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# A Framework of Medical Tourism as a Niche Trade Item: A System Approach*

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## Abstract

***Purpose*** – The purpose of this research is to develop two medical tourism system models which explain medical tourism phenomenon with a systemic approach.

***Design/methodology*** – This research was conducted by using a qualitative data analysis which mainly refers to previous references of medical tourism in the areas of tourism and medicine. Leiper's tourism system model was utilized as a conceptual framework. In-depth interviews with experts in the field were conducted in order to pretest the models.

***Findings*** – This research suggests a medical tourism system framework and a medical service provision framework. The first model presents medical tourism components and their relationships within a framework presented in a diagram. The second model shows the relationships among medical services required by medical tourists, the service providers, and service human resources along with movements of medical tourists.

***Originality/value*** – The first model presents a spatial composition of medical tourism components and their relationships, whereas the second model shows the linkage among medical services, the service providers, and relevant service human resources along with time sequential steps of medical tourists. These two models are complementary and may be used as useful tools to observe medical tourism phenomenon with a systemic and holistic approach. These two models may enable stake holders avoid unnecessary confusions and conflicts that result in duplication of government policies and a waste of budget and human resources.

*Keywords*: Medical Tourism, Medical Tourism Industry, Medical Tourism Service Linkage Framework, Medical Tourism System Framework, System Approach
**JEL Classifications**: L83, Z31

## 1. Introduction

In recent times, medical tourism has emerged in many countries as a new form of trade item or value-added tourist product. These countries have been actively developing this industry through government investment and support in order to earn foreign exchange. The global medical tourism industry is expanding as many countries, especially emerging economies, promote it. Furthermore, the growing presence of low-cost carriers and availability of viable information related to medical tourism are driving its growth (Market and Research, 2019a).

According to United Nations World Tourism Organization (2019), total exports from international tourism reached US$ 1.7 trillion in 2018. As a worldwide export category, tourism ranks third after chemicals and fuels, and ahead of automotive products (UNWTO, 2019). In many developing countries, tourism is the top export category. Tourism is an

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important component of export diversification both for emerging and advanced economies, with a strong capacity to reduce trade deficits and compensate for weaker export revenues from other goods and services (UNWTO, 2019).

The revenue from medical tourism as a part of tourism products is also counted as an export category (Bull, 1992). In the medical tourism system, medical tourists travel from one country to another to receive higher quality and advanced healthcare. Better quality refers to modernized hospitals, more experienced surgeons, advanced medical equipment and supplies, better prescription drugs and medications, or healthcare facilities that specialize in certain medical treatments (Stephano and Edelhet, 2010). When a patient from Country A purchases medical services from Country B with US dollars, it is treated as foreign currency in Country B. This can be seen as Country B's medical industry exporting medical services to patients in Country B.

In 2017, the total medical tourists around world was 14~16 million and their expenditure was US$ 440billion which implies the export effect of the same amount of medical services (Dalen and Alpert, 2019). Another report shows other indicators of the rapid growth of medical tourism. No less than 20 million medical tourists travel across the world every year to receive healthcare services, spending an average of US$ 3410 per visit (Edelheit, 2019). This expenditure includes medical related expenditure, inpatient stay, transportation, accommodation, and food and beverage. Technavio's analysts forecast that the global medical tourism market will grow by 12.6% during the period 2017-2021(Market and Research, 2019a). The Korean medical tourism industry also attracted 380,000 medical tourists and earned US$ 582million in 2017 (Ministry of Health and Welfare, 2018).

However, despite the high levels of interest in medical tourism in the public and private sectors, there is a lack of theoretical research or models that systematically and comprehensively explain the relationships between medical tourism industry and its components in academia and the mainstream media. As a result, there is much room for confusion and conflicts between industry stakeholders, governments, corporations, academia, research institutes and insurers. Thus, a theoretical model that can comprehensively and holistically cover the medical tourism industry is required, and a systemic approach is a vital component of this theoretical foundation.

The principal reason for the confusion and conflicts between stakeholders in this industry is that the medical tourism industry is not a single composite industry but a complex composite industry. This means that services for medical tourists are provided by a number of businesses such as medical facilities, tourism businesses, transportation, accommodation, food and beverage, travel agencies, government services and so on. If a stakeholder observes the medical tourism phenomenon with a singular perspective, it is difficult to understand, and a proportion of services will end up being neglected. As argued by Getz (1986), a system approach may improve coordination among stakeholders in a tourism destination and contribute to establishing an effective policy.

In order to explain medical tourism phenomena with a system approach, this study aims to develop a medical tourism system framework (MTSF – Fig. 2) and medical tourism service provision framework (MTSPF – Table 2). Using a spatial framework, MTSF can explain the relationships between the components (medical tourists, medical tourist generating regions, medical tourist destination regions, suppliers of medical tourism products, intermediaries, and medical tourism services supplied by the medical tourism industry). MTSPF can present the relationships among the services required by medical tourists, service suppliers, and related human resources corresponding to the time sequential steps of medical tourists' movements. In practice, these models will aid in resolving conflicts among the stakeholders in the medical tourism industry and will contribute to the formation of rational policies

regarding medical tourism and to the theory building process of medical tourism.

## 2. Literature Review

It is necessary to review relevant previous literature in order to formulate a medical tourism system framework (MTSF – Fig. 2) and medical tourism service provision framework (MTSPF – Table 2). This is because the concepts of medical tourism supporting the MTSF and MTSPF models require fundamental information in relation to system theory (approach) to show the six components of medical tourism services; medical tourists; medical tourist generating regions (MTGR); medical tourist destination regions (MTDR); medical tourism products and product providers; medical tourism intermediaries; and medical tourism services. These components are systematically connected to each other and they are holistically influenced by each other. This implies that these components are essential factors to construct the MTSF and MTSPF models.

### 2.1. Concepts of Medical Tourism

Dalen and Alpert (2019) note that patients who travel to another country to seek health care are referred to as medical tourists. However, the concept is not as simple as it seems. Along with the growth of this industry in the past decades, research on the concept of medical tourism or tourists has been expanding. The increase of customers pursuing quality and cheap medical services, as well as tourists attempting to improve their health has produced a special niche product known as medical tourism (Connell, 2006). The term is being used casually in the general market and academia, despite not being an accurate reflection of medical services in tourist destinations or the experiences of the tourist (Horowitz, Rosensweig and Jones, 2007). The American Medical Association (AMA) also uses the term in an official capacity, while the majority of hospitals, insurance companies, corporations, facilitators, doctors, and the media accept and use the term (Edelheit, 2008).

There is still much difficulty in gathering empirical findings regarding real world experiences of tourists who engage in medical tourism by their own accord using their own resources, and the actual implications of the medical tourism phenomenon are still unclear (Lautier, 2008). Many countries are offering medical services at relatively low prices, but reliable data regarding the number of medical tourists and other indices is significantly lacking. Discussion regarding issues such as the market, preferred destinations, treatment effects, quality and safety of services, and ethical and legal problems are limited to narrative reviews, which cannot be considered as evