which will increase willingness to express opinions to the leader, and reduce feelings of oppression and anxiety when making suggestions (Detert & Edmondson, 2005; Lee, 2022b). Howell and Avolio (1993) found that the more transformational leadership behaviors leaders exhibit, the more intrinsic motivation employees have, leading to more voices. Detert and Burris (2007) argued that transformational leadership is a "change-oriented" leadership behavior that encourages employees to express different ideas, and allows them to feel a higher sense of psychological safety by taking care of themselves. Transformational leadership also clearly explains the organization's and group's vision to employees, guiding employees to examine the work and the organization repeatedly. Furthermore, transformational leadership creates an atmosphere of open communication in the workplace, encouraging employees to present personal views and arguments in open discussions. Employees are more willing to make constructive proposals and voices (Liu et al., 2010).

According to Ji and Wang (2014), when leaders exhibit a contingent reward in transactional leadership, it promotes a rewarding and punitive atmosphere for the team, and transactional leadership also allows employees to be clearly

informed of organizational expectations, and employees will also engage in voice behavior to earn more rewards.

Based on the above inferences, this study argues that employees under transformational and transactional leadership exhibit more proactive work behaviors in making suggestions about the status quo (voice behavior). Therefore, we formed the following hypotheses.

H3: Transformational leadership has a positive influence on employee voice behavior.
H4: Transactional leadership has a positive influence on employee voice behavior.

3. Transformational Leadership, Transactional Leadership and Creative Behavior

Creative behaviors are the novel and valuable ideas that employees produce (George & Zhou, 2001). Creative behavior is also known as a type of out-role behavior, beyond the task requirements written in a job description (Park, 2021). Creative behavior goes beyond the mere generation of ideas and includes concrete practice and action (Lee, 2022a) Creative behavior can bring valuable products, services, manufacturing methods, and management methods to a company. Consequently, this study will explore how to increase the number of constructive and creative behaviors in organizations to help companies achieve sustainable development in a harsh and competitive environment.

In an organization, employees are motivated by charisma, actively notice the leader's behavior, and will learn from the leader. Through the influence of exemplary behavior, transformational leadership increases employee ability to conceive new ideas and positive ways of handling things. Moreover, transformational leaders deliberately stimulate employee talents and develop daily work abilities, encouraging them to play to their imagination and express unique ideas fully. Employees feel the genuine care of a transformational leader and are grateful. As a result, they are likely to be more focused on work and increase creativity. Because of this, transformational leadership can work positively with creative behavior.

Qu et al. (2010) argued that transactional leadership, emphasizing benefit exchange and material incentives, is less effective than transformational leadership. However, transactional leadership provides irreplaceable material conditions for promoting employees to improve their working methods and actively innovate. It helps establish a management mechanism with clear rewards and punishments and positively impacts employees' creative behavior. Hou (2017) targeted teachers as the subject of the study, found that head teachers could mobilize teacher achievement motivation, increase the sense of fair participation and job satisfaction, spontaneously pursue higher goals, and adopt innovative ways of working to improve the quality of teaching by establishing a transparent system of rewards and sanctions.

Based on the above inferences, this study argues that employees under transformational leadership and transactional leadership exhibit initiatives to engage in work behaviors that innovate the status quo (creative behavior). Therefore, we formed the following hypotheses.

H5: Transformational leadership has a positive influence on employee creative behavior.
H6: Transactional leadership has a positive influence on employee creative behavior.

4. Job Crafting, Voice Behavior, and Creative Behavior

Voice behavior is often viewed as a 'Will Do' behavior, influenced by individual differences in motivation. Although the willingness of the proponent is essential, voice behavior is not only a matter of willingness but also a matter of competence, as it is generated through a deliberate process by the individual (Detert & Burris, 2007; Morrison & Milliken, 2000). There are prior variables of job crafting, such as discretion, empowerment, and autonomy. They are naturally

extended to individual authorizations, and this means encouraging the individual to exert potential competence and creativity as much as possible (Ling & Chung, 2021). Thus, employees generate constructive ideas about business problems by enhancing competence. In other words, employees are likely to generate more voice behaviors when they can enhance work skills through job crafting.

Furthermore, Rank et al. (2004) argued that employees that engaged in job crafting are similar to creative behavior in that they drive more valuable change, echoing the need for innovation and change in modern organizations. Leana et al. (2009) argued that job crafting echoes organizational creativity, and that while job crafting is mainly at the individual level, there are creative and enthusiastic workers in organizations who often work in small collaborative groups to craft work. Because they are willing to embrace more change, they help managers drive organizational change (Kira et al., 2012). Thus, job crafting represents voluntary action by task-related employees, willing to accept responsibility and enthusiastic about improving organizational effectiveness, encouraging others to do the same.

Based on the above inferences, this study believes that employees that have undergone job crafting will exhibit more proactive job behaviors with voice that are creative about the status quo (voice behavior and creative behavior). Therefore, we formed the following hypotheses.

H7: Job crafting has a positive influence on employee voice behavior.

H8: Job crafting has a positive influence on employee creative behavior.

5. Mediating Role of Job Crafting

Tims et al. (2012) argued that transformational leaders motivate employees to change old job characteristics, and thus enhance the positive perceptions of the work. Furthermore, Duan et al. (2017) argued that transformational leaders encourage employees to break out of the current situation. Hence, they are more willing to take the initiative to craft work, actively learn new knowledge and skills to enhance capabilities, and seek exciting and challenging tasks to increase job enrichment. Then, they will use their voices and creative behaviors to adjust work content to avoid unnecessary resource consumption and maximize work effectiveness. Moreover, transformational leaders motivate employees to break out of the status quo with the company's future development so that employees realize the importance of change, and are motivated to engage in job crafting (Hetland et al., 2018). Employees improve their competencies by taking the initiative to engage in behaviors that contribute to job performance. Further, they will also be able to make the content of their work more responsive to their needs when changing the current situation according to their expectations, suggesting standard operating procedures. These can improve the organization, voice behavior, and creative behavior changes.

Based on Social Exchange Theory, transactional leaders give employees adequate rewards, incentives, promotion channels, and honors, and employees feel valued and nurtured by their leaders. To repay their leaders, employees take the initiative to learn, develop, and create meaning and value in their work: that is, job crafting. In the process of job crafting, employees redesign work processes following their personal preferences and values, meaning they adapt work patterns to their own needs, so that they take the initiative, from the bottom up, to initiate voice and creative behaviors.

Based on the above inferences, this study proposes that employees that engage in job crafting will show more proactive job behaviors (voice behavior and creative behavior) under transformational and transactional leadership. In other words, employees that engage in job crafting will have a mediating role. Therefore, we formed the following hypotheses.

H9: Transformational leadership is positively related to voice behavior via job crafting.

H10: Transactional leadership is positively related to voice behavior via job crafting.

H11: Transformational leadership is positively related to creative behavior via job crafting.

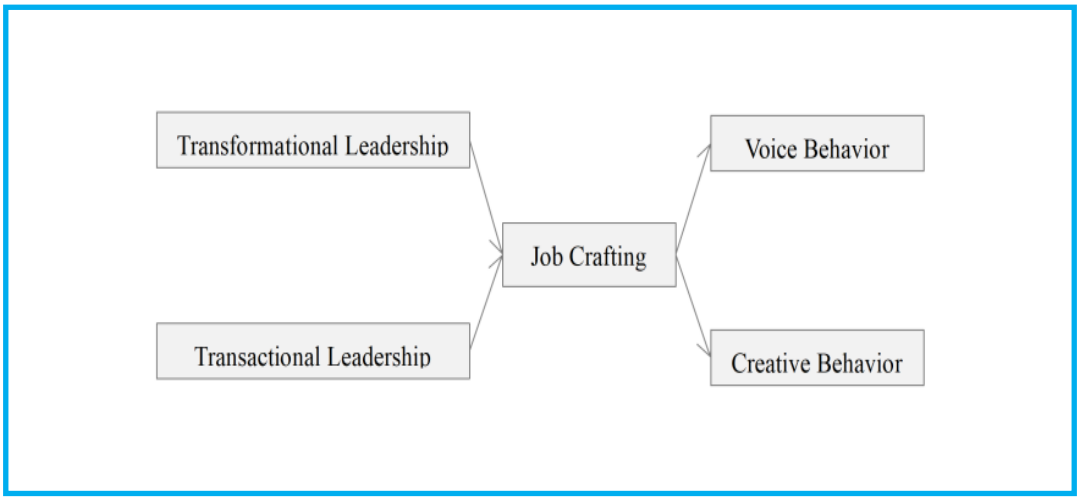
H12: Transactional leadership is positively related to creative behavior via job crafting.

III. Research Model and Analytical Methods

1. Research Model

In this study, the research model shown in Fig. 1 was set up to verify the influence relationship between transformational leadership, transactional leadership, job crafting, voice behavior, and creative behavior.

Fig. 1. Research Model



2. Sample and Procedure

We analyzed the data using SPSS 23.0, AMOS 23.0 and the bootstrap proceduce. Descriptive statistics were used to describe the respondents' demographic profiles, SEM (Structural Equation Modeling) was used to test the proposed hypotheses, and the bootstrap procedure was used to examine direct and indirect effects. This research spans from December 26th, 2022, to January 16th, 2023.

Our data collection instruments were initially developed in English. Following the procedure of translation-back translation, we translated all English measurements into Chinese. For all measurements, we utilized a 5-point Likert-type scale ranging from 1 (strongly disagree) to (strongly agree).

In addition, to ensure respondents could answer honestly, we promised that all data surveyed would be used for scientific research only, and told them personal information would be strictly confidential before questionnaires. This study took Chinese Beijing-Tianjin-Hebei Urban Agglomeration employees as respondents, sent 404 questionnaires to corporate employees nationwide, mainly via social media, and collected 364 questionnaires with a recovery rate of 90.1%. See Table 1 for specific demographic characteristics.

Table 1. Sample Characteristic (N=364)

Category		Proportion	Category		Proportion
Gender	Male	(131) 36.0%	Education background	High school or technical secondary school	(101) 27.7%
	Female	(233) 64.0%		Bachelor	(178) 48.9%
Marriage Status	Married	(197) 54.1%		Master and Doctor	(85) 23.4%
	Unmarried	(167) 45.9%	Job	General staff	(308) 84.6%
Age	20 – 29 years old	(174) 47.8%		Junior manager	(20) 5.5%
	30 – 39 years old	(95) 26.1%		Middle manager	(36) 9.9%
	40 – 49 years old	(84) 23.1%	Annual Salary (RMB)	< 36001	(106) 29.1%
	50 years above	(11) 3.0%		36001 - 72000	(115) 31.6%
Working Experience	Less than 1 years (including 1)	(68) 18.7%		72001 - 120000	(86) 23.6%
	1-3 years	(102) 28.0%		120001 - 240000	(33) 9.1%
	3-5 years	(109) 29.9%		> 240001	(24) 6.6%
	5-10 years	(55) 15.1%			
	10 years above	(30) 8.2%			

3. Measures

Li and Shi (2005) compiled TLQ (Transformational Leadership Questionnaire) based on Bass' transformational leadership theory study with Chinese employees as the research sample in the Chinese cultural context. They pointed out that transformational leadership can help members develop latent abilities and lead to more effort and education through inner satisfaction. Employees reported transformational leadership using the 5-item scale in Li and Shi (2005). The specific questions are as follows:

A1: My leader can sacrifice personal interests for the good of the department.
A2: My leader is patient and can work with me to solve problems.
A3: My leader is decisive in dealing with difficult problems at work.
A4: My leader can help my colleagues and I with life and family problems.
A5: My leader can explain to me the prospects of our department.

Bass and Avolio (1990) stated that transactional leadership emphasizes 'reward and punishment' and 'take what you can get'. Bass et al. (2003) stated that transactional leaders recognize employees when they complete tasks or correct deviations for the first time. This study adopts the transactional leadership scale developed based on this

operational definition with the 4-item scale. The specific questions are as follows:

B1: Our leadership will support what I want at the transactional level.
B2: My leader always told me that I had to do something to be rewarded.
B3: My leader always said that if I achieved good results, I would be given special compensation or promotion.
B4: My leader would treat the compensation given to me as a trade-off.

Job Crafting is a series of processes in which employees change the business they are responsible for to make the job more meaningful (Wrzesniewski & Dutton, 2001). We measured job crafting with Wrzesniewski and Dutton's (2001) 4-item scale. The specific questions are as follows:

C1: I try to improve my job skills.
C2: I will take into account all the factors of the job to make it more challenging.
C3: I see it as an opportunity to start a new job when there is less work to do.
C4: I always want to learn and try out new jobs first.

Voice behavior is not simply criticizing the organization's situation, but puts more emphasis on spontaneous ideas and suggestions for improving the organization (Van Dyne & LePine, 1998). We measured voice behavior using Van Dyne and LePine's (1998) 5-item scale. The specific questions are as follows:

D1: I provide constructive advice to leaders on company life.
D2: I encourage my colleagues to focus on problems that could improve the company.
D3: I communicate my opinions about work issues to others, even if my opinion is different and others disagree with me.
D4: I regularly check for information about my own business to help solve work problems.
D5: I am actively involved in activities to improve the company.

Creative behavior is defined as behavior that can contribute to the organization by developing new solutions related to work (George & Zhou,2001). We adopted George and Zhou's (2001) 3-item scale to measure creative behavior. The specific questions are as follows:

E1: I propose new ways to achieve the goals and objectives.
E2: I provide creative solutions to problems in the business.
E3: I often approach problems with a fresh perspective.

IV. Results

1. Validity and Reliability

This study used the internal consistency coefficient to test reliability, and by running SPSS 23.0, Cronbach's alpha was above 0.75, which suggests that the scale is reliable. Moreover, we examined the average variance extracted (AVE) and composite reliability; (CCR), AVE> 0.50, CCR > 0.70, meeting the criteria. In addition, this study adopts confirmatory factor analysis to examine the discriminant validity of transformational leadership, transactional leadership, job crafting, voice behavior, and creative behavior. By running AMOS 23.0, the fit indices of the models, such as CMIN/DF, RMR, RMSGFI, AGFI, NFI, TLI, IFI and RFI, were all acceptable. The specific analysis results are shown in Table 2.

2. Descriptive Statistics and Intercorrelations

The averages, standard deviations, and correlation coefficients of correlational research variables are shown in Table 3. JC(ρ=.506, p<.001), VB(ρ=.617, p<.001), CB(ρ=.624, P<.001) are significantly correlated with transformational leadership. VB (ρ=.692, P<.001) and CB (ρ=.725, P<.001) are significantly correlated with job crafting. In addition, the diagonal numbers in Table 3 represent the square root of AVE for each

Table 2. Confirmatory Factor Analysis

Constructs and Items	St. Facto loading	S.E.	C.R.	P	λ	AVE	CCR	Cronbach's α
Transformational L→ A5	1				0.922			
Transformational L→ A4	1.191	0.099	12.007	***	0.956			
Transformational L→ A3	1.219	0.113	10.822	***	0.973	0.896	.897	.896
Transformational L→ A2	1.175	0.111	10.607	***	0.927			
Transformational L→ A1	1.266	0.119	10.661	***	0.955			
Transactional L→ B4	1				0.863			
Transactional L→ B2	0.85	0.057	14.953	***	0.744	0.535	.841	.812
Transactional L→ B3	0.612	0.054	11.384	***	0.581			
Transactional L→ B1	0.887	0.061	14.538	***	0.711			
JC → C1	1				0.810			
JC → C4	1.027	0.063	16.246	***	0.859	0.681	.904	.907
JC → C3	0.925	0.059	15.754	***	0.833			
JC → C2	0.969	0.067	14.546	***	0.797			
VB → D5	1				0.756			
VB → D4	0.912	0.072	12.647	***	0.676			
VB → D3	1.069	0.081	13.517	***	0.705	0.506	.834	.832
VB → D2	1.073	0.079	13.522	***	0.718			
VB → D1	0.984	0.075	13.054	***	0.701			
CB → E1	1				0.743			
CB → E3	0.950	0.081	11.755	***	0.668	0.506	.724	.751
CB → E2	0.941	0.075	12.575	***	0.720			

χ^2=334.234 (df=154, P=.000), χ^2/df=2.170, RMR=.060, RMSEA=.057, GFI=.924, AGFI=.886, NFI=.939, TLI=.953, IFI=.966, RFI=.917

Note: Transformational L: Transformational Leadership, Transactional L: Transactional Leadership, JC: Job Crafting, VB: Voice Behavior, CB: Creative Behavior.

construct, which is greater than the correlations between all other constructs. This further demonstrates the discriminant validity of this study. Overall, this indicates that the criteria have been met, and that regression analysis and hypothesis testing can be conducted.

Table 3. Correlation Analysis (N=364)

Construct	Transformational L	Transactional L	JC	VB	CB
Transformational L	.896[b]				
Transactional L	.217 (.047[a])***	.535[b]			
JC	.506 (.256[a])***	.499 (.249[a])***	.681[b]		
VB	.617 (.380[a])***	.492 (.242[a])***	.692 (.479[a])***	.506[b]	
CB	.624 (.389[a])***	.442 (.195[a])***	.725 (.526[a])***	.696 (.484[a])***	.506[b]
Mean	3.6451	3.6120	3.7253	3.8357	3.8599
S.D.	.96971	.74273	.85968	.77874	.89324

Note: a=r^2, b=AVE.

3. Hypothesis Test

The results of the hypothesized relationships are presented in Table 4. The model fit indices of models, such as χ^2 = 795.751 (df = 170, p = .000), RMR = .074, RMSEA = .073, GFI= .887, AGFI = .846, NFI = .911, TFI = .925, IFI = .939, and RFI = .890, are all acceptable.

Hypothesis 1 and Hypothesis 2 state that there is a positive relationship between transformational leadership (β = .532, SE = .072, p < .001), transactional leadership, (β = .210, SE = .052, p < .001) and job crafting. At the same time, we can also find that transformational leadership has a greater impact on job crafting than transactional leadership. Hypothesis 3 and Hypothesis 4 state that there is a positive relationship between transformational leadership (β = .462, SE = .081, p < .001), transactional leadership (β = .119, SE = .042, p < .005), and voice behavior. Moreover, we can also find that transformational leadership has a greater impact on voice behavior than transactional leadership. Hypotheses 5 and 6 state that there is positive relationship between transformational leadership (β = .641, SE = .106, p < .001), transactional leadership (β = .104, SE = .051, p < .05) and creative behavior. Furthermore, we also find that transformational leadership has a greater impact on creative behavior than transactional leadership. Hypotheses 7 and 8 state that there is positive relationship between job crafting, voice behavior, and creative behavior. As expected, job crafting positively was related to both voice behavior (β = .535, SE = .064, p < .001) and creative behavior (β = .496, SE = .067, p < .001), providing support to Hypotheses 7 and 8.

To test Hypotheses 9, 10, 11, and 12, we estimated the indirect relationships between transformational leadership, transactional leadership, and voice behavior, with creative behavior via job crafting using 20,000 Monte Carlo replications to obtain 95% CIs for the indirect effects. Results show that the indirect effect between transformational leadership, job crafting, and voice behavior was significant (estimate = .001, 95%CI: .242, .421), lending support for Hypothesis

9. Moreover, the indirect between transactional leadership, job crafting, and voice behavior was significant (estimate = .017, 95%CI: .043, .239), lending support to Hypothesis 10. Furthermore, the indirect between transformational leadership, job crafting, and creative behavior was significant (estimate = .001, 95%CI: .247, .445), lending support to Hypothesis 11. However, the indirect effects between transactional leadership, job crafting, and creative behavior were non-significant (estimate = .109, 95%CI: -.003, .187), lending no support to Hypothesis 12.

Table 4. Hypotheses Testing (N=364)

Path (Hypothesis)		β	S.E.	t	Rseult
H1	Transformational L→JC	.532	.072	7.382***	Accept
H2	Transactional L→JC	.210	.052	4.072***	Accept
H3	Transformational L→VB	.462	.081	5.708***	Accept
H4	Transactional L→VB	.119	.042	2.833**	Accept
H5	Transformational L→CB	.641	.106	6.060***	Accept
H6	Transactional L→CB	.104	.051	2.043*	Accept
H7	JC→VB	.535	.064	8.381***	Accept
H8	JC→CB	.496	.067	7.355***	Accept

Path (Hypothesis)		St. Indirect Effects	St. Direct Effects	St. Total Effects	95% C.I.		Sig. (two-tailed)	Result
					Lower	Upper		
H9	Transformational L→JC→VB	.332	.204	.536	.242	.421	.001	Accept
H10	Transactional L→JC→VB	.139	.131	.270	.043	.239	.017	Accept
H11	Transformational L→JC→CB	.352	.145	.497	.247	.445	.001	Accept
H12	Transactional L→JC→CB	.092	.093	.185	-.003	.187	.109	Reject

χ^2=495.751 (df=170, P=.000), χ^2/df=2.916, RMR=.074, RMSEA=.073, GFI=.887, AGFI=.846, NFI=.911, TLI=.925, IFI=.939, RFI=.890

Note: *p<.05, **p<.005, ***p<.001.

V. Conclusion and Discussion

Based on social exchange theory, this study utilizes 364 employees in service industry-based companies in the Beijing, Tianjin, and Hebei regions of China as research subjects. Based on structural equation modelling (SEM), the study investigated the mechanisms of transformational and transactional leadership on job crafting, voice behavior, and creative behavior. The study showed that transformational and transactional leadership positively affected employee job crafting, voice behavior, and creative behavior. Job crafting mediates the relationship between transformational leadership and voice and creative behaviors. Moreover, job crafting mediates the relationship between transactional leadership and voice behavior. Specifically, when employees feel good about transformational and transactional leadership, they will take the initiative to improve their capabilities and spontaneously redesign work to express their suggestions, or propose new ideas to improve the organization.

Among the theoretical implications are that, first, both transformational leadership and transactional leadership in this study impacted job crafting, voice behavior, and creative behavior. The data results show that transformational leadership, compared to transactional leadership, had a more significant impact on job crafting (Transformational L=.532, Transactional L=.210); voice behavior (Transformational L=.462, Transactional L=.119); and creative behavior (Transformational L=.641, Transactional L=.104) to a greater extent. This may be because transformational leaders focus more on motivating their employees to look beyond individual interests to achieve the collective good. Therefore, transformational leaders will put forward higher ideals and values to evoke a sense of self-consciousness among organization members. Unlike transactional leaders, wherein employees are subservient to the leader based on their interests, transformational leaders engender trust, respect, and loyalty towards the leader, in line with Bass (1985) and Burns (1978). Thus, transformational leadership significantly impacts job crafting, voice behavior, and creative behavior more than transactional leadership.

Second, in this study, employee job crafting was used as a mediating variable, but it did not mediate between transactional leadership and creative behavior. However, in reality, some transactional leaders may reward employees with less compensation to reduce costs for the organization. When employees are paid less than they think they should, employees may feel that they are not valued by their leaders, and they will not be motivated to develop and learn; this means they will not be job crafting, and therefore, it is difficult to inspire creative behavior.

Next, this study provides significant practical implications for Chinese workplace human resource management. First, this study demonstrated that transformational leadership affects job crafting, voice behavior, and creative behavior to a greater extent than transactional leadership. The findings in Bass (1985) also showed that 'the relationship between transformational leadership and employee job satisfaction is more significant than that of transactional leadership'. However, transactional leadership is a base on which transformational leadership is built. The two are not opposites, but rather coexist and complement each other, and a leader must be able to use both leadership styles flexibly. Therefore, we must pay attention to training leaders to understand the importance of transformational and transactional leadership, and to strengthen the effective behaviors of transformational and transactional leaders to enhance leadership effectiveness and build an environment of continuous change. This way, employees will continue to craft and adjust work while increasing their voice and creative behaviors. The company will be able to respond more comfortably to environmental changes. Secondly, the organization should pay more attention to employee job crafting because the traditional top-down tedious and lengthy work task design method may make the company unable to keep up with the rapid changes in the external work environment. Employees are

the leading performers of work tasks and know the most suitable work style for themselves. Therefore, organizations or supervisors should appropriately grant employees work autonomy, provide them with enough space to adjust work content and carry out job crafting (Lv & Chen, 2020), and help organizations respond to the rapidly changing external environment. Third, voice behavior has a significant positive impact on job satisfaction, job engagement, and job performance (Cui, 2023). Creative behavior helps a company survive, adapt, and innovate in the harsh and fiercely competitive environment, suggesting that leaders should pay close attention to employee voice and creative behaviors.

This study attempted to ensure the scientific standardization of academic research and contributes to theoretical development and organizational management. However, it has limitations and requires additional research. The data in this study are cross-sectional and were collected for all variables simultaneously. However, this is convenient and can avoid bias in data collection due to personnel changes and other contexts. However, it is not easy to examine the dynamics of the impact of transformational and transactional leadership on job crafting, voice behavior, and creative behavior. It is suggested that subsequent studies collect longitudinal data to understand changes in job crafting, voice behavior, and creative behavior under time effects.

Moreover, the endogenous variables in this study are all spontaneous, proactive behaviors. Employees with proactive personalities would be more likely to engage in organizational citizenship behavior related to job crafting, voice behavior, and creative behavior than employees with introverted personalities. However, the questionnaire in this study did not ask questions about employee personality traits, so it is impossible to determine whether there is an effect at the individual level. It is suggested that subsequent research break down the impact of the Big Five personality traits as well.

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U.S. Re-entry into the 2015 Paris Climate Agreement and Implications for the EU, Korea, China, and Japan: A CGE Approach*

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ABSTRACT

Purpose – With renewed greenhouse gas (GHG) emissions, abatement commitments and the rejoining of the Paris Climate Agreement of 2015 by the U.S., this study assesses the impact of carbon dioxide (CO_2) emissions reduction, and the opportunity cost of the U.S. in implementing its nationally determined commitments (NDCs).
Design/Methodology/Approach – The study employs the GTAP-E model, an extension of the static GTAP model with CO_2 emissions trading, and GTAP DB version 10A with a base year of 2014. Model implementation includes a baseline scenario that projects the global economy from 2014 to 2030, and four policy scenarios representing the implementation of U.S. NDC targets without and with emissions trading.
Findings – Simulation results suggest that CO_2 emissions reduction with trading significantly lowers the emissions abatement cost compared to CO_2 emissions reduction with no trading. Furthermore, the study finds that CO_2 emissions reduction leads to a drop in industry output by all energy and most non-energy sectors. Simulation results illustrate that CO_2 emissions reduction by the U.S. significantly affects most of its trading partners' real GDPs, welfare, export and import flows, and industry outputs.
Research Implications – The study provides a comprehensive impact assessment of global CO_2 emissions reduction, including U.S. contributions to addressing climate change. Moreover, the study has quantified the opportunity cost the U.S. will likely pay for meeting its NDC targets, and the likely impact of CO_2 emissions reduction by the U.S. on its major trading partners, especially the EU, Korea, Japan, and China.

Keywords: climate change, economic costs of carbon emissions reduction, GTAP-E model, nationally determined commitments (NDCs), U.S.' re-entry into the Paris Climate Agreement
JEL Classifications: C68, C83 D31, O15

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I. Introduction

The continually rising concentration of greenhouse gases (GHG) in the atmosphere from increased use of fossil fuels has led to numerous climatic consequences, including surging global temperatures (IEA, 2021; IPCC, 2018, 2022), rising sea levels, changes in precipitation, loss of glaciers, and the increased intensity, frequency, and duration of hurricanes, drought, and heatwaves (IPCC, 2007, 2013). For instance, from 2019 to 2022, numerous studies found that concentrations of heat-trapping gasses have increased, including CO_2, which increased by 5.7 to 415.7 ppm, methane by 42 to 1,908 ppb, and nitrous oxide by 2.5 to 334.5 ppb, relative to the pre-industrial period (IPCC, 2021; Weather Meteorological Organization, 2022). These intensified GHG emissions, to a great extent, are due to human activities on land or sea (IPCC, 2021), with the radiative forcing by the heat-trapping greenhouse gases rising by nearly 50%, whereby CO_2 contributed to about 80% of this rise between 1990 to 2021 (Weather Meteorological Organization, 2022).

These drastically changed atmospheric compositions and extreme climatic occurrences have not only negatively impacted the environment and health of humans and animals but also incurred high societal costs, or the monetary value that the economy must spend to abate the damage done by CO_2 emissions (Chepeliev et al., 2021; De Mooij et al., 2012; Rennert et al., 2021).

While many of these adverse effects are irreversible during the timescale of the current generation, with appropriate measures (Wang & Jin, 2023), it is still possible to ensure a sustainable environment and economic growth, primarily through promoting the production and consumption of green energy. Accomplishing such goals requires a shared approach from all stakeholders, with developed economies playing a critical role, as envisioned in the United Nations Framework Convention on Climate Change (UN, 1992), the Kyoto Protocol (UN, 1998), the Paris Climate Agreement, and the Conference of the Parties (UN, 2021).

The urgent need for mobilizing such global efforts calls for political goodwill in coordinating national policies (Lia & Hong, 2023), especially in providing funds or sharing environmentally friendly technologies (Bak et al., 2019) by developed countries and major carbon emitters to implement climate mitigation and adaptation programs. On June 1, 2017, U.S. President Donald J. Trump announced the intention of the U.S. to withdraw from the Paris Climate Agreement, citing the redistribution of U.S. wealth through the Green Climate Fund (GCF) and the economic lopsidedness of the treaty against the U.S. in terms of harsh economic restrictions (Cama & Henry, 2017; Mai, 2021). A case in point was the permission of some high-emitting countries like China to continue increasing emissions for several years. Sustaining the withdrawal of the U.S. from the climate agreement would have devastating ramifications, including slowing the momentum of climate change mitigation and giving rise to alternative forms of international collaboration on climate policy (Pickering et al., 2018).

Notwithstanding, addressing these environmental and climate change concerns involves reducing the use of energy commodities such as coal, oil, gas, and oil products in production, which will likely lead to the reallocation of national resources, impacting domestic production (Lee & Yoo, 2022), hence the economy. CO_2 emissions reduction policies involve imposing a cost burden on emissions to disincentivize the use of production processes that increase CO_2 emissions. According to the "double dividend hypothesis", imposing a price on carbon emissions will likely improve the environment and the economy. However, this remains contested, with some in agreement (Ruocco & Wiegard, 1996), while others disagree (Bovenberg & De Mooij, 1994; Kitetu & Ko, 2022).

Amidst the discourse around energy and environment-related policies, a matter of particular interest is to derive the social cost (Griffiths et al., 2012; Kitetu & Ko, 2020; Syed & Ullah, 2021) that GHG emissions impose on the environment and society, and estimate the economic benefits of CO_2 emissions reduction. Such estimates are

essential for policymakers in deciding whether to maintain current policies, such as fiscal and monetary measures promoting investment in developing low-carbon production technologies and the effectiveness of existing environmental policies, such as CO_2 emissions regulations and sequestration. Given the size of the U.S. economy, its recommitment to CO_2 emissions reduction will likely have significant ramifications on the global economy and CO_2 emissions. Several studies have attempted to quantify the potential impacts of U.S. withdrawal and recommitment to reducing CO_2 emissions (Böhringer & Rutherford, 2017; Kitetu & Ko, 2022; Pickering et al., 2018; van de Ven et al., 2021). However, there is insufficient literature on the opportunity costs the U.S. will likely pay for implementing its new Nationally Determined Contribution emissions targets. Furthermore, this study applies the most current GTAP database version 10A, and while projecting the global economy to 2030, it also accounts for the most current historical macroeconomic data.

The aim of this paper is twofold. The first aim is to provide insight into the U.S.' global contribution to reducing CO_2 emissions based on its current Nationally Determined Commitments (NDC) emissions reduction targets. We assess the potential economic impacts of CO_2 emissions reduction and the economic costs the U.S. will likely pay for implementing its NDC targets. The study applies a global multi-sector static GTAP-E approach using the GTAP DB version 10A, with the base year of 2014. The second aim is to assess whether the opportunity costs of the U.S. re-entry into the Paris Climate Agreement vary with regions. The findings of this study mainly contribute to the growing empirical literature on the economic and social costs of GHG emissions reductions in leading economies, including the U.S., EU, Korea, China, and Japan.

This paper is structured as follows. After an introduction in Section I, we describe the CGE model applied in Section II. Section III reviews the data and simulation design employed. Simulation results are discussed in Section IV, while Section V presents concluding remarks and policy recommendations.

II. The GTAP-E Model

We employ GTAP-E, an energy environment model. This model extends the global, multi-sector standard GTAP model (Burniaux & Truong, 2002; Hertel & Tsigas, 1997; McDougall & Golub, 2009) by introducing inter-fuel and energy-capital substitution in production, emissions accounting, taxation, and CO_2 emissions trading. In this regard, the GTAP-E model can assess energy, climate, and environmental-related policy issues (Burniaux & Truong, 2002), along with other external shocks, including the resultant efficiency in resource reallocation within an economy. To be specific, one of the outstanding features of the model is the utilization of inter-fuel and inter-factor substitution in the production structure of firms and the consumption and expenditure behaviors of private households and the government.

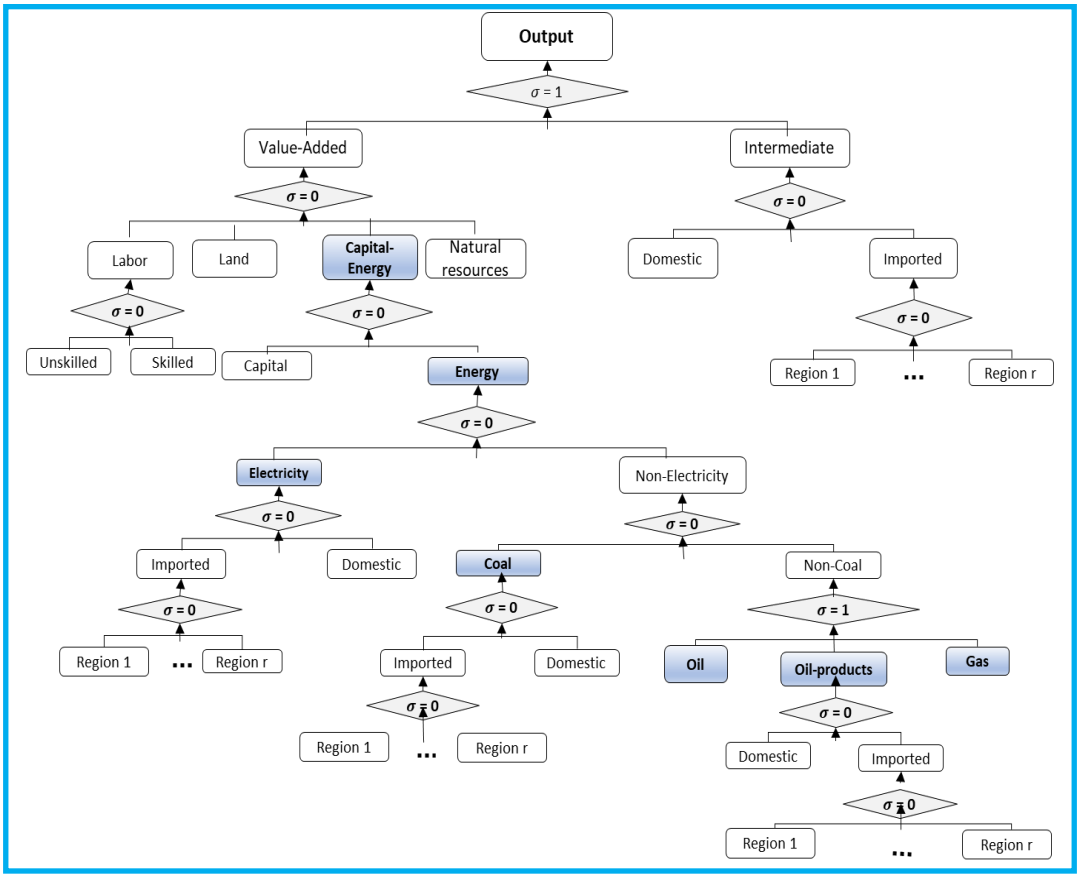
CGE models are policy tools that economists employ to conduct an economy-wide impact assessment of policies or external shocks. The models are grounded in the general equilibrium theory. Using simultaneous equations drawn from these economic theories and actual economic data, researchers can evaluate economic changes and behavioral responses by different economic agents, such as producers, consumers, investors, and the government. Due to their capacity and structure, the models capture the interactions and feedback impacts between different industries and economic agents, and the possible adjustments in response to policies or external shocks (Ko, 1993).

Fig. 1 shows the production structure of the GTAP-E model. The model allows each sector to produce one commodity using inputs from the value-added and the intermediate nests based on the prevailing production technology, usually of a CES functional form (Corong et al., 2017; Hertel & Tsigas, 1997). The value-added nest comprises primary factors of production: unskilled labor, skilled labor, land and natural resources, and a capital-energy nest. Another shift from the standard GTAP model is that the GTAP-E model assumes land immobile and, therefore, less substitutable for other primary factors in the production process. In the GTAP-E model, land is a significant input in

agricultural production, with energy introduced as an additional input in the value-added composite (Burniaux & Truong, 2002).[1]

Producers are assumed to minimize production costs under a technology constraint at each production stage. Extension of the standard GTAP model involves relocating the energy commodities from the intermediate input nest and incorporating them into the value-added nest. Including the energy sector in the value-added bundle is a two-step process. The first step involves the separation of energy commodities into electricity and non-electricity composites. Some degree of substitution is allowed through a CES structure between the electricity and the non-electricity composite, and within the non-electricity composite (Babiker et al., 1997; Burniaux & Truong, 2002). The second step involves combining the energy composite with capital to produce an energy-capital composite, which, together with other primary factors of production, forms the value-added-energy composite nest through a CES structure. The

Fig. 1. Production Structure of the GTAP-E Model



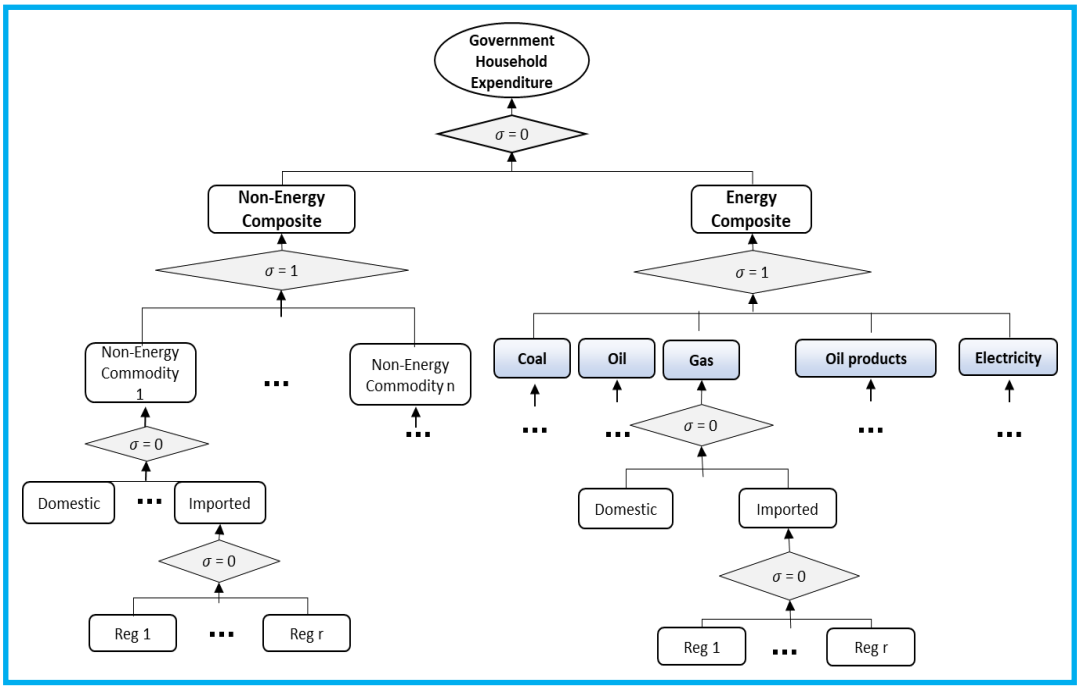
Source: Authors' drawing based on Burniaux and Truong (2002).

1. Energy sectors such as coal, oil, gas, oil products, and electricity are assumed to increase CO_2 emissions from fossil fuels. In comparison, the linkage between agricultural production and climate change is CO_2 emissions from fossil fuel use due to land reclamation, and the release of methane gas from animal waste.

elasticity of substitution between capital and the energy composite is assumed to be positive, which implies that capital and energy are substitutes in the inner nest.

The GTAP-E model's production structure is organized into eight levels, as shown in Fig. 1. At the top level, the value-added and intermediate composites are combined to produce industry output using a Cobb-Douglas production function. The value-added composite at the second level is a CES aggregation of the capital-energy and primary factor composites. However, the intermediate composite is aggregated using the Armington elasticities (Armington, 1969), and likewise regarding substitution between domestically produced and imported intermediate inputs. At the third level, labor is a CES aggregation of skilled labor and unskilled labor, with the capital-energy composite being a CES aggregation of capital and the energy composite.

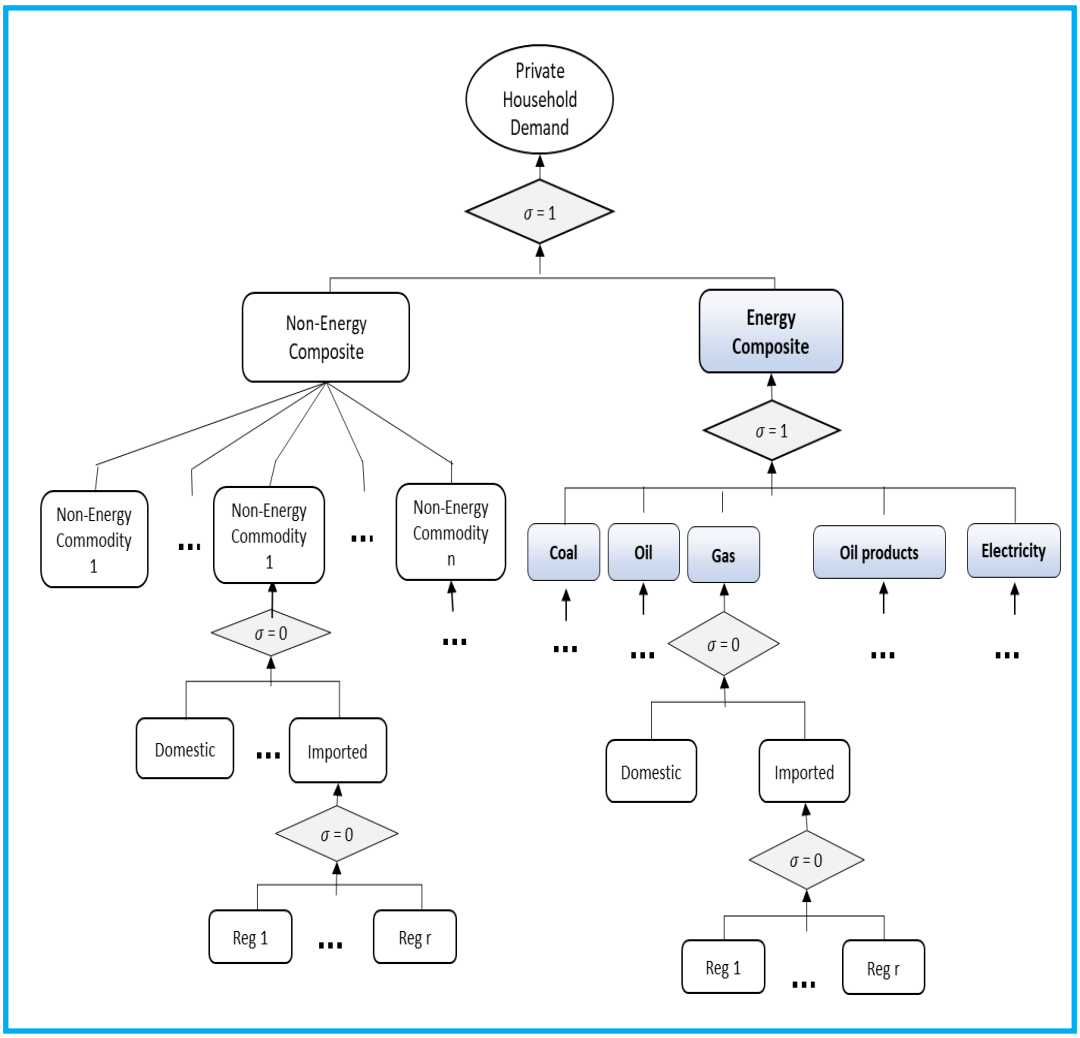
Fig. 2. Government Expenditure in the GTAP-E Model



Source: Authors' drawing based on Burniaux and Truong (2002).

The CGE model's architecture allows accounting for demand through government spending, private household consumption, and savings, a proxy for investment. However, the demand structure for the three components of final demand is heterogeneous. For example, government spending adopts a Cobb-Douglas expenditure utility function wherein energy and non-energy commodities are combined using a CES functional form. Regarding locally produced and imported non-energy products, aggregation uses a CES structure, and the imported non-energy goods aggregation follows the Armington structure. Notwithstanding, the GTAP-E model's flexibility enables the provision of substitution elasticities between energy and non-energy commodities.

Fig. 3. Private Household Purchases in the GTAP-E Model



Source: Authors' drawing based on Burniaux and Truong (2002).

As illustrated in Fig. 3, the private household energy composite and non-energy commodity consumption follow the CDE functional form. Based on the structure of the GTAP-E model, the same parameter values are applied to the four energy commodities: coal, oil, gas, and electricity. Employing the same parameter values for the four energy commodities makes aggregating them into a subset with similar CDE parameter values possible. Finally, a CES sub-structure is designed to create a flexible substitution structure for energy goods in specifying the composite energy commodity (Babiker et al., 1997).

The CGE model employs an input-output accounting approach accounting for all incomes and expenditures for each traded commodity, including use in the production process. Accordingly, any cost or income accrued is accounted for as consumption of endowment commodities.

III. Data and Simulation Architecture

1. Data

In assessing the effect of CO_2 emissions reduction and the likely economic costs to the U.S. in meeting its NDC targets, we employ GTAP database version 10A, released in 2019 with a base year of 2014. This database contains 141 regions and 65 sectors (Aguiar et al., 2019). Considering the study's objectives, we aggregated the 141 regions and 65 sectors into 12 regions and 14 sectors based on the share of global CO_2 emissions and trade flows with the U.S., as seen in Table 1.

Table 1. Regional and Sectoral Classification of GTAP Database Version 10A

No.	Region	Description	No.	Sector	Description
1	KOR	Korea	1	Agr	Primary agriculture
2	JPN	Japan	2	F_F	Forest and Fishing
3	CHN	China	3	Coal	Coal mining
4	U.S.	United States	4	Oil	Crude oil
5	UK	United Kingdom	5	Gas	Natural gas extraction
6	FSU	Former Soviet Union	6	Oil_pcts	Refined oil products
7	OIC	Other Industrialized Countries	7	Prcfood	Processed food
8	OEX	Oil Exporters	8	En_Int_Ind	Energy-Intensive Industries
9	EU27	European Union 27	9	TMV	Transport Motor Vehicles
10	NAF	Northern Africa	10	Oth_Ind	Other Industries
11	SSA	Sub-Saharan Africa	11	Electricity	Electricity
12	ROW	Rest of World	12	Construct	Construction
			13	Transport_S	Transport service
			14	Othsvcs	Other services

Source: Aguiar et al. (2019).

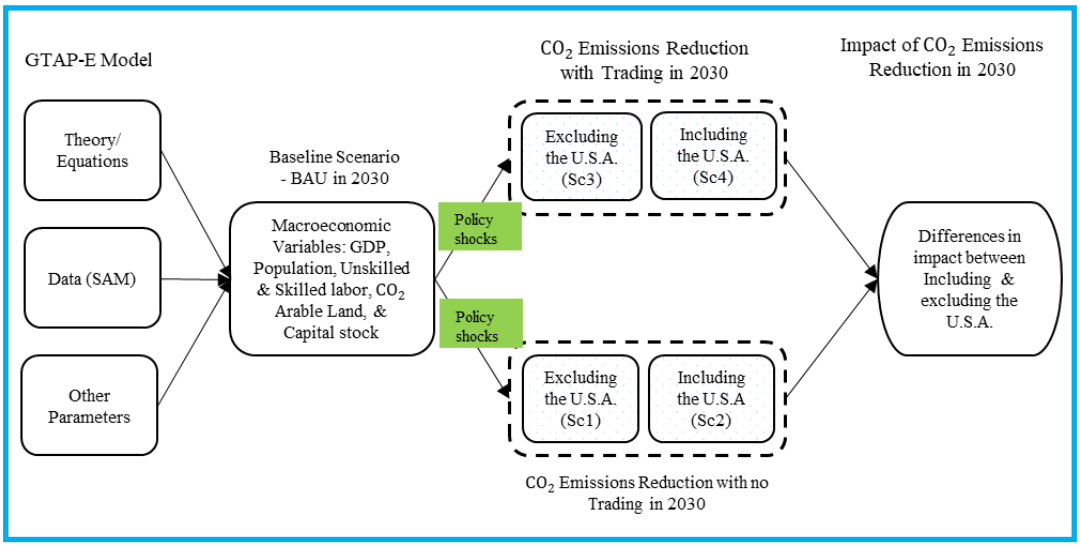
2. Simulation Procedures

The economic impacts of CO_2 emissions reduction by the U.S. and opportunity costs are presented as changes in real GDP, welfare, and the industry output of sectors by comparing policy scenarios against the baseline scenario. The simulation design employed in this study is shown in Fig. 4.

2.1. Baseline Scenario

The baseline scenario illustrates the global economy in 2030 under a business-as-usual CO_2 emissions provision. In developing the baseline scenario, we integrate projected growth rates for GDP, population, unskilled and skilled labor, capital stock, agricultural land, and CO_2 equivalents of GHG emissions. Projections for

Fig. 4. Applied Research Design



Source: Authors' drawing.

GDP are from the SSP2 database (Cuaresma, 2017; Riahi et al., 2017), projected population data is from the United Nations Department of Economic and Social Affairs, Population Division (UN DESA) (2019), skilled and unskilled labor is from SSP2, physical capital stock supply growth comes from Foure et al. (2012), with the projected arable land growth coming from Bruinsma (2011). Finally, projections for CO_2 emissions are from United Nations Environmental Programme (UNEP) (2022).

2.2. Policy Scenarios

Table 2 details the policy scenarios implemented in this study. We design counterfactual policy scenarios while assuming that all countries meet the NDC reduction targets of the Paris Climate Agreement of 2015. In total, we implement four policy scenarios. Scenarios 1 and 2 simulate a CO_2 emissions reduction with no trading (a regulatory approach), while Scenarios 3 and 4 simulate a CO_2 emissions reduction with trading (a market-oriented approach). To account for the economic costs, the U.S. would pay for implementing its NDC targets; we only simulate emissions reduction by the U.S. in Scenarios 2 and 4. In the above context, the difference between Scenarios 1 and 2 and between Scenarios 3 and 4 reflects the economic price the U.S. will likely bear in meeting its NDC emissions reduction targets.

The CO_2 emissions trading system provides greater versatility in reallocating resources to reduce CO_2 emissions, lowering abatement costs. In both the regulatory and market-oriented simulations, we account for the U.S. exit and re-entry into the Paris Climate Agreement of 2015. We implement four distinct scenarios. Scenarios 1 and 2 focus on CO_2 emissions reduction with no trading while excluding and including the U.S. In comparison, Scenarios 3 and 4 focus on CO_2 emissions reduction with trading while excluding and including the U.S.

IV. Simulation Outcomes

This section discusses the impact of CO_2 emissions reduction on real GDP, export and import volumes, output by industry, and national

Table 2. CO_2 Emissions Reduction for Policy Scenarios

Region	CO_2 Emissions Reduction with No Use of Flexibility Mechanisms		CO_2 Emissions Reduction with Trading	
	Sc1 (Excluding the U.S.)	Sc2 (Including the U.S.)	Sc3 (Excluding the U.S.)	Sc4 (Including the U.S.)
Korea	40% compared with 2018[a]			
Japan	50% compared with 2013[a]			
China	65% compared with 2005[a]			
US	52% compared with 2005[a]			
United Kingdom	68% compared with 1990[a]			
Former Soviet Union	29.5% compared with 2030			
Other-Industrial Countries	41.2% compared with 2030			
Oil-Exporting Countries	23.5% compared with 2030			
EU27	55% compared with 2030			
North Africa	18% compared with 2030			
SSA	23.4% compared with 2030			
Rest of World	20.4% compared with 2030			

Note: [a]: The implementation of all NDC targets has been adjusted to 2030 emission levels when conducting scenarios.
Source: United Nations Environmental Programme (UNEP) (2022).

welfare. Simulated results indicate that the market-oriented emissions reduction approach would lead to a slightly lower negative impact on real GDP growth than the regulatory approach, as detailed in Table 3. Overall, the impact of CO_2 emissions reduction on real GDP is significant. Compared to CO_2 emissions reduction with trading, changes in real GDP are more pronounced under CO_2 emissions reduction with no trading.

As depicted in Table 3, the costs of implementing NDCs are reflected in the drop in real GDP for all countries/regions, including the U.S. However, if the U.S. does not reduce NDC emissions, its real GDP growth will likely rise by 0.04% and 0.05% in Scenarios 1 and 3, respectively. On the contrary, if the U.S. reduces CO_2 emissions, as in Scenarios 2 and 4, its real GDP will likely contract by 0.33% and 0.34%, respectively. Therefore, the opportunity costs for the U.S. CO_2 emissions reduction would be a drop in its real GDP of 0.37% and 0.39% under CO_2 emissions reduction without and with trading, respectively. Further, the participation of the U.S. in global CO_2 emissions reduction will cause negative real GDP growth in most countries under CO_2 emissions reduction with no trading (Scenarios 1 and 3). For instance, Korea will suffer a 0.01% real GDP decline if the U.S. participates in CO_2 emissions reduction with no trading, with China facing a similar drop in real GDP growth as Korea. However, Japan's real GDP decline would

be insignificant under the same scenarios.

The impacts of CO_2 emissions reduction on real GDP in the U.S., EU, Korea, Japan, China, and other economies mainly result from changes in reduced private household consumption, government expenditure, and investments.

Table 3. Impact of CO_2 Emissions Reduction on Real GDP (% change)

Region	Impact				Opportunity Costs	
	Sc1	Sc2	Sc3	Sc4	Sc2-Sc1	Sc4-Sc3
Korea	-1.77	-1.79	-0.49	-0.48	-0.01	0.01
Japan	-0.36	-0.36	-0.30	-0.29	0.00	0.01
China	-0.64	-2.40	-2.55	-2.59	-1.76	-0.03
U.S.	0.04	-0.33	0.05	-0.34	-0.37	-0.39
United Kingdom	-1.05	-1.06	-0.53	-0.52	-0.01	0.01
Former Soviet Union	-3.80	-3.92	-2.21	-2.28	-0.12	-0.07
Other-Industrial Countries	0.24	0.23	0.00	0.00	-0.01	-0.01
Oil-Exporting Countries	-0.63	-0.65	-0.94	-0.95	-0.02	-0.01
EU27	-0.54	-0.55	-0.30	-0.29	-0.02	0.01
North-Africa	-2.48	-2.51	-1.74	-1.78	-0.03	-0.04
Sub-Saharan Africa	-0.46	-0.48	-0.78	-0.79	-0.03	-0.01
Rest of the World	-0.70	-0.73	-0.84	-0.85	-0.03	-0.01

Source: Authors' calculation.

Table 4. Impact of CO_2 Emissions Reduction on Export Volumes (% change)

Region	Change (%)				Opportunity Costs (%)	
	Sc1	Sc2	Sc3	Sc4	Sc2-Sc1	Sc4-Sc3
Korea	0.86	0.75	4.87	4.91	-0.11	0.04
Japan	0.05	-0.14	0.35	0.31	-0.19	-0.04
China	8.44	5.92	5.40	5.25	-2.52	-0.15
U.S.	-3.83	-5.23	-3.81	-5.49	-1.40	-1.68
United Kingdom	5.13	5.09	6.81	6.85	-0.04	0.04
Former Soviet Union	-0.86	-1.04	3.75	3.71	-0.18	-0.04
Other-Industrial Countries	-15.85	-15.81	-17.69	-17.75	0.04	-0.06
Oil Exporting Countries	3.56	4.05	2.76	2.93	0.49	0.17
EU27	-1.83	-1.90	-1.06	-1.05	-0.06	0.01
North-Africa	-1.62	-1.90	0.92	0.77	-0.28	-0.14
Sub-Saharan Africa	-6.42	-6.30	-7.59	-7.60	0.12	-0.01
Rest of the World	-2.32	-2.39	-2.86	-2.94	-0.07	-0.08

Source: Authors' calculation.

Table 4 illustrates the effect of CO_2 emissions reduction on exports for all regions. Simulated results indicate that most regions will likely face an increase in exports relative to the baseline. Regions expected to face an increase in exports include Korea, Japan, China, the UK, the Former Soviet Union, oil-exporting countries, and the North African region. In contrast, the US will likely experience a decline in exports in all four scenarios. The decline in exports is explained by the reduction in investment, which significantly impacts domestic output, the capacity to meet domestic demand, and international market supply.

Table 5 presents the impact on imports per region from 2021 to 2030. Except for the US, all other countries/regions, including Korea, Japan, China, the UK, the Former Soviet Union, and the EU 27, will likely face a fall in total imports. However, imports by the US will likely increase by 2.35% (Sc1), 1.35% (Sc2), 2.37% (Sc3), and 1.29% (Sc4). The magnitude of change in industry output and changes in demand can play a more significant role in determining the direction of trade flows.

Table 5. Impact of CO_2 Emissions Reduction on Import Volumes (% change)

Region	Change (%)				Opportunity Costs (%)	
	Sc1	Sc2	Sc3	Sc4	Sc2-Sc1	Sc4-Sc3
Korea	-5.84	-5.86	-4.08	-4.03	-0.03	0.04
Japan	-2.21	-2.26	-2.13	-2.13	-0.05	0.00
China	-5.96	-7.89	-7.63	-7.63	-1.93	-0.01
U.S.	2.35	1.35	2.37	1.29	-0.99	-1.09
United Kingdom	-6.11	-6.16	-5.84	-5.84	-0.05	-0.01
Former Soviet Union	-6.93	-7.65	-6.44	-6.75	-0.72	-0.31
Other-Industrial Countries	5.31	5.26	5.08	4.96	-0.05	-0.12
Oil Exporting Countries	-5.87	-6.86	-5.93	-6.52	-0.99	-0.59
EU27	-1.17	-1.19	-0.82	-0.83	-0.02	-0.01
North-Africa	-0.94	-1.38	-1.46	-1.64	-0.43	-0.18
Sub-Saharan Africa	1.20	0.89	1.10	0.92	-0.31	-0.18
Rest of the World	-1.07	-1.44	-1.23	-1.32	-0.37	-0.10

Source: Authors' calculation.

Tables 6 to 9 describe the impact of implementing NDC targets on changes in industry output. Generally, output by industry declines more under carbon emissions reduction with no trading (Scenarios 1 and 2) compared to carbon emissions with trading (Scenarios 3 and 4), and more under carbon emissions reduction without and with trading while excluding the U.S. (Scenarios 1 and 3) compared with carbon emissions reduction with and with no trading while including the U.S. (Scenarios 4 and 2). For the U.S., industries with adversely affected output include coal, oil, and energy-intensive industry. Industries of the EU, Korea, Japan, China, and other regions positively impacted by the reduction of emissions by the U.S. include agriculture, gas, and transport. These findings are expected given that reduction of emissions by the U.S. negatively affects its production in the agriculture, gas, and transport services sectors. If the U.S. implements its roadmap to cut carbon emissions as intended, output in most industries will likely drop.

Table 6. Impact of CO_2 Emissions Reduction with No Trading, Including the U.S. (Sc1), on Production by Sector (% change)

Sector	KOR	JPN	CHN	U.SA.	UK	FSU	OIC	OEX	EU27	NAF	SSA	ROW
Agriculture	0.31	-0.26	0.11	-0.63	0.81	0.17	-1.44	0.08	-1.52	-0.21	-0.59	-0.36
Forest & Fishing	-1.85	-0.72	-0.09	-0.88	-0.64	-1.84	-0.79	-0.52	-1.12	-0.36	0.11	-0.43
Coal	-3.85	-3.83	-12.72	-0.73	-7.05	-10.39	-19.92	0.26	-7.61	-16.83	-18.29	-5.42
Oil	-5.27	-4.04	-2.46	-2.60	-6.50	-3.25	-4.20	-1.73	-6.03	-7.39	-2.66	-3.42
Gas	0.66	-6.58	-17.13	-4.42	-6.81	-10.70	-24.60	-0.75	-9.35	-4.11	-8.05	-12.47
Oil Products	-13.26	-2.34	-0.28	2.52	-7.37	-14.38	-1.23	-8.41	-3.24	-26.20	-6.60	-3.42
Processed Food	-0.54	-0.17	0.10	-0.27	0.84	1.53	-2.12	0.90	-1.10	-0.18	-0.73	-0.18
Energy-Intensive Industry	-2.61	-0.44	1.21	0.75	3.13	-12.30	-6.43	5.72	-0.51	-3.67	-6.17	-2.78
Transport Motor Vehicle	1.91	0.24	-1.43	-0.24	3.44	0.24	-2.30	3.99	-1.38	0.84	-1.03	0.68
Other Industry	2.30	-0.66	2.50	-1.18	3.80	2.21	-9.81	3.98	-1.36	1.66	-2.20	-2.24
Electricity	-12.78	-4.58	-7.39	0.77	-5.77	-17.22	-2.50	-9.16	-4.32	-15.52	-13.65	-7.18
Construction	-7.10	-2.04	-6.81	2.52	-8.18	-4.84	22.66	-6.01	0.17	0.77	10.22	0.63
Transport Services	-5.39	-0.57	1.15	2.30	-2.60	-5.80	-0.59	-4.99	-2.53	-12.07	-3.27	-1.96
Other Services	-0.89	-0.21	-0.69	-0.04	-0.45	-0.46	-0.09	-0.71	-0.21	-0.42	-0.77	-0.32

Source: Authors' calculation.

Changes in industry output from the impact of emissions reduction with no use of flexibility mechanism (Sc3) while excluding the U.S. are presented in Table 6. Simulated results indicate that implementing NDC targets will generally lead to a drop in output for most industries in most countries/regions. Production in all energy sectors for all countries, including the developed countries of Korea, Japan, China, the U.S., U.K., and EU27, except in oil products (+2.52%) and electricity (+0.77%) for the U.S., decline. Even so, the participation of the U.S. in emissions reduction (Sc2) led to a slight decrease in industry output for the other countries/regions. The study's findings indicate that the U.S. significantly contributes to global emissions reduction. In Scenario 1, the impact on industry output is less severe for the U.S. than other countries. In addition to the oil products and electricity industries in the U.S., output for the energy-intensive sector (+0.37%), construction (+2.52%), and transport services (+1.31%) will likely increase.

Table 7. Impact of CO_2 Emissions Reduction with No Trading, Including the U.S. (Sc2), on Production by Sector (% change)

Sector	KOR	JPN	CHN	USA	UK	FSU	OIC	OEX	EU27	NAF	SSA	ROW
Agriculture	0.13	-0.44	-0.08	-1.18	0.58	0.08	-1.62	0.02	-1.79	-0.22	-0.72	-0.43
Forest & Fishing	-2.11	-1.06	-0.43	-1.34	-0.89	-2.43	-0.93	-0.65	-1.31	-0.40	0.09	-0.51
Coal	-3.87	-3.83	-20.32	-9.14	-7.11	-11.11	-22.97	-1.65	-7.74	-16.93	-19.87	-9.74
Oil	-7.98	-6.33	-6.62	-6.35	-8.37	-5.65	-6.64	-3.52	-7.83	-10.26	-4.86	-5.48
Gas	-14.74	-6.76	-17.21	-14.39	-6.82	-10.87	-25.12	0.03	-9.54	-4.18	-8.42	-12.95
Oil Products	-13.38	-2.11	-10.54	-4.09	-7.42	-14.87	-1.06	-8.11	-3.15	-28.24	-6.41	-3.00
Processed Food	-0.61	-0.21	-0.23	-0.63	0.71	1.55	-2.18	0.90	-1.25	-0.18	-0.79	-0.19
Energy-Intensive Industry	-1.69	-0.04	-2.13	0.02	3.84	-10.35	-5.19	9.83	-0.08	-2.77	-4.60	-1.93
Transport Motor Vehicle	1.60	-0.11	-3.29	-0.54	3.20	1.55	-2.44	4.94	-1.57	1.56	-1.16	0.66
Other Industry	1.95	-0.88	0.93	-1.29	3.79	3.38	-9.92	5.35	-1.42	2.41	-2.05	-2.24
Electricity	-12.86	-4.69	-16.15	-5.62	-5.73	-17.17	-0.97	-9.42	-4.27	-15.47	-13.44	-7.20
Construction	-7.08	-2.04	-8.98	2.17	-8.20	-4.99	22.63	-6.31	0.14	0.63	10.08	0.33
Transport Services	-5.27	-0.40	-1.28	-1.32	-2.33	-5.46	0.24	-4.66	-2.12	-11.47	-2.79	-1.45
Other Services	-0.89	-0.22	-1.32	-0.19	-0.50	-0.54	-0.20	-0.95	-0.28	-0.50	-0.92	-0.37

Source: Authors' calculation.

The impact on industry output from global CO_2 emissions reduction with no trading (Scenario 2) is shown in Table 7. Suppose the U.S. discharges its roadmap to low CO_2 emissions as intended with no emissions trading (scenario 2); output in all industries except the energy-intensive industry (+0.02%) and the construction industry (+2.17%) will likely decrease. Korea's agriculture, transport-motor vehicle, and other-industry sectors remain resilient, with production expected to grow by 0.13%, 1.60%, and 1.95%, respectively. For Japan, the output of all industries is negatively affected. In contrast, for China, output for all industries, except for other industry sectors, is expected to drop.

Table 8. Impact of CO_2 Emissions Reduction with Trading, Excluding the U.S. (Sc3), on Production by Sector (% change)

Sector	KOR	JPN	CHN	USA	UK	FSU	OIC	OEX	EU27	NAF	SSA	ROW
Agriculture	0.40	-0.42	-0.12	-0.78	0.94	0.11	-1.86	0.05	-1.39	-0.15	-0.69	-0.47
Forest & Fishing	-1.25	-1.01	-0.46	-1.23	-0.42	-1.69	-1.18	-0.56	-1.01	-0.38	0.08	-0.55
Coal	-3.71	-3.82	-20.62	-0.55	-4.69	-9.38	-24.11	-1.12	-7.01	-16.66	-20.33	-8.72
Oil	-4.36	-4.80	-5.90	-3.07	-3.72	-3.58	-6.26	-2.23	-5.23	-7.25	-3.54	-4.31
Gas	-14.68	-6.73	-17.21	-4.34	-6.67	-9.00	-27.42	-1.75	-8.10	-3.54	-9.00	-13.32
Oil products	-4.08	-1.81	-11.59	2.86	-2.51	-8.89	-4.91	-11.06	-1.49	-23.07	-8.38	-4.20
Processed Food	-0.18	-0.19	-0.24	-0.28	1.31	1.38	-2.26	0.91	-0.98	-0.07	-0.74	-0.21
Energy-Intensive Industry	5.62	0.32	-2.62	1.09	5.97	-3.18	-8.27	4.13	0.71	-0.59	-7.14	-2.99
Transport Motor Vehicle	2.34	0.16	-3.58	-0.37	4.15	3.41	-2.76	4.77	-1.20	2.70	-1.95	0.31
Other Industry	2.56	-0.57	0.77	-1.12	4.59	4.42	-10.04	3.80	-0.89	3.30	-2.52	-2.39
Electricity	-8.06	-4.23	-16.65	1.02	-2.78	-13.60	-7.79	-11.22	-2.66	-12.55	-15.27	-7.70
Construction	-7.19	-2.02	-8.95	2.52	-8.12	-4.97	22.77	-5.94	0.18	0.16	10.25	0.48
Transport Services	-1.83	-0.48	-2.06	2.41	0.09	-3.71	-3.43	-6.50	-1.08	-9.77	-4.60	-2.54
Other Services	-0.87	-0.21	-1.28	-0.05	-0.42	-0.62	0.08	-0.55	-0.22	-0.65	-0.87	-0.32

Source: Authors' calculation.

Emissions reduction will significantly affect U.S. industry output (Table 8, Scenario 3). Energy sectors will likely be most affected, with gas output expected to drop by 4.34%, oil by 3.07%, and coal by 0.55%. In contrast, the output of energy-intensive industry is projected to rise by 1.09%, oil products by 2.86%, construction by 2.52%, and transport services by 2.41%, respectively. For Korea, Japan, and China, industries negatively impacted by U.S. emissions reduction include forestry, oil, transport-motor vehicle, other-industry, and electricity. However, other industries are expected to be positively affected.

Tables 8 and 9 describe the effect of emissions reduction on industry output with trading while excluding and incorporating the U.S. emissions reductions in Scenarios 3 and 4, respectively. Generally, implementing NDC targets leads to a decline in sector output in most countries. Based on Scenario 3, industry output in the U.S., EU27, Korea, Japan, China, U.K., and OIC declines in all industries, except agriculture for Korea and the U.K. (+0.40% and 0.94%, respectively); forestry and fishing +0.8% for Sub-Saharan Africa; energy-intensive industry +5.62%, +0.32%, +1.09%, +5.97%, +4.13% and +0.71% for Korea, Japan, the U.S., U.K., OEX, and EU27, respectively. Industries expected to have increased output include the transport motor vehicle, other industry, and transport services sector. Only Korea, Japan, the OEX, and EU27 will likely have improved output in energy intensive industries.

Table 9. Impact of CO_2 Emissions Reduction with Trading, Including the U.S. (Sc4), on Production by Sector (% change)

Sector	KOR	JPN	CHN	USA	UK	FSU	OIC	OEX	EU27	NAF	SSA	ROW
Agriculture	0.40	-0.41	-0.11	-1.20	0.92	0.13	-1.86	0.06	-1.43	-0.09	-0.68	-0.46
Forest & Fishing	-1.27	-1.02	-0.48	-1.39	-0.45	-1.64	-1.19	-0.61	-1.04	-0.39	0.08	-0.55
Coal	-3.71	-3.82	-20.65	-9.09	-4.74	-9.57	-24.26	-2.06	-7.08	-16.72	-20.56	-9.20
Oil	-5.70	-6.04	-6.97	-6.56	-4.67	-4.66	-8.15	-3.20	-6.10	-8.75	-4.64	-5.57
Gas	-14.68	-6.76	-17.21	-14.40	-6.67	-8.88	-27.39	-0.73	-8.13	-3.52	-8.84	-13.40
Oil Products	-3.56	-1.58	-11.52	-4.53	-2.30	-9.62	-4.92	-10.88	-1.23	-24.72	-8.25	-3.99
Processed Food	-0.19	-0.18	-0.25	-0.64	1.29	1.47	-2.26	0.99	-1.02	-0.04	-0.72	-0.21
Energy Intensive Industry	6.05	0.38	-2.65	-0.30	6.16	-2.47	-8.10	5.47	0.75	-0.44	-6.95	-2.86
Transport Motor Vehicle	2.22	0.07	-3.57	-0.64	4.11	4.12	-2.79	5.41	-1.28	3.20	-1.76	0.34
Other Industry	2.44	-0.63	0.65	-1.29	4.55	4.92	-10.10	4.75	-0.99	3.65	-2.36	-2.40
Electricity	-8.11	-4.26	-16.74	-5.71	-2.75	-13.63	-7.19	-11.28	-2.51	-12.63	-15.09	-7.69
Construct	-7.18	-2.02	-8.95	2.17	-8.12	-5.04	22.75	-6.09	0.18	0.12	10.21	0.46
Transport Services	-1.54	-0.30	-1.77	-1.61	0.55	-3.30	-2.92	-6.19	-0.51	-9.13	-4.22	-2.16
Other Services	-0.87	-0.21	-1.29	-0.18	-0.43	-0.67	0.05	-0.64	-0.24	-0.69	-0.90	-0.33

Source: Authors' calculation.

These countries have been key players in global efforts to combat climate change through environmentally friendly policies, so they likely have already shifted to cleaner production technologies. In such cases, emissions reduction is not likely to adversely affect long-run economic growth (Brown et al., 2022). Therefore, the level of economic and technological development, along with economic structure, plays a vital role in determining the likely impact of emissions reduction.

Suppose the U.S. implements its NDC emission targets as intended under the emissions trading system (Scenario 4). In this case, U.S. production in all industries except the energy-intensive industry and the construction industry will likely drop. The U.S. industry output of coal, oil, gas, oil products, and electricity decline by 9.14.0%, 6.35%, 14.39%, 4.09%, and 5.62%, respectively. Notwithstanding, the output of U.S. energye-intensive industry with emissions trading will likely grow by 0.02%. However, if the U.S. does not reduce its CO_2 emissions (Scenario 3), production of energy sectors and energy-intensive industry will increase by 0.75%, which means that emissions reduction hurts the output of the energy sectors and energy intensive industry.

The impact of emissions reduction on industry production is shown in Tables 10 and 11. Table 10 illustrates the impact of emissions reduction without the flexibility mechanism, while Table 11 describes the emissions reduction under an emissions trading system. In both Tables 10 and 11, except for the U.S., values for all regions represent the likely impact of the implementation of NDC targets by the U.S. on production by industry. Simulation results for the U.S. illustrate the opportunity (economic) costs the U.S. will incur in meeting its NDC emission targets in the form of changes in production by sector. Compared to emissions reduction under the regulatory approach, emissions reduction with trading results in a minimal loss in industry output. Another critical observation is that apart from the energy sectors (coal, oil, gas, oil products, and electricity), other sectors significantly affected include agriculture, forestry, energ-intensive industry, construction, and transport services. Additionally, the impact on sector output is heterogeneous concerning industry and region.

Table 10. Loss in Industry Output from CO_2 Emissions Reduction with No Trading (Sc2-Sc1) (% change)

Sector	KOR	JPN	CHN	USA	UK	FSU	OIC	OEX	EU27	NAF	SSA	ROW
Agriculture	-0.18	-0.18	-0.19	-0.55	-0.23	-0.10	-0.19	-0.06	-0.27	-0.01	-0.13	-0.08
Forest & Fishing	-0.26	-0.34	-0.34	-0.46	-0.25	-0.59	-0.14	-0.13	-0.20	-0.03	-0.02	-0.08
Coal	-0.02	0.00	-7.61	-8.42	-0.05	-0.73	-3.05	-1.91	-0.14	-0.10	-1.58	-4.32
Oil	-2.71	-2.29	-4.17	-3.75	-1.87	-2.40	-2.43	-1.79	-1.81	-2.87	-2.20	-2.06
Gas	-15.41	-0.18	-0.08	-9.97	0.00	-0.17	-0.52	0.78	-0.19	-0.07	-0.37	-0.48
Oil Products	-0.12	0.24	-10.26	-6.61	-0.04	-0.49	0.17	0.29	0.09	-2.04	0.19	0.42
Processed Food	-0.07	-0.04	-0.33	-0.37	-0.13	0.02	-0.06	0.00	-0.15	0.00	-0.06	-0.01
Energy Intensive Industry	0.92	0.40	-3.33	-0.73	0.71	1.95	1.24	4.11	0.43	0.90	1.57	0.85
Transport Motor Vehicle	-0.31	-0.35	-1.87	-0.31	-0.24	1.32	-0.14	0.94	-0.19	0.72	-0.14	-0.02
Other Industry	-0.35	-0.22	-1.57	-0.10	0.00	1.17	-0.11	1.36	-0.07	0.74	0.15	0.01
Electricity	-0.08	-0.11	-8.76	-6.39	0.04	0.05	1.53	-0.26	0.05	0.05	0.21	-0.03
Construction	0.01	-0.01	-2.17	-0.35	-0.01	-0.14	-0.03	-0.31	-0.02	-0.14	-0.14	-0.29
Transport Services	0.11	0.16	-2.43	-3.63	0.27	0.34	0.83	0.32	0.41	0.60	0.48	0.51
Other Services	0.00	-0.01	-0.62	-0.15	-0.05	-0.08	-0.12	-0.25	-0.07	-0.08	-0.15	-0.05

Source: Authors' calculation.

As seen in Table 10, the loss in industry output for the U.S. due to emissions reduction is its opportunity costs, which amount to 8.42% for coal, 3.75% for oil, 9.97 % for gas, 4.09% for oil products, 0.73% for energy- intensive industry, and 6.39% for electricity. Industry output for China is projected to be adversely affected, with oil product output dropping by 10.26%, followed by electricity, which will likely fall by 8.76%, coal by 7.61, oil by 4.17%, and energy- intensive industry by 3.33%. The output for Korea's gas sector will likely decrease by 15.41%, the highest, while oil is projected to decline by 2.71%. The impact on sectoral output for Japan and EU27 is mild compared to other countries, with output for Japan and the EU27's oil sectors dropping by 2.29% and 2.87%, respectively.

Table 11. Loss in Industry Output from CO_2 Emissions Reduction with Trading (Sc4-Sc3) (% change)

Sector	KOR	JPN	CHN	USA	UK	FSU	OIC	OEX	EU27	NAF	SSA	ROW
Agriculture	-0.01	0.02	0.00	-0.42	-0.02	0.02	0.00	0.01	-0.04	0.05	0.01	0.00
Forest & Fishing	-0.01	-0.01	-0.01	-0.16	-0.02	0.05	-0.01	-0.05	-0.03	-0.01	0.00	0.00
Coal	0.00	0.00	-0.03	-8.54	-0.04	-0.18	-0.15	-0.94	-0.07	-0.06	-0.23	-0.49
Oil	-1.34	-1.24	-1.06	-3.49	-0.95	-1.08	-1.89	-0.97	-0.87	-1.51	-1.10	-1.26
Gas	0.00	-0.03	0.00	-10.07	-0.01	0.12	0.02	1.03	-0.03	0.02	0.16	-0.08
Oil Products	0.53	0.23	0.07	-7.39	0.21	-0.73	-0.01	0.19	0.26	-1.65	0.14	0.20
Processed Food	-0.01	0.01	0.00	-0.36	-0.02	0.10	0.00	0.08	-0.04	0.03	0.02	-0.01
Energy Intensive Industry	0.43	0.06	-0.03	-1.39	0.19	0.71	0.17	1.34	0.05	0.15	0.19	0.13
Transport Motor Vehicle	-0.12	-0.09	0.01	-0.27	-0.05	0.71	-0.03	0.64	-0.08	0.50	0.19	0.04
Other Industry	-0.12	-0.06	-0.12	-0.17	-0.04	0.49	-0.06	0.95	-0.10	0.35	0.16	-0.01
Electricity	-0.06	-0.03	-0.09	-6.73	0.03	-0.03	0.59	-0.06	0.15	-0.08	0.18	0.00
Construction	0.01	0.00	0.00	-0.35	0.00	-0.07	-0.01	-0.15	-0.01	-0.05	-0.04	-0.02
Transport Services	0.29	0.18	0.29	-4.03	0.46	0.41	0.51	0.31	0.57	0.64	0.39	0.38
Other Services	0.00	0.00	-0.01	-0.13	-0.02	-0.04	-0.03	-0.10	-0.02	-0.04	-0.03	-0.01

Source: Authors' calculation.

Simulated results in Table 11 describe the likely impact of emissions reduction on output under the market-based trading system. Generally, the loss in production is not homogenous, but differs by sector and region. Even with emissions trading, the impact on the oil and electricity sectors is still significant. The impact on third party sector output is mild, though for many sectors it is positive. Even with emissions trading (Sc4), except for the oil sector, U.S. production for other energy sectors will likely drop more than under emissions reduction with no trading scenario (Sc3). For example, for the U.S., the loss in output is projected to be 8.54 % (8.42%) for coal, 10.07% (9.97 %) for gas, 7.39% (6.61%) for oil products, and 6.73% (6.39%) for electricity. With emissions trading, oil sector output will likely improve by 0.26% compared to emissions reduction under the regulatory scenario. Simulation results indicate that emissions reduction with trading will positively impact sector output. Even with emissions trading, oil sector output declines significantly across all economies. For example, oil output for Korea fell by 1.34%, Japan by 1.24%, China by 1.06%, the U.K. by 0.95%, and EU27 by 0.87%. Other regions significantly impacted include other industrialized countries, a drop of 1.89%; North Africa, a drop of 1.51%; SSA at 1.01%, and for the Rest of the World, a drop of 1.26%.

Table 12. Impact of CO_2 Emissions Reduction on Welfare in US$ (millions)

Region	Change (US$ million)				Opportunity Costs	
	Sc1	Sc2	Sc3	Sc4	Sc2-Sc1	Sc4-Sc3
Korea	-22,750.8	-22,441.0	-20,704.4	-20,564.3	309.8	140.0
Japan	-12,901.5	-11,778.5	-11,995.8	-11,376.6	1,123.0	619.1
China	-148,761.0	-258,464.6	-252,985.3	-252,214.3	-109,703.6	771.0
USA	22,557.3	-37,836.9	23,144.3	-37,001.9	-60,394.2	-60,146.2
United Kingdom	-46,014.7	-46,495.7	-39,903.4	-40,061.4	-481.0	-157.9
Former Soviet Union	-109,285.1	-118,440.6	-100,361.7	-104,952.2	-9,155.4	-4,590.4
Other Industrial Countries	43,190.5	40,882.0	61,767.1	60,326.6	-2,308.5	-1,440.6
Oil Exporting Countries	-67,634.4	-84,105.6	-69,970.1	-78,089.3	-16,471.2	-8,119.2
EU27	-60,821.2	-61,538.3	-52,687.5	-52,328.2	-717.2	359.3
North-Africa	-16,436.4	-17,323.1	-16,756.2	-17,236.4	-886.8	-480.1
Sub-Saharan Africa	-7,422.0	-9,494.3	-7,473.3	-8,299.7	-2,072.3	-826.4
Rest of the World	-83,489.1	-91,782.1	-84,232.4	-85,937.7	-8,293.0	-1,705.3

Source: Authors' calculation.

The effects of CO_2 emissions reduction on welfare, measured in terms of the equivalent variation (EV), are in Table 10. EV is a monetary measure of the change in utility emanating from a change in the prices of goods due to an economic shock. Generally, CO_2 emissions reduction adversely affects welfare among industrialized nations (major global CO_2 emitters). In particular, countries/regions where welfare is projected to drop sharply include China (US $109.70 billion), the U.S. (US $60.39 billion), the oil exporting region (US $16.47 billion), the Former Soviet Union region (US $9.16 billion), and the Rest of the World (US $8.29 billion). Welfare decomposition indicates that much of the welfare gain emanates from technical change, which is in line with available literature (Brown et al., 2022). However, this gain is not sufficient to offset the welfare loss from allocative efficiency, carbon trade balance, and loss in endowment.

V. Conclusion

In the present study, we have attempted to examine the impact of reducing CO_2 emissions by the U.S. and 11 other countries/regions using a global multi-sector static GTAP-E model.

The study's findings suggest that emissions reduction will likely lead to significant economic losses for all economies. Simulated results indicate that, even in scenarios where the U.S. is excluded from emissions reduction, such as Scenarios 1 (no trading) and 3 (with trading), the U.S. will suffer significant losses in real GDP and welfare. The fall in real GDP and welfare is possibly due to decreased output in energy sectors: coal, oil, gas, oil products, electricity, and the transport services sector.

According to the simulation results, emissions reduction by the U.S. will lead to a decline in output in all scenarios. The economic costs of implementing the NDC targets by the U.S. will be the reduced output of the energy sectors, energy-intensive industry, and transport-services sector. The opportunity costs the U.S. will likely incur for implementing its new NDC targets upon re-entry into the Paris Climate Agreement of 2015 in case of CO_2 emissions reduction without trading and with trading are a 0.37% and a 0.39% decline in real GDP, respectively, and a $ 61.87% and $60.08 billion decline in welfare, respectively. Additional opportunity costs include a likely drop in industry output of 38.07% and 5.71% in coal, a decrease of 6.87%, and 1.61% in oil, a 61.23% and 9.62% drop in gas, a 17.41% and a 1.88% fall in oil products, a 20.39% and a 2.92% decline in electricity, and a 10.35% and a 0.37% fall in transport services sector, under an emissions reduction scenario with no flexibility mechanism, and another with trading, respectively.

Excluding the U.S. in global CO_2 emissions reductions (Scenario 1) with no trading will likely lead to a lower economic impact than CO_2 emissions reduction by all countries, including the U.S. The real GDP for Korea will likely decline by 1.77% (SC1) compared to 1.79% (SC2), with that of Japan, China, and EU27 declining by 0.36% (SC1) and 0.36% (SC2), 0.64% (SC1) and 2.40% (SC2), and 0.54% (SC1) and 0.55% (SC2), respectively. On the other hand, simulation results indicate that implementing NDC emission targets under a market trading system leads to a relatively lower decline in real GDP growth. Regarding bilateral trade, simulation results indicate that CO_2 emissions reduction leads to mixed effects. Generally, bilateral export transactions across all scenarios are least impacted compared to import flows. Further, even though imports by most regions will significantly decline, imports by the U.S., EU27, Korea, China, and Japan will be mildly impacted.

A review of simulated results indicates that changes in domestic production are heterogeneous concerning industry output and region. Taking the difference between Scenarios 1 and 2 (emissions reduction with no use of flexibility mechanism) shows that implementing NDC targets by the U.S. will significantly reduce the industry output of the energy sectors. For Korea, gas output will likely decline by 15.41%, while oil products for China will decrease by 10.26%, coal by 7.61%, and electricity by 8.76%. For the U.S., coal will likely drop by 8.42%, gas by 9.97%, oil products by 6.61%, and electricity by 6.39%. On the other hand, the impact on domestic industry output for Japan and the EU27 will likely be mild.

Simulation results also suggest that several factors influence the magnitude of the impact of emissions reduction by the U.S. on its trading partners. These factors include technological advancement, the volume of bilateral trade with the U.S., the nature of traded commodities, and efforts to implement environment-promoting policies. For instance, Japan is less impacted than China and Korea; on the other hand, China is more affected than Korea. Overall, the EU27 is less impacted compared to all other developed economies. Besides being technologically advanced, the EU27 has been leading in implementing environment-friendly policies (Brown et al., 2022).

Furthermore, simulation results corroborate prior studies on the ability of the market-oriented emissions trading system to lower the

costs associated with CO_2 emissions reduction owing to its greater flexibility in reallocating resources. This study's simulation results encourage empowering the global emissions reduction flexibility mechanisms, taxation, and environmental policies that support a smooth transfer of green technologies that enhance energy efficiency (IRENA, 2021; Ko, 2014). Additionally, governments should re-calibrate regulatory instruments to fix minimum efficiency standards in buildings, appliances, vehicles, and industry; fiscal or financial incentives to encourage the installation of energy-efficient equipment; and information programs to aid energy consumers in making environmentally supportive choices (IRENA, 2021).

In addition, this study emphasizes the need for shared responsibility concerning CO_2 emissions reduction since including the U.S. in emissions reduction lessens the NDC-derived economic losses for third-party countries. Additionally, to ensure a fair distribution of responsibility and economic costs, each country's contribution to global emissions reduction must align with its GHG emissions, rather than burdening developed countries.

Finally, simulation results indicate that environmental policies are unlikely to result in a double dividend situation, meaning an improved environment and economy simultaneously. The reason is that reducing CO_2 emissions will lead to a decline in real GDP growth for all countries rather than an increase, as argued by the double dividend hypothesis. Hence, this study shows that the double dividend hypothesis may not hold.

Future studies should consider adopting the dynamic CGE model to uncover further insights into the impact of global emissions reduction, the impact of emissions reduction by the U.S. on its trading partners, and the opportunity costs of implementing U.S. NDC targets. The ability of the dynamic CGE model to account for capital accumulation and policy implementation over time makes it more appropriate since CO_2 emissions reduction is a commitment for the future.

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Financial Intermediation and Economic Growth: Evidence from Nepal

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ABSTRACT

Purpose – This study aims to investigate the role of financial intermediation in Nepalese economic growth using time-series data over the period from 1974 to 2019. In order to establish the relationship, GDP per capita is used as a proxy for economic growth, while private sector credit, commercial bank assets, and the broad money supply serve as proxy measures of financial intermediation.

Design/Methodology/Approach – To obtain empirical results, the Johansen test of co-integration, the vector error correction model, and the Granger causality test are applied.

Findings – The results support finance-led growth in Nepal, implying that financial intermediation is positively associated with economic growth in the long run. A positive association with total trade was observed in the short run, but a negative effect was found in the long run. Granger causality tests indicate that the broad money supply and commercial bank assets are bidirectionally related to Nepal's economic growth, while private sector credit is unidirectional.

Research Implications – The findings suggest that if central bank authorities prioritized monetary policy tools, it may foster economic growth in Nepal in both the short- and long terms. In addition, for the persistent growth of the Nepalese economy, the banking sector should be reformed by employing more liberal policies. The study also suggests that policymakers should take immediate action to correct the direction of Nepalese foreign trade.

Keywords: economic growth, financial Intermediations, Nepal, VECM
JEL Classifications: C51, E44, E47

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I. Introduction

Financial intermediations perform an efficient role in economic growth through the accumulation of savings for sustainable economic development. Therefore, financial intermediation and economic growth are considered complementary. Financial institutions contribute by channelizing funds from surplus units to deficit units (Shaw, 1973; McKinnon, 1973). Generally, financial institutions enhance economic growth by mobilizing resources, increasing saving rates, endorsing market expansion and instruments, providing efficient payment mechanisms, and so on. (Levine & Zervos, 1998). The banking system played a crucial role in promoting industrialization in England by making it easier to mobilize capital (Bagehot, 1873; Hicks, 1969). There have been a number of studies that have shown support for the supply-leading hypothesis, which posits that financial intermediation leads to economic growth (Graff, 2002; Islam et al., 2004; Murinde & Eng, 1994; Neusser & Kugler, 1998; Rousseau & Wachtel, 1998). On the other hand, some other scholars also found bidirectional causality between financial intermediation and growth (Arestis & Demetriades, 1997; Demetriades & Hussein, 1996; Luintel & Khan, 1999). The above studies provided strong evidence of the theoretical and empirical backgrounds for the financial intermediation-growth nexus.

Nepal is a developing country with an economy heavily dependent on agriculture, remittances, and tourism. Agriculture is the backbone of Nepal's economy, employing around 65% of the population, and contributing around 30% of the country's GDP. Remittance plays a significant role in the Nepalese economy. A large number of citizens work abroad, primarily in the Gulf countries, Malaysia, and India. Remittances from these workers make up around 25% of Nepal's GDP. Tourism is an important industry for the Nepalese economy. Nepal's rich culture and natural beauty attract a large number of tourists each year. Tourism accounts for around 7% of Nepal's GDP. Nepal's industrial sector is small and mainly focused on light manufacturing, such as textiles and food processing. Heavy industry is limited due to the country's mountainous terrain and lack of natural resources, and contributes only about 5% of Nepal's GDP. Hence, Nepal has a trade deficit and relies heavily on imports, particularly petroleum products, machinery, and consumer goods. Nepal is one of the world's poorest countries, with a large portion of the population living below the poverty line. GDP per capita is an average of around $1,100 (Ministry of Finance, 2019). The government has implemented various programs to alleviate poverty and promote economic development, along with the financial sector.

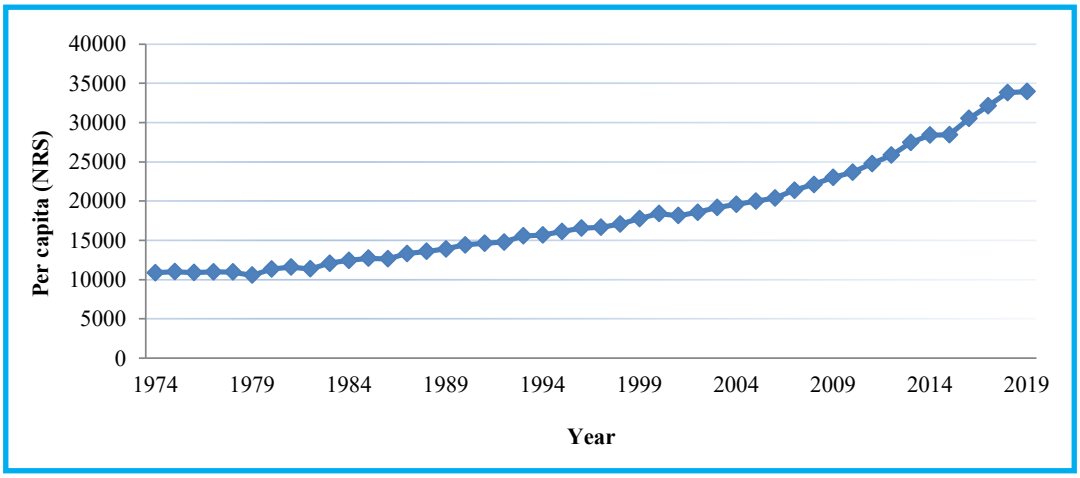
The financial system of Nepal consists of deposit receiving as well as the contract saver organization. Financial institutions that accept deposits are commercial banks, intermediations banks, finance companies, microfinance institutions, cooperatives, and non-government financial organizations. At the same time, contract saving institutes consist of insurance companies, employee provident funds, the Nepal stock exchange, postal saving offices, and citizen investment trusts. The central bank of Nepal, Nepal Rastra Bank, regulates and supervises all banks in the country. By the middle of April 2019, 175 banks and financial institutions will be operating, including 28 commercial banks, 32 intermediary banks, 24 finance companies, and 91 microfinance institutions.

Additionally, there are 40 insurance firms, 34,737 cooperatives, the employees' provident fund, citizen investment trust, and postal savings banks. (Ministry of Finance, 2019). The banking sector has obtained a significant contribution to total assets and liability composition rather than other financial organizations. In 2019, the bank and financial institutions made the most considerable contribution of 87.3 percent to overall financial sectors assets and liabilities, with the Nepal Rastra Bank and Commercial Bank sharing 18.5 percent and 57.7 percent, respectively. The GDP ratio of broad money, credit issues by the private sector, and total deposits have been rising.

The intermediations of the financial sector

in Nepal were observed when widespread revolutionary changes occurred in the 1980s. Under the liberalization policy, the Nepalese financial sector transferred from government-owned to the private sector. Several steps have been taken by the central bank and the Government of Nepal to further accelerate the speed of this transition process for the growth of the country's financial sector. The significant impact of private sector credit was found in the early 2000s after the financial liberation policy was implemented. The data suggest that financial access and economic monetization have increased over the last few decades. According to the Ministry of Finance (2019), private sector credit increased by 80.6%, total deposits by 90.5%, and broad money supply to GDP ratio by 102.2% in the fiscal year 2017/2018.

Fig. 1. Trend of Nepal's GDP per Capita



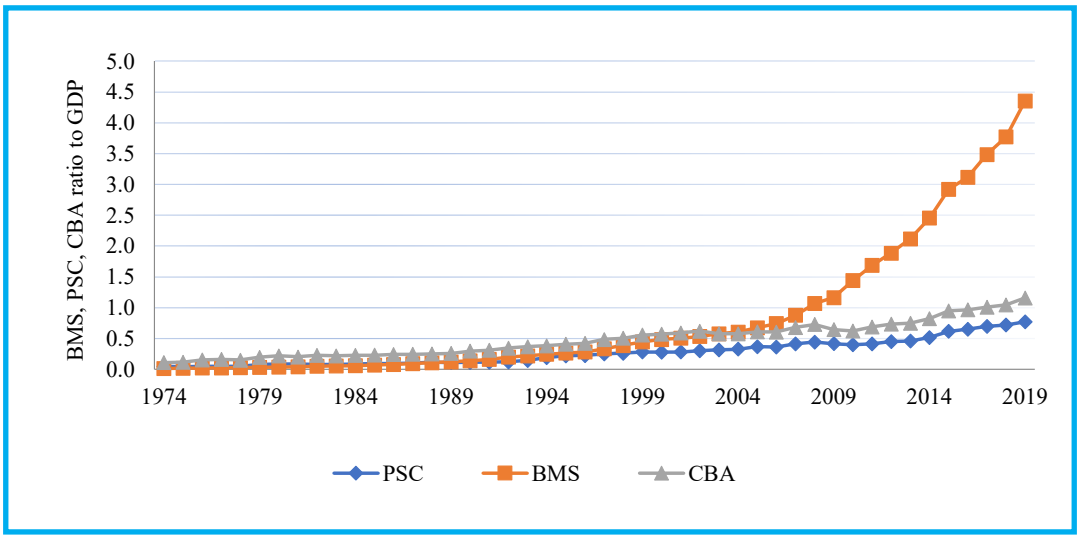
Sources: Nepal Rastra Bank (2019/20) and World Bank (2020).

Fig. 1 illustrates that GDP per capita has not increased continuously at the same ratio. Before the 1980s, such a ratio was the minimum, but after the 1980s, when a broad-based program of reforms was launched, the ratio has increased continuously. Similarly, the banking sector of Nepal witnessed revolutionary changes. The banking sector transformed from a government-owned inefficient form to an efficient private sector. The government and the Central Bank of Nepal adopted several measures for better performance of the financial sector.

Fig. 2 depicts the changes in financial intermediation after the implementation of the Nepalese Financial Liberalization Policy in early 2000. As shown in the Fig., indicators such as the ratio of the broad money supply to nominal GDP (BMS), private sector credit to nominal GDP (PSC), and commercial bank assets to nominal GDP (CBA) had a significant impact. The graph demonstrates that after the liberalization policy, there is an upward trend in all indicators mentioned, indicating an increase in the financial intermediation in the economy.

Despite the Central Bank of Nepal's efforts to reform the financial sector and the success of the banking sector in terms of profits, it is unclear to what extent the financial sector is contributing to the economic growth of the country. Different findings have led to different views on the relationship between financial development and economic growth. There are three main views.

Fig. 2. Major Indicators of Financial Intermediation in Relation to the Nominal GDP Ratio



Source: Nepal Rastra Bank (2019/20).

The first view suggests that financial development and economic growth are strongly related, and the financial sector drives economic growth. The second view proposes a bidirectional relationship, wherein economic growth leads to financial development, and vice versa. The third view suggests that the financial sector may have a negative effect on economic growth. Our review of the literature reveals no common findings on the relationship between financial intermediation and economic growth, but rather contradictory empirical results. These differing views highlight the need for further research in the context of Nepal in order to fully understand the role of financial development in driving economic growth.

Previous studies in Nepal have focused on a single factor as a financial intermediary, and have overlooked other crucial factors. In the case of Nepal, there are also relatively few empirical studies on the relationship between financial intermediation and economic growth. Overall, while the financial sector in Nepal still faces challenges, the government and financial sector stakeholders are working to promote development and improve access to finance for all Nepalese citizens, it may have great importance in economic planning, policy formulation, and implementation. These various views indicate the scope of further research in the context of Nepal, which motivates us to identify the role of financial development in economic growth.

The study uses slightly different approaches, which are summarized as follows. First, this study simultaneously incorporates all major financial intermediations such as broad money supply, private sector credit, and commercial bank assets. By considering these key indicators, the study hopes to provide a more nuanced understanding of the link between financial intermediation and economic growth in Nepal. Secondly, three separate models are employed to estimate the relationship between financial intermediation and economic growth to reduce the spurious results caused by multicollinearity in regression analysis. Finally, we compare the result of each financial intermediation with the existing result. For empirical analysis, the Johansen test of co-integration, the vector error correction model, and the Granger causality test are applied using time-series data over the period of 1974 to 2019.

Thus, an empirical attempt seems obligatory to fill this research gap in the literature and show the significance of financial sector intermediations on economic growth in Nepal.

The remainder of this paper is organized as follows. Section II examines an overview of the literature review with the theoretical background and empirical analysis. Section III describes the research methodology with a descriptive summary. Section IV provides empirical results with a discussion, and Section V concludes.

II. Literature Review

The examination of the relationship between financial intermediation and economic growth has been a topic of interest among scholars since the pioneering contributions of Cole (1974), Lucas (1988), McKinnon (1974), and Robinson (1952). This has led to a vast amount of theoretical and empirical literature on the subject. The literature on financial intermediation and economic growth can be broadly categorized into four groups: (a) financial-led growth, (b) growth-led finance, (c) bi-directional causality, and the (d) independent hypothesis, which is considered to be the main theoretical foundation of financial intermediation and economic growth (Al-Yousif, 2002; Majid & Mahrizal, 2007). Many studies have been conducted on this topic, and they provide a comprehensive literature review. (Acaravci et al., 2009; Al-Yousif, 2002; Demirguc-Kunt & Levine, 2008; Eschenbach, 2004; Levine & Zervos, 1998; Tsuru, 2000). Besides these studies, some other empirical analyses also concluded the significant role of the financial sector and trade for economic development (Atajanov & Yi, 2023; Cha & Yi, 2021; Gao & Jin, 2022; Qin & Jin, 2022; Salam & Hwang, 2021; Yang & Kang 2021).

Islam et al. (2004) studied the impact of financial development on the economic growth of Bangladesh using time series data from 1975 to 2002. By employing the Granger causality test, empirical evidence only supported growth-led financial development. Liang and Jian-Zhou (2006) disclosed the relationship between the financial development and economic growth of China for the period of 1952 to 2001. The multivariate vector autoregressive (VAR) model suggested long-run association and unidirectional causality from economic growth to financial growth. Khan (2008) examined the relationship between financial development and economic growth in Pakistan utilizing annual data over the period of 1961 to 2005. Based on the autoregressive distributed lag (ARDL) approach, the empirical findings suggested that deposit rate has a positive and significant association with economic growth in the short run, but is insignificant impact in the long run. The study suggests that to achieve sustainable economic growth, Pakistan should focus on liberalization processes with strong commitment. Ilhan (2008) reviewed the finance-growth nexus in Turkey for the period of 1975 to 2005. Based on the vector autoregression (VAR) model, the empirical results revealed no long-run association between financial development and economic growth. Furthermore, there was evidence of one-way causality, with economic growth causing changes in financial development. Perera and Poudel (2009) investigated the causal relationship between financial development and economic growth in Sri Lanka for the period of 1955 to 2005. The empirical results supported bilateral causality between broad money and growth, while private sector credit has unilateral causality. Aggarwal and Mehra (2013) explored the multipart relationship between financial development and economic growth in India from 1970/1971 to 2011/2012. For empirical results, a co-integration test and vector error correction model (VECM) was conducted. The result revealed that deposits and money supply have both short-run and long-run associations, implying that an increase in bank deposits enhances investment and growth.

Samargandi et al. (2015) revisited the relationship between financial development and economic growth in middle-income countries using panel data from 52 countries over the period of 1980 to 2008. Based on the estimation of the pooled mean group (PMG) and dynamic fixed effect

(DFE) model, the results supported only the long-run association between finance and growth. Additionally, they discovered that an inverted-U-shaped relationship existed, indicating that too much finance can have a negative effect on growth. Ibrahim and Alagided (2018) tested the overall impact of financial development on economic growth in 29 sub-Saharan African countries for the period of 1980 to 2014. The empirical outcome from the system-generalized methods of movement (GMM) reported that financial development had a positive effect on economic growth, but that excessive levels of finance could negate this positive impact. Cizo et al. (2020) analyzed the impact of financial development and economic growth in EU member countries over the period of 1995 to 2017. The result reported a close relationship between financial development and growth, and confirmed the finance-led growth hypothesis. They also reported that causality may differ if a separate group of countries is considered. Cheng et al. (2021) explored the association between financial development and economic growth based on panel data from 72 countries for the period of 2000 to 2015. The generalized methods of movement (GMM) stated that financial development does not favor economic growth. However, they also reported that the negative impact of financial development on economic growth was more pronounced in high-income countries than in middle- and low-income countries.

In the Nepalese economy, the empirical analysis found that an efficient financial system could only effectively allocate resources for sound economic growth (Bhetuwal, 2007). The financial sector, particularly the banking sector, is more important to Nepal's economic growth than the capital market (Kharel & Pokhrel, 2012). Private sector credit issued by commercial banks has a long-run positive impact on Nepalese economic growth (Timsina, 2014). Economic growth is important for financial intermediations and vice-versa. Both supply-led and demand-led conditions are present in the Nepalese economy (Gautam, 2014).

The relationship between financial development and economic growth is a complex and controversial topic in economics. Studies have produced conflicting results, and the relationship can vary depending on the indicators used, the stage of economic development, and the methods employed in the analysis. Further research is needed to fully understand the connection between these factors in a time series context.

III. Research Methodology and Data

In this study, the basic form of the estimation model used to establish the influence of financial intermediation, along with explanatory variables such as total trade, on economic growth is developed as follows:

$$PGDP = f\ (FI,\ TTR) \tag{1}$$

where *PGDP* stands for real gross domestic product per capita income, *FI* stands for financial intermediations, which is represented by the three indicators, such as broad money supply (*FI1*), private sector credit (*FI2*), and commercial bank assets (*FI3*), and *TTR* is total trade.

Equation (1) can be specified using the following vector error correction models (VECM) after transforming the variables into natural logarithms.

$$\Delta LPGDP_t = \theta_1 + \alpha_1 ECT_{t-1} + \sum_{i=1}^{k} \gamma_{11i}\, \Delta LPGDP_{t-i} + \sum_{j=1}^{k} \gamma_{12j}\, \Delta LFI_{t-j} + \sum_{m=1}^{k} \gamma_{13m}\, \Delta LTTR_{t-m} + \mu_{1t} \tag{2}$$

$$\Delta LFI_t = \theta_2 + \alpha_2 ECT_{t-2} + \sum_{i=1}^{k} \gamma_{21i} \Delta LPGDP_{t-i} + \sum_{j=1}^{k} \gamma_{22j} \Delta LFI_{t-j} + \sum_{m=1}^{k} \gamma_{23m} \Delta LTTR_{t-m} + \text{ц}_{2t} \quad (3)$$

$$\Delta LTTR_t = \theta_3 + \alpha_3 ECT_{t-3} + \sum_{i=1}^{k} \gamma_{31i} \Delta LPGDP_{t-i} + \sum_{j=1}^{k} \gamma_{32j} \Delta LFD_{t-j} + \sum_{m=1}^{k} \gamma_{33m} \Delta LTTR_{t-m} + \text{ц}_{3t} \quad (4)$$

However, the main objective of this study is to find the impact of financial intermediations and economic growth; therefore, Equation 2 is further elaborated into the following form:

$$\Delta LPGDP_t = \theta + \alpha\, ECT_{t-1} + \sum_{i=1}^{k} \beta_i \Delta LPGDP_{t-i} + \sum_{j=1}^{k} \gamma_j \Delta LFI_{t-j} + \sum_{m=1}^{k} \phi_m \Delta LTTR_{t-m} + \text{ц}_t \quad (5)$$

Where k is the lag length. β, γ and ϕ are short-run dynamic coefficients, α is the speed of adjustment parameters, ECT_{t-1} is the error correction term, and ц_t is residuals (stochastic error terms).

In this study, GDP per capita, denoted by *LPGDP*, is used as a measure of output per head. GDP per capita is defined as the ratio of real GDP to the total population, and it is a widely used indicator of a country's standard of living and economic welfare. The data on real GDP was obtained from Nepal Rastra Bank's Statistical Tables 2019, while population data was sourced from the World Development Indicators of the World Bank. The broad money supply is the sum of total currency plus demand and time deposited. It shows the liquidity liabilities of an economy. More specifically, this study uses the ratio of broad money supply and nominal GDP (*M2*), and is denoted by *LFI1*. The data on broad money supply and Nominal GDP are from Nepal Rastra Bank's Statistical Tables in 2019. Private sector credit depicts the total credit capacity of a commercial bank. It also shows the efficiency of the financial service. This study uses the ratio of private sector credit and nominal GDP (*PSC*), as denoted by *LFI2*. The data on private sector credit is from Nepal Rastra Bank's Statistical Tables in 2019. Commercial bank asset shows efficiency in delivering financial service, the capacity for risk tolerance, and others. In this study, the ratio of commercial bank assets and nominal GDP (*CBA*) is taken and denoted by *LFI3*. The data on commercial bank assets are from Nepal Rastra Bank's Statistical Tables in 2019Total trade indicates specialization and competitiveness in real sectors of economic growth. Here, the ratio of total trade and nominal GDP ratio is taken as a control variable in this study and denoted by *LTTR*. The data was obtained from the World Development Indicators published by the World Bank.

The descriptive statistics of both dependent and independent variables such as mean, median, maximum, minimum, standard deviation, coefficient of variation, skewness, and kurtosis are calculated and presented in Table 1. The entire study period consists of 46 years. The positive values of kurtosis for all variables suggest that the variable frequency curves are peaked. The positive values of *PGDP*, *BMS*, *PSC*, *CBA*, and *TTR* confirm that they are positively skewed. The Jarque-Bera statistics and the respective probabilities for each observation show that some variables in the dataset are normal, while others are not, indicating that the variables are heterogeneous in terms of distribution. The overall summary statistics infer that all variables show somewhat similar characteristics.

Table 1. Descriptive Statistics

	FI1	FI2	FI3	TTR	PGDP
Mean	0.83	0.27	0.48	0.31	18257.75
Median	0.31	0.24	0.45	0.35	16635.56
Maximum	4.36	0.77	1.16	0.44	33958.19
Minimum	0.01	0.04	0.11	0.16	10569.73
Std. Dev.	1.13	0.20	0.28	0.08	6732.16
Skewness	1.68	0.83	0.59	-0.36	0.85
Kurtosis	4.76	2.75	2.46	1.68	2.71
Jarque-Bera	27.56	5.35	3.18	4.36	5.67
Probability	0.00	0.07	0.20	0.11	0.06
Period	46	46	46	46	46

Notes: 1. *FI1*, *FI2*, and *FI3* denote financial intermediations and are measured by *M2*/*NGDP* (broad money supply), *PSC*/*NGDP* (private sector credit issued by commercial), and *CBA*/*NGDP* (commercial bank assets) respectively Similarly, *TTR* and *PGDP* indicate total trade and GDP per capita and calculated by *TTR*/*NGDP* and *GDP*/*POP* respectively.

2. The above values are calculated without transforming the variables in a natural logarithm.

Table 2. Correlation Matrix

	LFI1	*LFI2*	*LFI3*	*LTTR*
LFI1	1.00			
LFI2	0.94	1.00		
LFI3	0.91	0.95	1.00	
LTTR	0.40	0.48	0.42	1.00

Note: *LFI1*, *LFI2*, and *LFI3* denote financial intermediations and are measured by *M2*/*NGDP* (broad money supply), *PSC*/*NGDP* (private sector credit issued by commercial), and *CBA*/*NGDP* (commercial bank assets) respectively Similarly, *LTTR* indicate total trade and calculated by *TTR*/*NGDP*.

Table 2 displays the correlation matrix. The dependent variables, *LFI1*, *LFI2*, and *LFI3*, exhibit strong correlations with coefficients ranging from 0.91 to 0.95. This indicates that if these variables are used together in a regression model, multicollinearity issues may arise. Therefore, the model considers *LFI1*, *LFI2*, and *LFI3* separately. On the other hand, the correlation between financial intermediation variables does not show a significant correlation with *LTTR*, as coefficients range from 0.40 to 0.48. It is worth noting that there is a positive correlation among the variables.

Making non-stationary data into stationary data is the first stage in creating an econometric model of time series data. For time series analysis, data stationary is a necessary condition. If the mean and variance of the time-series data are constant across time, then the data is considered stationary.

Table 3. Unit Root Test

Variable	Intercept		Intercept and Trend		None	
	Level	1st Diff.	level	1st Diff.	Level	1st Diff.
LFI1	-1.53 (0.51)	-5.70** (0.00)	-2.60 (0.28)	-5.78** (0.00)	-0.28 (0.58)	-0.94 (0.30)
LFI2	-0.56 (0.87)	-6.71** (0.00)	-3.09 (0.12)	-6.69** (0.00)	-3.96** (0.00)	-4.77** (0.00)
LFI3	-1.35 (0.60)	-7.37** (0.00)	-3.15 (0.11)	-7.45** (0.00)	-4.52** (0.00)	-5.16** (0.00)
LTRR	-2.01 (0.28)	-5.73** (0.00)	-1.53 (0.80)	-5.97** (0.00)	-1.76 (0.07)	-5.80** (0.00)
LGDP	2.36 (-1.00)	-6.87** (0.00)	-1.79 (0.690)	-8.22** (0.00)	7.28 (1.00)	0.52 (0.820)

Notes: 1. The type of this unit root test is Augmented Dickey-Fuller and based on Schwarz info criteria.
2. *p*-values are provided in parentheses.
3. ** and *: significant at 1% and 5 % significance levels, respectively.

Table 3 shows that each variable at the level is non-stationary, but becomes stationary after the first difference. Hence, the further process is estimated through lag selection and the Johansen test of cointegration.

Table 4. Lag Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	70.24282	NA	3.31e-08	-3.034550	-2.829759	-2.959029
1	316.4218	423.6569*	1.14e-12*	-13.32195*	-12.09320*	-12.86882*
2	333.9407	26.07454	1.69e-12	-12.97398	-10.72129	-12.14326
3	357.4353	29.50487	2.07e-12	-12.90397	-9.627315	-11.69564

Notes: 1. *indicates lag order selected by the criterion.
2. LR is the sequential modified LR test statistic (each test at 5% level).
3. FPE is the final prediction error, AIC is the Akaike information criterion, SC is the Schwarz information criterion, and HQ is the Hannan-Quinn information criterion.

The maximum lag length is determined by Schwarz and Akaike's Information Criterion based on the lag criteria with the lowest value. Most of the criteria suggest that lag 1 is optimal (see Table 4) for further process. Hence, lag one is used in Johnson's Cointegration Test and Granger Causality Test.

Table 5. Cointegration Test

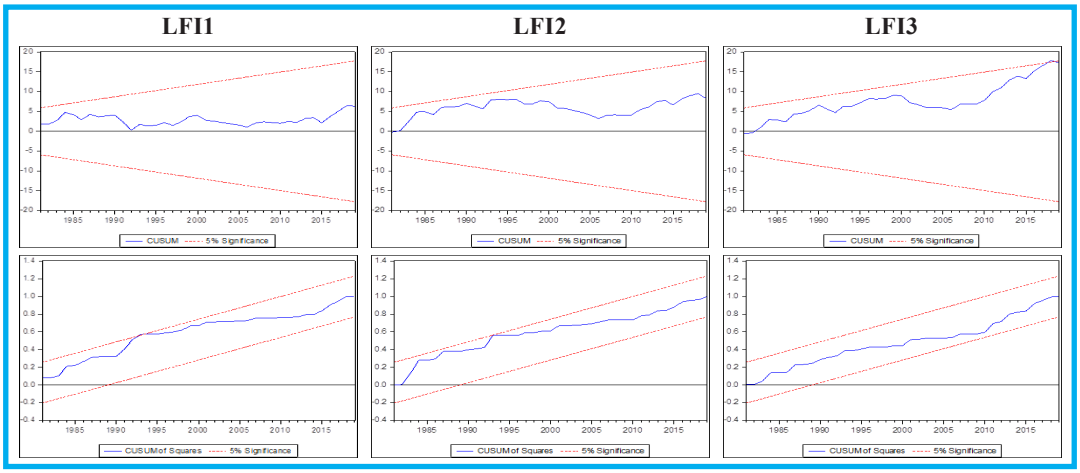
Series: LFI1, FI2, FI3, PGDP LTTR						
	Trace Value			Maximum Eigenvalue		
Hypothesized No. of C.E. (s)	Trace Statistic Value	Critical Value	Prob. Value	Trace Statistic Value	Critical Value	Prob. Value
None *	95.6	69.82	0.0001	36.24	33.88	0.0257
At most 1*	59.38	47.86	0.0029	29.94	27.59	0.0245
At most 2	29.43	29.8	0.0549	15.67	21.14	0.2452
At most 3	13.78	15.5	0.0892	12.93	14.27	0.0859
At most 4	1.04	3.85	0.3081	1.04	3.85	0.3081

Note: * Denotes rejection of the hypothesis at the 0.05 level.

Johansen Cointegration Test results show that the variables in this model are related over time. All variables of financial intermediation indicators are cointegrated with economic growth as it is rejected the null hypothesis at five percent, as reported in Table 5. Due to the statistical value of the trace being higher than the critical value and the statistical value of the maximum eigenvalue being higher than the critical value, both tests, the unrestricted cointegration rank test (trace) and the unrestricted cointegration rank test (maximum eigenvalue), explicitly state that the variables are mutually integrated.

To check the stability of the model we employ the CUSUM and CUSUM Squares Test. Fig. 3 shows that the CUSUM and CUSUM Squares line passes through the upper and lower bounds, which confirms the model is dynamic and stable in the long run. Hence, this ensures the model is fit for further econometric analysis.

Fig. 3. CUSUM and CUSUM Squares Test



Source: Authors.

More specifically, Equation (5) is estimated separately in three models called *LFI1*, *LFI2*, and *LFI3* as Equations 5a, 5b, and 5c, respectively, to reduce the spurious result caused by multicollinearity in regression analysis.

$$\Delta LPGDP_t = \theta_1 + \alpha_1 ECT_{t-1} + \sum_{i=1}^{k} \beta_{1i} \Delta LPGDP_{t-i} + \sum_{j=1}^{k} \gamma_{1j} \Delta LFI1_{t-j} + \sum_{m=1}^{k} \phi_{1m} \Delta LTTR_{t-m} + \mu_{t1} \quad (5a)$$

$$\Delta LPGDP_t = \theta_2 + \alpha_2 ECT_{t-1} + \sum_{i=1}^{k} \beta_{2i} \Delta LPGDP_{t-i} + \sum_{j=1}^{k} \gamma_{2j} \Delta LFI2_{t-j} + \sum_{m=1}^{k} \phi_{2m} \Delta LTTR_{t-m} + \mu_{t2} \quad (5b)$$

$$\Delta LPGDP_t = \theta_3 + \alpha_3 ECT_{t-1} + \sum_{i=1}^{k} \beta_{3i} \Delta LPGDP_{t-i} + \sum_{j=1}^{k} \gamma_{3j} \Delta LFI3_{t-j} + \sum_{m=1}^{k} \phi_{3m} \Delta LTTR_{t-m} + \mu_{t3} \quad (5c)$$

The research is entirely based on annual time-series data from fiscal year 1974 to fiscal year 2019. The estimated coefficients of the explanatory variables (β_1, β_2, β_3, γ_1, γ_2, γ_3, ϕ_1, ϕ_2, ϕ_3 signs, sizes, and significances provide an interpretation of the empirical result. Additionally, we also examine the causal relationship between dependent and independent variables.

IV. Empirical Results and Discussion

All variables of financial intermediations indicators are cointegrated with economic growth. The normalized cointegration coefficient of the Johansen cointegration equation shows long-run causality between variables (see Table 6). As the sign of the coefficient is reversed, in the long run, *LFI1*, *LFI2*, and *LFI3* have a positive impact, while *LTTR* has a negative impact on *LPGDP* on average, ceteris paribus. This means an increase in *LFI1*, *LFI2*, and *LFI3* will lead to an increase in *LPGDP*, while *TTR* will eventually lead to a decrease in *LPGDP*. At the 1% level, the coefficients are statistically significant.

The coefficient of the cointegration model (ECT) is negative and significant at one percent (see Table 7). In other words, the divergence from long-run equilibrium from the prior year has been addressed. The values of *ECT* are -0.25, -0.08, and -0.11, respectively, indicating shocks to the rate of *LPGDP* adjusted annually toward equilibrium of 25, 8, and 11 percentage points.

Table 6. Johansen Cointegration Equation

The Normalized Cointegration Coefficient **Stander Error in ( )**				
LPGDP	*LFI1*	*LFI2*	*LFI3*	*LTTR*
1.00000	-0.26*** (17.69)	-0.69*** (6.62)	-0.89*** (2.80)	0.21*** (3.68)

Note: ***, **, and * refers to the significance levels of 1%, 5%, and 10%, respectively.

Table 7. Vector Error Correction Model

Variable	*LFI1*	*LFI2*	*LFI3*
ECT(-1)	-0.25*** (-5.96)	-0.08*** (-4.52)	-0.11*** (-3.54)
D(*LPGDP*(-1))	-0.17 (-1.31)	-0.26* (-1.87)	-0.01 (-0.08)
D(*LFI*(-1))	0.02 (0.37)	0.02 (0.53)	0.05 (1.07)
D(*LTRR*(-1))	0.15*** (3.97)	0.14*** (3.02)	0.11** (2.12)
C	0.02** (2.40)	0.03*** (5.35)	0.02*** (3.57)
R^2	0.52	0.43	0.33
Prob(F-statistic)	0.00	0.00	0.00
D-W stat	2.06	1.92	1.75

Notes: 1. *LFI1*, *LFI2*, and *LFI3* denote financial intermediations and are measured by *M2*/*NGDP* (broad money supply), *PSC*/*NGDP* (private sector credit issued by commercial), and *CBA*/*NGDP* (commercial bank assets), respectively.
2. t-values are provided in brackets.
3. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

LTTR has a short-term association with economic growth since its coefficient is positive and statistically significant at 5 percent. The fact that *LTTR* has a coefficient value of 0.15 indicates a 15% increase in *PGDP* with a 1% increase in *TTR*. Meanwhile, the coefficients of *FI1*, *FI2*, and *FI3* in error correction suffered from the issue of being statistically insignificant in the short run.

Table 8. Residual Test

Diagnostic Test	*LFI1*	*LFI2*	*lFI3*
Serial Correlation Test (Breusch-Godfrey Serial Correlation LM Test)	0.31 (1.17)	0.48 (0.74)	0.22 (1.55)
Heteroskedasticity Test (Breusch-Pagan-Godfrey Test)	0.62 (0.74)	0.15 (1.68)	0.30 (1.25)
Histogram-Normality Test (Jarque-Bera)	0.42 (1.72)	0.52 (1.28)	0.48 (1.44)

Note: The initial value represents the probability value of the respective test, and the values presented in the brackets are F-statistics for the serial correlation test and heteroscedasticity, but the Jarque-Bera value for the histogram-normality test.

Table 8 shows that there is no serial correlation as the null hypothesis is accepted. Additionally, the absence of heteroscedasticity indicates a well-fitted model. Similarly, the Jarque-Bera test demonstrates that the model's data is normally distributed.

It was observed that broad money supply and *PGDP* were found to be causally related in both directions, as well as a commercial bank and *PGDP*, whereas finance-led growth was found in the case of private sector credit and *PGDP*. In other all cases, causality was not seen in Table 8.

The results of the augmented Dickey-Fuller test show that *PGDP*, *BMS*, *PSC*, *CBA*, and *TTR* are all stationary at the initial differences, but are non-stationary at the level. The Johansen Cointegration Test demonstrates that *FI* and *PGDP* have a positive and strong long-run correlation. Furthermore, the VECM result made this very clear as the sign of ECT was negative and significant. This suggests that, over time, the previous year's deviation is corrected annually in the direction of equilibrium. Similarly, the Granger causality test reveals a bidirectional causal relationship between the broad money supply and commercial bank assets, whereas the relationship between private sector credit and Nepal's economic growth is unidirectional.

Table 9. Granger Causality Tests

Null Hypothesis	F-statistic and P-value	Direction of Causality
LFI1 does not Granger Cause *LPGD*	5.40** (0.02)	Bidirectional
LPGDP does not Granger Cause *FI1*	7.03** (0.01)	
LFI2 does not Granger Cause *LPGD*	3.30* (0.07)	Unidirectional
LPGDP does not Granger Cause *FI2*	2.27 (0.13)	
LFI3 does not Granger Cause *LPGDP*	2.89* (0.09)	Bidirectional
LPGDP does not Granger Cause *FI3*	7.34*** (0.00)	
LTTR does not Granger Cause *LPGDP*	0.07 (0.78)	----
LPGDP does not Granger Cause *LTTR*	0.04 (0.78)	

Notes: 1. Causality indexes are calculated using the estimation results of the VEC model, as suggested by Granger and Lin (1995).
2. *LFI1*, *LFI2*, and *LFI3* denote financial intermediations, and are measured by '*M2*/*NGDP*,' '*PSC*/*NGDP*,' and '*CBA*/*NGDP*,' respectively.
3. *LTTR* and *LPGDP* denote total trade and GDP per capita, and are measured by *TTR*/*GDP*.
4. Real *GDP*/*POP* t-values are provided in brackets.
5. ***, **, and * refers to the rejection of the null hypothesis at 1%, 5%, and 10%, respectively.

The empirical results support finance-led growth in Nepal, implying that financial intermediation is positively associated with economic growth in the long run. A positive association with total trade is observed in the short run, but a negative effect is found in the long run. Granger causality tests indicate that the broad money supply and commercial bank assets are bidirectionally related to Nepal's economic growth, while private sector credit is unidirectional. These results are consistent with previous studies on Nepal (Aggarwal & Mehra, 2013; Bhetuwal, 2007; Cizo et al., 2020; Gautam, 2014; Gnawali, 2019; Kharel & Pokhrel, 2012; Kunwar, 2020; Paudel et al., 2018; Perera & Paudel, 2009; Timsina, 2014).

Schumpeterian and endogenous growth theories support finance-led growth by emphasizing the financial sector's role in funding investment and innovation, leading to productivity gains and economic growth. Credit channel theory suggests credit availability and interest rates influence investment and consumption, driving economic growth. Market-oriented growth theory emphasizes the role of financial markets in promoting economic growth by facilitating efficient resource allocation. The institutional theory highlights the legal and regulatory environment's importance in promoting financial stability, investor confidence, and efficient capital allocation, driving economic growth. These theories stress the significance of financial intermediaries, legal frameworks, and regulatory environments in driving finance-led growth (Bernanke & Gertler, 1995; De Haan et al., 2006; Lucas, 1988; Romer, 1986; Schumpeter, 1934/2008; Sukharev, 2005).

Several reasons suggested a bi-directional relationship between the broad money supply as well as commercial bank assets and economic growth in Nepal. The Nepalese economy is heavily dependent on remittances, and the growth of remittance inflows is linked to the growth of the broad money supply in the country. As remittances increase, the demand for credit and money also increases, leading to an expansion of the broad money supply. This in turn leads to increased economic activity and growth. The Nepalese government has undertaken policies to expand access to credit and financial services, which has led to an increase in the broad money supply. This has contributed to economic growth by providing financing for investment and consumption. Similarly, increased commercial bank assets can lead to an expansion in lending activities, which can provide a boost to investment and consumption spending in the economy, alternatively leading to growth. At the same time, a growing economy can also lead to an increase in financial sector activities, including lending and investment, which can contribute to the growth of commercial bank assets.

Private-sector credit has a unidirectional relationship with economic growth in Nepal, implying that credit lending has a positive association with economic growth in the long run. Firstly, limited access to alternative sources of finance makes private-sector credit a major determinant of growth. Secondly, insufficient government support for investment makes private-sector credit the primary source of funding for investment projects. Thirdly, the high level of informality in the Nepalese economy means that private-sector credit can provide a more reliable and stable source of financing for firms operating in the informal sector. Finally, the increasing demand for credit as the economy grows can be met by private-sector credit to support further economic growth.

The study found a positive relationship between trade openness and economic growth in the short run, but a negative relationship in the long run. The short-run positive relationship is attributed to increased investment and productivity growth, while the long-run negative relationship is due to an increase in import dependency, a crowding-out effect in non-tradable sectors, and the deterioration of the balance of payments position.

The findings suggest that expansionary fiscal policy can contribute to the economic growth in Nepal. Financial intermediation and economic growth are positively associated in the long run. Therefore, central bank authorities prioritize monetary policy tools that can foster economic

growth in Nepal. Although finance-led growth can have some positive implications, the growth itself has a greater impact on the real sector, such as trade, which has a stronger influence on GDP than financial intermediaries in Nepal. This study also predicts a negative relationship between trade openness and economic growth in the long run, which supports the deficit trade condition of Nepal, meaning the import of consumer goods may not lead to an increase in the GDP per capita in the long run. Hence, policymakers should take immediate action to correct the direction of Nepalese trade. However, the Nepalese growth rate typically leads to a higher demand for financial services induced by economic growth. Financial intermediation, particularly through the broad money supply and private sector credit creation, can help boost short-term economic growth and sustain long-term growth, as evidenced by the positive relationship between *LFI*s and *LPGDP* through VECM.

This study recommends prioritizing the development of the real sector of the economy, with an equal focus on the development of financial intermediation, as both complement each other. This is in line with Patrick's demand-following and supply-leading hypothesis (Patrick, 1966), which has mixed implications. From a policy perspective, the priority should be to enhance the accessibility, efficiency, and integration of the financial sector with the real sector. However, there are still challenges related to financial governance, stability, and regulation in the Nepalese financial market that need to be addressed. To promote growth in both financial and economic activities, appropriate measures need to be taken, given the existence of the bidirectional causality between financial development and economic growth in Nepal.

V. Conclusion

This study conducted a time-series analysis of the relationship between financial intermediation indicators and GDP per capita in the Nepalese economy over the period of 1974 to 2019. The primary objective of this research is to examine the existence of a long-run relationship between financial intermediation and economic growth in Nepal, given the widespread changes that have occurred in the financial sector in recent years. To achieve this objective, the study employs econometric techniques such as the Johansen test of cointegration, the vector error correction model, and the Granger causality test. The results of the study indicate a positive correlation between financial intermediation and economic growth in the long run. Additionally, the study also finds a path of causality among the variables.

The study found that finance-led growth was more beneficial in the long run as compared to the short run. In the long run, the proxy variables of financial intermediation such as broad money supply, private sector credit, and commercial bank assets have a positive relationship with economic growth. However, total trade, a representative variable of the real sector, has a short-term positive impact on growth, but a negative impact in the long run. These results are consistent with previous studies on Nepal, such as the work of Bhetuwal (2007), Kharel and Pokhrel (2012), Paudel et al. (2018), and Timsina (2014), which also emphasized the importance of the financial sector, particularly the banking sector, for economic growth in Nepal. The Granger causality test supports bidirectional causality in the case of the broad money supply and commercial bank assets, whereas private sector credit has unidirectional causality with the growth of Nepal. This result is in line with the findings of Gautam (2014), Gnawali (2019), Kharel & Pokhrel (2012), and Kunwar (2020).

The empirical results of this paper recommend that the Central Bank of Nepal promote commercial banks through liberalization policies in order to promote economic growth. Similarly, in the long term, the negative association of trade with growth requires urgent policy intervention to correct the direction of Nepalese trade. Furthermore, this study can be broadened by incorporating the examination of other forms of contract saving institutions, such as insurance

companies, employee provident funds, Nepal stock exchange, postal saving offices, and citizen investment trusts with economic growth. This would provide more comprehensive insights into the different channels through which financial intermediation can contribute to economic growth and diversify the financial sector.

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The Effect of Perceived Service Quality on Brand Loyalty in Hotels: The Causal Role of Relationship Quality and the Mediating Effect of Employee Trust

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ABSTRACT

Purpose – As the spread of COVID-19 has weakened recently, countries have switched to 'with Corona' policies. The hotel service industry, which has been hit hard in sales, is also making every effort to overcome difficulties through various brand strategies to provide high-quality services to customers and strengthen relationship quality through the trust of service employees at service points. Therefore, this study aims to verify the mediating role of employee trust in the relationship between perceived service quality and brand satisfaction and brand trust, and the causal effect of brand commitment by verifying whether brand satisfaction and brand trust affect brand loyalty or through brand commitment.

Design/Methodology/Approach – Data were collected from consumers with experience using upscale hotels in Korea, and the research hypotheses were verified by structural equation model analysis using the SPSS 21.0 and Amos 21.0 statistical packages.

Findings – First, the mediating effect of employee trust was confirmed in the relationship between perceived service quality, brand satisfaction, and brand trust. Second, brand satisfaction influenced brand trust and brand commitment, and brand trust influenced brand commitment. Third, brand satisfaction did not directly affect brand loyalty, but it did affect brand trust and brand commitment, and these constructs affected brand loyalty.

Research Implications – In conclusion, it is necessary to manage service training for employees, as interactions with customers at the service point can provide the correct service and strengthen brand loyalty by identifying each component of brand relationship quality and checking the influence in the channel relationship.

Keywords: brand commitment, brand loyalty, brand satisfaction, brand trust, employee trust, perceived service quality

JEL Classifications: M10, M30, M31

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I. Introduction

The global spread of COVID-19 has had a great impact on many service industries. In recent years, as the spread of the virus has slowed down, with each country implementing a "With Corona" policy making face-to-face contact possible, the hotel service industry, which has been hit hard by sales, is gradually recovering. Accordingly, in order to overcome the slump, it is necessary to provide excellent service to increase service competitiveness, and at the same time, reorganize branding strategies after COVID-19. Relevant research also shows that it is necessary to strengthen the branding strategy as a way to secure a competitive advantage centered on upscale hotels (Hemsley-Brown & Alnawas, 2016). For branding strategy, it has become important to improve the quality of service perceived by customers by providing unique and differentiated services beyond those existing to excellent customers (Chinomona, 2013), and to strengthen relationship quality through interaction with customers at service points (Choi, 2023). However, most upscale hotels have been struggling to differentiate services, making poor progress in securing brand loyalty by strengthening relationships with customers (Choi & Xu, 2021). Service companies need marketing strategies that allow customers to recognize excellent services and strengthen the quality of relationships with customers at service points so they can recognize these favorably and continue to use the service in the future. Previous studies have also shown that establishing and maintaining brand loyalty based on relationship marketing is considered to be an effective business strategy (Choi, 2017; Sui & Baloglu, 2003). Meanwhile, a number of studies have suggested constituent concepts such as satisfaction, trust, and commitment as relationship quality factors (Menidjel et al., 2021; Prayag et al., 2019). Therefore, it is necessary to strengthen satisfaction, trust, and commitment in hotel brands in order to provide excellent quality services customers, and strengthen relationship quality through service employee trust at service points. In this regard, the role of service employees in the service industry is very important, and 40 to 80% of customer satisfaction and loyalty are determined by customer-employee relationships, suggesting the importance of strengthening relationships with service employees at service points (Madhani, 2019). In research on the quality of brand relationship, the most basic element of the hotel service industry is to compare customer expectations before and perceptions after use, so as to strengthen the evaluation and trust of the service, expounding the importance of brand satisfaction and trust (Rather & Hollebeek, 2019). In addition, satisfaction (Zeithaml et al., 1996), trust (Caudhuri & Holbrook, 2001; Kamran-Dispani et al., 2017), and commitment (Choi & Xu, 2021; Fullerton, 2005) were suggested as essential elements in the long-term relationship between the two. As described above, by allowing customers to perceive hotel service quality favorably, customers trust service employees, which strengthens relationship qualities such as satisfaction, trust, and commitment in hotel brands. In addition, in a study of the relationship between brand commitment and loyalty, brand commitment was an important driver of loyalty as a result of relationship quality. (Morgan & Hunt, 1994; Shin et al., 2019). Therefore, it is necessary to confirm how and through what channels constituent concepts such as brand satisfaction, brand trust, and brand commitment affect brand loyalty as relationship quality factors.

Therefore, this study aims to verify how the mediating role of employee trust in the relationship of perceived service quality by customers in the domestic upscale hotel industry affects brand satisfaction and brand trust. In addition, we attempt to explain the causal role of brand commitment by verifying whether brand satisfaction and brand trust directly affect brand loyalty or brand commitment.

II. Theoretical Background and Research Hypothesis

1. Theoretical Background

1.1. Perceived Service Quality

In previous studies, service quality was not simply evaluation of whether consumers were able to meet their standards, it was also an overall evaluation of performance in the service provision process (Cronin & Taylor, 1994). Therefore, it can be confirmed that perceived service quality is a subjective evaluation of the service process and performance by consumers. Other studies also show that service companies need the ability to meet or exceed customer needs and expectations (Bergman & Klefsjö, 2010), so service quality basically depends on the judgment of customers. With increases in the level of and changes in consumer demands for service, it is crucial to correctly determine the perceived service quality of target customers. Therefore, service companies that provide excellent quality can attract new customers, in addition to maintaining existing customers (Cronin & Taylor, 1994). As it is difficult for customers to evaluate services objectively, they are generally judged subjectively, especially in the hotel industry, which is based on providing services (Choi & Xu, 2021). In particular, in the case of upscale hotels that provide complex services, perceived service quality is an important factor because it increases brand value, and ultimately improves customer loyalty by focusing on the service quality perceived by customers.

1.2. Employee Trust

Employee trust is defined as a customer's belief that service employees have the skills, abilities, and knowledge necessary to perform their work effectively (Smith & Barclay, 1997). In the process of a service contact, consumers meet expectations through interaction with employees, which may cause emotional responses in the process (Rabbanee et al., 2015). In particular, hotel services require direct interactions between service employees and customers, so they create value together, and the unique consumption experience of customers is important (Kandampally et al., 2015). It can be inferred that the consumption experience, through the interaction of service employees, can strengthen employee trust, and eventually strengthen brand loyalty (Li et al., 2022). In the study of hotel service, in order to strengthen the brand relationship with customers and enhance loyalty, hotel enterprises must ensure the correct actions of workers (Kandampully et al., 2015), which means that trust in workers can strengthen the relationship with customers by providing correct services. In other studies, employee trust plays an important role in relationship quality and continuous relationship intention (Kim & Cha, 2002), and employee trust is an essential element in order to strengthen relationships with customers when high-touch individual customer-oriented services are provided in upscale hotels (Choi & Xu, 2021).

1.3. Brand Satisfaction

Relationship quality refers to the degree to which service providers want to maintain relationships with customers (Crosby et al., 1990), and favorable relationship quality plays a very important role in long-term relationships with customers because it affects positive consumer attitudes (Menidjel et al., 2021). In previous studies, relationship quality includes satisfaction, trust, and commitment (Lee & Jin, 2019). Consumer-brand relationship quality is an important concept in brand building from a long-term perspective (Hidayanti & Nuryakin, 2018), so constituent concepts such as brand satisfaction, brand trust, and brand commitment can be presented as components of brand relationship quality. Brand satisfaction is an overall evaluation based on the difference between the expectations that consumers have before consumption, and perceptions after consumption (Chinomona, 2013; Kim et al., 2022). In the previous studies, it was emphasized that consumers tended to choose brands that met their needs and expectations. Therefore, enterprises with high profitability were those that successfully used brands to meet consumer needs (Kaur et

al., 2020), which can confirm the importance of brand satisfaction. Other studies also point out that satisfied customers are less sensitive to price, will continue to buy products or services, are less influenced by competitors, and tend to maintain long-term relationships with each other (Lee & Kim, 2022). Therefore, from the perspective of enterprises, brand satisfaction has many advantages in improving customer loyalty (Hansemark & Albinsson, 2004).

1.4. Brand Trust

In previous studies, brand trust was defined as the customer belief that a brand could perform certain functions (Chaudhuri & Holbrook, 2001). When a consumer interacts with a brand, the brand is defined as a reliable state (Munuera-Aleman et al., 2003); when consumers trust the brand, it becomes psychologically stable, and shows a positive emotional response (Munuera-Aleman et al., 2003). Therefore, brand trust is important for stable and sustainable growth because brand trust is formed after consumers purchase or experience products or services (Choi & Choi, 2022). Related studies have also said that trust applies to uncertain situations, and brand trust reduces perceived consumer risk because they rely on trutworthy brands when there is a large difference between brands, or they are unstable (Chaudhuri & Holbrook, 2001; Yang et al., 2021). In addition, if service enterprises want to maintain stable profits through customers and long-term systems, they should regard building trust as the basic goal (Xu, 2022). In particular, the hotel service industry explained the importance of brand trust by making decisions to reduce risks by relying on the brand when customers are certain of the brand's competitive advantage before using the service (Sürücü et al., 2019).

1.5. Brand Commitment

Brand commitment can be defined as a positive interaction when the brand induces a love for the brand and strives to maintain a valuable relationship (Osuna Ramírez et al., 2017), along with customer willingness to make efforts to maintain a favorable relationship with the brand (Eisingerich & Rubbera, 2010). In previous studies, commitment is a strong antecedent factor to form a long-term relationship with customers, and to reduce uncertainty in purchasing decisions as a behavioral and attitude propensity of consumers to continue relationship with the brand, this helped to reduce the cost of brand selection (Shin et al., 2019) as brands want to commit and invest in long-term business relationships customers(Lee & Lee, 2023). Therefore, customer brand commitment can be an important driver for brand loyalty in the hotel service industry.

1.6. Brand Loyalty

Loyalty is defined as repeatedly purchasing, using, or being deeply committed to preferred products or services as a central constituent concept in relationship marketing (Choi, 2017). Such loyalty is a concept that includes psychological and behavioral characteristics such as purchase ratio, continuity, and possibility, which is evaluated as a behavioral change resulting from relationship formation (Dick & Basu, 1994). In addition, loyalty is one of the most frequently presented outcome variables in relationship marketing research, promoting relationship maintenance efforts with customers, resisting transition to competitors, and increasing transition difficulties (Dick & Basu, 1994). According to relevant research, customers with high brand loyalty pay a higher premium than ordinary customers to obtain higher value results, which is helpful to improve market share (Chaudhuri & Holbrook, 2001; Lee & Yang, 2022).

2. Research Hypothesis and Research Model

In previous studies, perceived service quality was described as a kind of attitude from comparing expectations before service use, and performance

after a service experience. Therfore, it is not the same as satisfaction (Brady & Robertson, 2001) as satisfaction is an evaluation and emotional response, and consumers evaluate satisfaction or dissatisfaction after experiencing an object (Lee et al., 2000). In addition, even if consumers are satisfied with a specific service, they do not necessarily recognize it as a high service quality (Parasuraman et al., 1988). Therefore, it is possible to confirm differences in the concept of perceived service quality and satisfaction (Chu et al., 2021). Looking at the relationship between perceived service quality and satisfaction, a positive brand experience tends to produce positive emotions and cognitive states, which in turn leads to psychological satisfaction with the brand (Kim, 2005). In other studies, service quality is a prerequisite for customer satisfaction, and was positively related (Chinomona, 2013; Ladhari, 2009). Accordingly, the following research hypothesis can be proposed.

H1: Perceived service quality has a positive effect on brand satisfaction.

Perceived service quality and customer satisfaction are leading variables of consumer attitude toward service providers, which affects purchase intention, and customer trust in service providers plays a mediating role in the process (Cronin, 2003). It is possible to confirm the importance of trust with service providers in an interactive relationship in order for customers satisfied with service quality to gain loyalty. Other studies also point out that customer trust is very important in promoting a profitable customer relationship, and the main methods to establish a stable and reliable relationship with customers is service quality (Eisingerich & Bell, 2008). In addition, if high quality service is provided to satisfied consumers, trust will be formed (Yim et al., 2008), indicating that service quality will affect trust. Service quality is a prerequisite for customer trust and has a positive effect (Chang et al., 2013). If consumers evaluate services favorably during the consumption process, there is less concern about other choices or moral hazard, and consumers gain trust in suppliers (Chiou & Droge, 2006). The following research hypothesis is presented.

H2: Perceived service quality has a positive (+) effect on brand trust.

In upscale hotel services, the role of service employees is very important because of the high-contact and individualized consumer services (Choi & Xu, 2021). In a related study, hotel service quality has a significant impact on employee ability to respond to customers in various situations (Jones & DeCotis, 1986). Service quality is evaluated by service employees that interact with customers (Zhao & Guo, 2019). In other words, it can be interpreted that the evaluation of service quality provided through interaction with customers at the service point affects the trust of service employees. In other studies, customers can gain an impression of service quality from contact with service providers, and positive contact creates trust in service employees (Kim & Cha, 2002). Based on the preceding studies, the following research hypothesis is presented.

H3: Perceived service quality has a positive effect on employee trust.

In previous studies, one party evaluated and trusted the reliability and integrity of the other party during the exchange process, and trust in employees during the service process affected satisfaction (Aggarwal et al., 2005). In addition, service satisfaction is the emotional response caused by the degree of interaction evaluation and communication between service providers and customers (Bahadur et al., 2019). It has been confirmed in high-end hotel service studies that efficient communication between customers and service employees is also important, which is a prerequisite for satisfaction (Kim et al., 2001). In other studies, when customers trust the relationship with a service employee, they are more likely to express needs and expectations, and the positive

role of the service employee is to provide services that are more satisfying to the customer (Hui & Yee, 2015). From the above studies, trust in service employees affects satisfaction. In the relationship between employee trust and satisfaction, positive customer satisfaction is formed when employees behave positively (Bahadur et al., 2019). Therefore, the following research hypothesis is presented.

H4: Employee trust has a positive (+) effect on brand satisfaction.

Due to services' unique nature of non-separability, interaction becomes the basis of the service (Choi & Xu, 2021). Since customers rely on interacting service employees, the behavior of front-line service employees becomes a factor that can differentiate a brand from competitors (Zhao & Guo, 2019). In particular, in the case of highly involved services, trust in service employees is important to reduce uncertainty (Choi & Xu, 2021). In order to provide a high level of customer service in upscale hotel service research, it is important to build trust with service employees at service points (Claycomb & Martin, 2001). In addition, in a study on customer and employee trust and service company trust, employee trust has a significant effect on service company trust (Yim et al., 2008). From the preceding studies, employee trust can affect brand trust, so the following research hypothesis is presented.

H5: Employee trust has a positive (+) effect on brand trust.

Satisfaction in a service area is a positive result when a brand exceeds expectations, and it is an overall judgment of the service experience (Oliver, 1993). Trust is an expectation of how an exchange partner will perform in the future, and trust in a brand means that the brand is likely or expected to have positive results for consumers (Hansemark & Albinson, 2004). In the customer relationship study of service companies, customers confirmed that satisfactory experience with a service company's products or services is a prerequisite for trust (Lee & Back, 2009). Other studies have also shown that trust is strengthened when consumers are satisfied with service contacts and trust the service providers (Sirdeshmukh et al., 2002). Therefore, it can be seen that satisfaction with service companies affects trust. Through this, if the service brand meets and is satisfied with consumer expectations, it can lead to brand trust, so the following research hypothesis is presented.

H6: Brand satisfaction has a positive (+) effect on brand trust.

Commitment includes concepts such as identification and attachment (Fullerton, 2005). It appears when the value provided by a service provider coincides with the value a consumer pursues (Guo et al., 2016). Other studies have also stated that as consistency between service providers and customers is the core of relationship development, it takes time to develop a commitment. This commitment cannot be built simply with a consumption experience (Fullerton, 2005). In addition, if customers are satisfied in the long term, customers can become enthusiasts of the company, which leads to high loyalty through relationship maintenance (Osarenkhoe & Bennani, 2007). From the above studies, it can be confirmed that service providers are satisfied and bring high commitment by providing continuous satisfaction to customers. A number of previous studies on the relationship between brand satisfaction and brand commitment have also confirmed that brand satisfaction has a positive effect on brand commitment (Jamshidi & Rousta, 2020). Accordingly, the following research hypothesis is presented.

H7: Brand satisfaction has a positive (+) effect on brand commitment.

Strengthening relationship qualities such as trust and commitment in exchange relationships is an important condition for successful customer management (Morgan & Hunt, 1994). Previous studies explain that trust has a positive relationship with commitment in two dimensions (Xu, 2022).

The first dimension pertains to consumers forming and maintaining relationships with another party based on efficiency and social needs (Hennig-Thurau & Klee, 1997), and the second occurs when consumers form relationships by forming connectedness and empathy in the psychological process (Fullerton 2011). In the consumer-brand relationship, consumers feel at risk because they are perceived as weak compared to companies when they have limited resources such as time, money, and information. When there is uncertainty, in order to build high-quality brand-consumer relationships, brands can increase integrity, reliability, and altruistic behaviors to bring benefits to consumers (Wang, 2002). Through this, on the relationship between brand trust and brand commitment explains that brand trust has a positive effect on brand commitment (Fullerton, 2011). Based on such previous studies, the following research hypothesis is presented.

H8: Brand trust has a positive (+) effect on brand commitment.

Since satisfied customers have a high probability for repeated purchase, it is suggested that those satisfied with brands and are more inclined to choose those brands compared to competitor offerings (Zeithaml et al., 1996). Therefore, customer satisfaction can be used to predict future consumer purchasing behavior. According to previous studies, brand satisfaction is a leading factor in brand loyalty (Zeithaml et al., 1996). Various studies have also confirmed the close correlation between satisfaction and loyalty (Fornell, 1992; Taylor & Baker, 1994). In the hotel service industry, service providers can satisfy without loyalty, but without loyalty, it is difficult to gain customer loyalty (Shoemaker & Lewis, 1999). Satisfied consumers have more repurchase intentions and tend to defend or recommend the brand to others (Zeithaml et al., 1996). When user satisfaction increases, loyalty is also enhanced, and both user satisfaction and loyalty are positively correlated (Zheng & Kim, 2022). From the preceding studies, brand satisfaction can have a positive effect on brand loyalty. The following research hypothesis is presented.

H9: Brand satisfaction has a positive (+) effect on brand loyalty

Brand trust is a stable psychological state in which one believes in a brand, and this is a core element in building a long-term relationship with the other party (Munuera-Aleman et al., 2003). If consumers trust a particular brand, they are more likely to implement positive actions toward that brand (Matzler et al., 2008). In addition, exchange relationships lead to interdependence and reduce risks and uncertainties, which is a necessary condition for future behavioral intentions. (Kamran-Disfani et al., 2017). Consumers increase long-term purchase behavior intentions when detecting a stable transaction environment provided by a brand (Kamran-Disfani et al., 2017). Since previous studies explain that trust is formed through exchange relationships that affect loyalty, the following research hypothesis is presented.

H10: Brand trust has a positive (+) effect on brand loyalty.

Commitment has characteristics such as identification, dependence, and emotional attachment, which are linked to loyalty (Fullerton, 2005). It was confirmed that commitment has a positive effect as an essential antecedent element of loyalty (Seo & Hwang, 2021; Shin et al., 2019). In addition, securing customer loyalty is an efficient means of achieving important marketing goals and maintaining a continuous customer base, explaining the importance of marketing. (Choi & Xu, 2021). Loyalty can be divided into attitudinal loyalty and behavioral loyalty, with the former leading deep emotional commitment and encouraging consumers to recommend and defend brands (Chaudhuri & Holbrook, 2001). The latter has characteristics of facilitating consumption, increasing the possibility of repeated purchases, and expressing behaviors such as purchase to maintain relationships with the brand if it

matches the norms and values of the consumer (Keiningham et al., 2015). Based on the preceding studies, the following research hypothesis is presented as commitment to a brand affects brand loyalty.

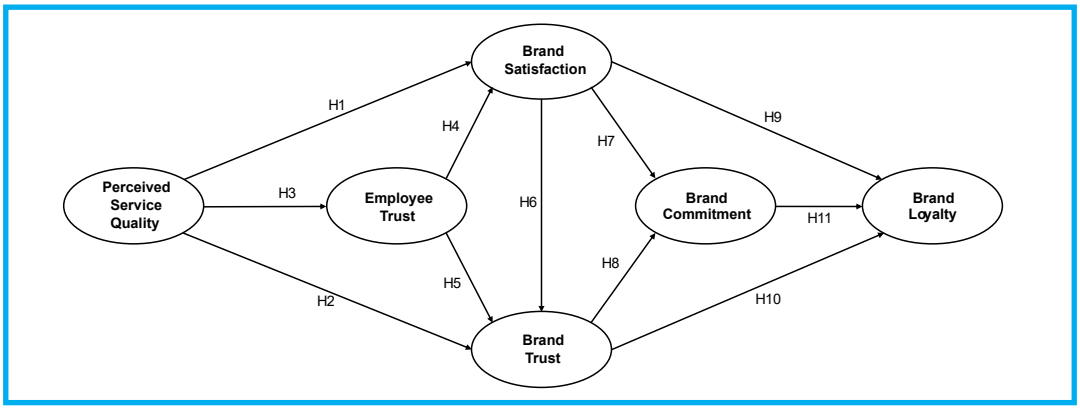
H11: Brand commitment has a positive (+) effect on brand loyalty.

In upscale hotels, customers interact with service employees at service contact points; in order to form a friendly relationship, building trust plays a very important role. In previous studies, customers rely heavily on interacting with service employees, so front-line employee behavior achieves service objectives and improves service quality, differentiating the brand from competing companies (Zhao & Guo, 2019). In addition, in the service environment of luxury hotels that provide customer-specific services, service employees play a role in responding to customers on behalf of service companies. If service evaluation is positive, trust in service employees can be created. (Castellanos-Verdugo et al., 2009). When the relationship between front-line employees and customers is perceived to be reliable, customers are more likely to express their needs and expectations to employees, leading employees to provide products and services that better satisfy customers (Hui & Yee, 2015). Based on the preceding studies, it can be judged that employee trust plays a mediating role in the process in which perceived service quality affects brand satisfaction. Similarly, from the perspective of service companies, customer trust is influenced by excellent service quality as a way to differentiate a brand from competitors, and build stable and reliable relationships with customers (Eisingerich & Bell, 2008). In particular, hotel services can strengthen the overall evaluation and trust in a brand by recognizing expectations for customer service quality and overall excellence (Rather & Hollebeek, 2019). In addition, if a customer perceives quality service, confidence in the abilities of the service employee is affected. Related studies also show that building trust between service providers and customers is a very basic goal, and for this, it is necessary to first build the trust of service employees that have contact customers (Claycomb & Martin, 2001). Based on the preceding studies, the following research hypothesis is presented.

H12: Employee trust mediates the relationship between perceived service quality and brand satisfaction.

H13: Employee trust mediates the relationship between perceived service quality and brand trust.

Fig. 1. Research Model



III. Research Method

1. Measurement and Operational Definitions of Variables

A multi-item scale was developed to verify the proposed constructs and aid in comprehensive understanding. The measurement item (item) is a 7-point Likert scale composed of "1. Not at all" to "7. Very much". The measurement items were revised and supplemented to suit the contents of this study based on previous studies. The measurement items and operational definitions for each variable are shown in Table 1.

Table 1. Measurement and Operational Definitions of Variables

Construct		Item	Operation Definition	Research
Perceived Service Quality	PQ1	This hotel provides services that reflect my needs.	The degree of difference between the expectations before receiving a service and the overall evaluation of service performance by the consumer.	Su et al. (2016), Dedeoğlu & Demirer (2015)
	PQ2	My reservation at this hotel was processed efficiently.		
	PQ3	This hotel employee immediately responded to my request.		
	PQ4	This hotel clearly explained my accommodation details.		
	PQ5	This hotel is visually appealing.		
Employee Trust	ET1	This hotel employee keeps promises well.	The degree of belief in the brand's ability to perform tasks for customers.	Kim et al. (2001), Choi et al. (2020)
	ET2	This hotel employee is sincere.		
	ET3	This hotel employee is reliable.		
	ET4	I think this hotel employee is honest.		
	ET5	This hotel employee puts the customer's interests first.		
Brand Satisfaction	ET1	I liked this hotel brand.	An emotional response that satisfies customer needs through a comprehensive assessment of the hotel brand's purchasing and consumption experience.	Zehir et al. (2011), Wang et al. (2004)
	ET2	I like the service provided by this hotel brand.		
	ET3	It's a good thing to use this hotel brand.		
	ET4	I am satisfied with this hotel brand as a whole.		
	ET5	I think it's good to use this hotel brand.		
Brand Trust	ST1	This hotel brand is reliable.	The extent to which consumers believe in brand-provided service capabilities.	Li et al. (2008), Zehir et al. (2011)
	ST2	This hotel brand protects customer personal information and maintains transactions confidentially.		
	ST3	I think this hotel brand is always honest		
	ST4	This hotel brand is good at keeping promises with customers.		
	ST5	Other customers will also trust this hotel brand.		
Brand Commitment	AC1	I feel a strong emotional attachment to this hotel brand.	The degree to which consumers strive to maintain positive feelings and relationships with upscale hotel brands.	Choi & Xu (2021), Shin et al. (2019)
	AC2	I feel a strong sense of belonging at this hotel brand.		
	AC3	The kindness of this hotel employee makes me feel good.		
	AC4	It's a fun to use this hotel brand.		
	AC5	There are other hotels, but I still want to use this hotel brand.		
Brand Loyalty	AL1	I have a good feeling here.	The degree to which customers have a willingness to purchase luxury hotel brands and show favorable word of mouth.	Choi & Xu (2021), Zeithaml et al. (1996)
	AL2	I am attached to this hotel.		
	AL3	I have a favorable attitude toward this hotel.		
	AL4	I want to speak positively about this hotel.		
	AL5	I'm willing to introduce this place to others.		

2. Research Design

This study tested research hypotheses by distributing and collecting data through a survey, and then statistically analyzing it. Major variables such as perceived service quality, employee trust, brand satisfaction, brand trust, brand commitment, and brand loyalty were presented in the questionnaire. In order to confirm the characteristics of the data, questions such as hotels used, services used, and frequency of use were organized. The survey was conducted based on a previous study that defined upscale hotels as 4-star or 5-star hotels (Hsu et al., 2012; Wei & Kim, 2022). We refer to the standards of the Korea Hotel Association (Korea Hotel Association, 2021) that five-star hotels provide the highest level of facilities and services. Data were collected through the self-administered questionnaires of customers that experienced five-star hotel services. The survey period was conducted from September 1, 2022, to the 30th of the same month.

3. Analysis

For empirical analysis, Amos 21.0 and SPSS 21.0 statistics software were used. In order to confirm the validity and reliability of the data, the suitability of factor analysis was first confirmed with KMO and Bartlett's Test. Next, confirmatory factor analysis (CFA) was conducted to confirm the effectiveness and convergence validity of the constructs by checking factor values between variables. In addition, discriminant validity was confirmed by converting the derived item into a value and comparing it with the AVE value by performing a correlation analysis. In addition, reliability was confirmed by verifying the Cronbach'α coefficient for each variable through internal consistency analysis. The mean and standard deviation (S.D.) of each variable were identified to confirm the basic statistics of the collected data. Frequency analysis was conducted to confirm the demographic characteristics of the respondents. Structural equation modeling (SEM) was conducted to confirm the model fit and research hypotheses of the research of the study.

IV. Empirical Analysis

1. Analysis of Data and Demographic Characteristics

A total of 350 questionnaires were collected, excluding 37 questionnaires with inaccurate or incomplete responses, of which 313 were used for the final analysis. Analysis of the data characteristics resulted in 117 people having stayed at The Shilla (37.4%), 102 at Lotte (32.6%), 34 at Marriott (10.9%), 25 at Hyatt (8.0%), 33 at Hilton (10.5%), and 2 at other hotels (0.6%). 135 people noted the importance of accommodation (43.1%), 94 emphasized restaurants (30.0%), 25 noted meeting room services (8.0%), 24 noted business center services (7.7%), 26 noted fitness services (8.3%), and other services were emphasized by 9 (2.9%). Of the number of times used in a year, 143 people stayed once (45.7%), 47 (15.0%) twice, 35 (13.4%) three times, 67 (21.4%) four times, 11 (3.5%) five times, and three (1.0%) six or more times. The results of the analysis of the demographic characteristics of the respondents are shown in Table 2.

2. Data Analysis of Validity and Reliability

Prior to the test of the research hypotheses, the validity and reliability of the data were confirmed. KMO and Bartlett's Test were conducted to confirm the validity of factor analysis. As a result of the analysis, the KMO (Kaiser-Meyer-Olkin) measured value was .947, and Bartlett's Test showed the significance of all correlation values of the matrix, with $p<.000$ being statistically significant. Therefore, it was confirmed that data used for analysis in this

Table 2. Data and Demographic Characteristics

	Item	Frequency (%)		Item	Frequency (%)
Gender	Male	178(56.9)	Occupation	Student	24(7.7)
	Female	135(43.1)		Company employee	47(15.0)
Age	Below 20 years old	5(1.6)		Government official	27(8.6)
	20–29 years old	52(16.6)		Full-time housewife	111(35.5)
	30–39 years old	108(34.5)		Business owner	86(27.5)
	40–49 years old	69(22.0)		Other	18(5.8)
	50–59 years old	70(22.4)	Income	Below 3 million won	96(30.7)
	Over 60 years old	9(2.9)		3-5 million won	133(42.50
Education	High School or Below	66(21.1)		Over 5 million won	84(26.8)
	Undergraduate	189(60.4)			
	Graduate or higher	58(18.5)			

study were suitable. Accordingly, as a result of conducting a confirmation factor analysis (CFA) to confirm the convergent validity of the variable, the Q value was 1.408 (302.731/215), showing a standard value was below . In addition, the fitness index showed GFI (.922), NFI (.945), NFI (.945), TLI (.980), and CFI (.983), all higher than standard value of .900, and as an RMSEA (.036) less than .700. The standardization regression weights was at least .777 and to maximum .901, which is higher than the standard value of .700. The composite reliability and average variance extraction value (AVE) were found to be above the standard values of .700 and .500, and the convergence validity was confirmed. In addition, as a result of checking the internal consistency to confirm the reliability of each variable, Cronbach'α coefficient was higher than the baseline of .700 for all variables, confirming the reliability of the data used in this study. The analysis results are shown in Table 3.

Next, correlation analysis was conducted to analyze discriminant validity by comparing the correlation coefficient square value (r^2) with the AVE value. If the correlation coefficient square value is lower than the AVE value, it is confirmed that there is discriminant validity. As a result of the analysis, the significant probability .000 was found in p<.05, which was significant in all variables. The correlation coefficient square value was lower than the average variance extraction value (AVE). Therefore, the discriminant validity between variables was confirmed. The analysis results are shown in Table 4.

Table 3. Results of Confirmatory Factor Analysis, Reliability Analysis, and KMO and Bartlett's Test

Construct	Items	Estimate	Standardized Regression Weights	C.R.	*p*	Composite Reliability	AVE
Perceived Service Quality	PSQ1	1.000	.789			.875	.713
	PSQ2	.902	.874	16.191	***		
	PSQ4	.963	.868	18.087	***		
Employee Trust	ET1	1.000	.780			.859	.670
	ET3	.984	.874	14.483	***		
	ET4	1.084	.837	16.538	***		
	ET5	1.048	.779	15.760	***		
Brand Satisfaction	BS1	1.000	.821			.892	.736
	BS2	.935	.882	17.111	***		
	BS3	1.012	.901	19.062	***		
	BS4	1.049	.824	19.667	***		
Brand Trust	BT1	1.000	.777			.837	.636
	BT2	1.003	.810	15.180	***		
	BT3	1.036	.824	16.054	***		
	BT4	.985	.779	15.238	***		
Brand Commitment	BC2	1.000	.818			.866	.721
	BC3	1.108	.864	18.122	***		
	BC4	1.069	.868	18.244	***		
	BC5	1.046	.843	17.517	***		
Brand Loyalty	AL1	1.000	.820			.868	.716
	AL2	.904	.834	17.700	***		
	AL3	.914	.879	18.175	***		
	AL4	1.022	.850	19.746	***		

x^2(302.731)/*df*(215)=1.408, *p*=.000, GFI(.922), NFI(.945), TLI(.980), CFI(.983), RMSEA(.036).
KMO Measure of Sampling Adequacy(.947), Approx. Chi-Square(7398.147), *df*(435), Sig.(.000)

Note: ***p<.000.

Table 4. Result of Discriminant Validity Analysis

AVE	1	2	3	4	5	6
1	.713					
2	.460** (.212)	.670				
3	.326** (.106)	.507** (.257)	.736			
4	.351** (.123)	.564** (.361)	.582** (.339)	.636		
5	.244** (.060)	.499** (.249)	.563** (.317)	.629** (.396)	.721	
6	.305** (.093)	.556** (.307)	.509** (.259)	.552** (.305)	.653** (.426)	.716
Mean	4.6709	4.6909	4.5527	4.6350	4.6550	4.6733
S.D.	.92795	.99865	1.03891	1.03891	1.12320	1.10293

Note: a. ***p<.010, b( )=r2. b. Perceived Service Quality=1, Employee Trust=2, Brand Satisfaction=3, Brand Trust=4, Brand Commitment=5, Attitudinal Loyalty=6, Behavioral Loyalty=7.

3. Analysis of Research Hypotheses

First, as a result of checking the research model fit, p<.000, the (325.497)/(219) = Q value was 1.486, and it was confirmed that the reference value was 3 or less. The suitability index is GFI (.917), NFI (.940), TLI (.976), and CFI (.980), all of which are reference values. This was .900 or more, and RMSEA (.039) was lower than the reference value of .07. Therefore, this research model was confirmed to be suitable. The research hypotheses raised was analyzed. Perceived service quality had a significant impact on employee trust (1.572, p<0.05), but did not affect brand satisfaction and brand trust. Employee trust had a significant impact on brand satisfaction (.564, p<0.05) and brand trust (.401, p<0.05), and brand satisfaction had a significant impact on brand trust (.377, p<0.05). Brand satisfaction had a significant impact on brand commitment (.294, p<0.05), and brand trust had a significant impact on brand commitment (.642, p<0.05). Brand trust had a significant impact on brand loyalty (.642, p<0.05), and brand commitment had a significant impact on brand loyalty (.262, p<0.05). However, there was no statistically significant impact on perceived service quality, brand satisfaction and brand trust, and brand satisfaction and brand loyalty. Next, the mediating effect of employee trust was tested in the relationship between perceived service quality, brand satisfaction, and brand trust. To this end, as a result of analyzing boost wrapping using 2,000 samples and a 95% bias correction trust level, it was confirmed that perceived service quality completely mediated employee trust in the brand satisfaction and brand trust relationship. Therefore, Hypotheses 3, 4, 5, 6, 7, 8, 10, and 11 were supported, hypotheses 1, 2, and 9 were rejected. The results of the analysis are shown in Tables 5 and 6, and the path coefficient and final model are shown in Fig. 2.

Table 5. Summary of Path Coefficients

H	Path	Estimate	S.E.	C.R.	*p*	Result
1	Perceived Service Quality → Brand Satisfaction	.104	.080	1.304	.192	Rejected
2	Perceived Service Quality → Brand Trust	.049	.064	.768	.442	Rejected
3	Perceived Service Quality → Employee Trust	.572	.071	8.037	***	Supported
4	Employee Trust → Brand Satisfaction	.564	.080	7.077	***	Supported
5	Employee Trust → Brand Trust	.401	.072	5.596	***	Supported
6	Brand Satisfaction → Brand Trust	.377	.057	6.557	***	Supported
7	Brand Satisfaction → Brand Commitment	.294	.071	4.120	***	Supported
8	Brand Trust → Brand Commitment	.642	.086	7.482	***	Supported
9	Brand Satisfaction → Brand Loyalty	.118	.071	1.657	.098	Rejected
10	Brand Trust → Brand Loyalty	.262	.095	2.758	.006	Supported
11	Brand Commitment → Brand Loyalty	.502	.077	2.758	***	Supported

Note: ***Significant to p<.050.

Fig. 2. Research Results

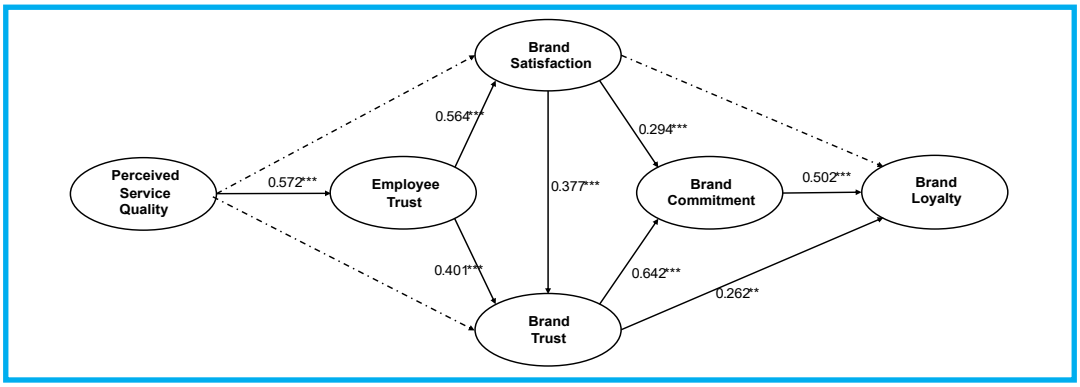


Table 6. Results of Mediation Effect

Hypothesis	95% Confidence Interval				Result
	Total	Direct Effect	Indirect Effect	Boot LLCI-ULCI	
H12	.352***	.086(p=0.183)	.266***	.193~.486	Full Mediation
H13	.398***	.0445(p=0.477)	.354***	.247~.536	Full Mediation

Note: 1. LLCI: Lower Limit Confidence Interval, ULCI: Upper Limit Confidence Interval.
2. ***p<0.01.

V. Conclusion

1. Results and Theoretical Implications

As a result of this study, perceived service quality affected employee trust, but did not affect brand satisfaction and brand trust. Employee trust affected brand satisfaction and brand trust, and brand satisfaction affected brand trust. Brand satisfaction affected brand commitment, and brand trust affected brand commitment. Brand trust and brand commitment both affected brand loyalty. However, there was no effect on the relationship between perceived service quality, brand satisfaction and brand trust, and brand satisfaction and brand loyalty. In addition, the mediating effect of employee trust was confirmed in the relationship between perceived service quality, brand satisfaction, and brand trust.

Based on research results, the theoretical implications are as follows. First, it was confirmed that employee trust was fully mediated in the path relationship between perceived service quality, brand satisfaction, and brand trust in upscale hotel services. This is because customers that use upscale hotel services interact with service employees at service points, and sometimes cooperate to execute services; if the service provided is positive, service quality is perceived as excellent and can differentiate a brand from competitors (Zhao & Guo, 2019). In addition, a significant portion of satisfaction depends on the relationship between service employees and customers, which is consistent with the results of previous studies (Kandampally et al., 2015). These results confirm the importance of employee trust when securing satisfaction and trust for a brand. This means that when service users increase employee trust through interaction with service employees at service points, service employees themselves are evaluated as part of the brand, which affects satisfaction and trust. Second, brand satisfaction affected brand trust and brand commitment, and brand trust affected brand commitment. However, comparing the degree of influence in the relationship between variables, brand satisfaction had a greater impact on brand commitment through brand trust than on brand commitment. This is consistent with the results of a generalized study that the mutual influence of relationship quality factors such as satisfaction, trust, and commitment is immersed through trust. (Rather & Hollebeek, 2019). In addition, it can be seen that the relationship between the two sides of the service exchange relationship is strengthened through factors such as satisfaction, trust, and commitment in the relationship in which service quality affects loyalty. Third, brand satisfaction did not directly affect brand loyalty, but it did affect brand trust and brand commitment, and these constituent concepts affected brand loyalty. This is consistent with previous studies in that brand trust and brand commitment are essential factors in the process of building brand loyalty. (Chaudhuri & Holbrook 2001; Choi & Xu, 2021; Kamran-Disfani et al., 2017).

2. Management Implications

In a fiercely competitive environment, the hotel industry has seen trends in branding promotion strategies to reduce competitive costs and secure competitive advantage through service differentiation (Chinomona, 2013; Hemsley-Brown & Alnawas, 2016). To this end, the hotel industry, which has seen difficulties due to COVID-19, emphasized the importance of services perceived by customers, confirming the importance of relationship marketing to build a high level of brand loyalty by strengthening service quality. (Choi & Xu, 2021; Xu, 2022). These research results can help establish branding strategies for hotels in the future. Through the results of this study, the following practical implications can be provided. First, in order to increase satisfaction and trust in a brand for the target customers of upscale hotels, it is necessary to manage service training for employees so that employees that interact with customers can provide the necessary services at service points. Specifically, by honestly and reliably providing various services, service employees should execute sincere services so that

they can be recognized as prioritizing promises with customers and putting customer interests first. Second, in order for customers that use upscale hotel services to increase loyalty to a brand, it is necessary to strengthen the quality of the relationship with the hotel brand. In other words, by increasing trust in service employees at service points, the quality of relationships with brands should be strengthened by increasing satisfaction, trust, and commitment in hotel brands. Third, it is necessary to try to strengthen brand loyalty sequentially by distinguishing each component of brand relationship quality and confirming its influence in path relationships. In other words, brand satisfaction does not directly affect brand loyalty, but it dies affect brand trust and brand commitment, and these factors affect brand loyalty, so it is necessary to strengthen brand loyalty by increasing brand satisfaction first. Specifically, brand loyalty can be strengthened by strengthening the sense of belonging to a brand, or the belief of the superiority of the brand.

3. Research Limitations and Future Research

This study is significant in that it identified the causal roles of brand relationship quality factors such as satisfaction, trust, and commitment in the process of brand loyalty for upscale hotels, and explained the mediating effect of employee trust between service quality and relationship quality. However, this is limited to the domestic market only, and this is recognized as a limitation of the research due to difficulties in generalization due to differences depending on cross-cultural characteristics. Therefore, future studies aim to identify and explain the results by comparing the relationship between these constituent concepts with the various cultures of other nations.

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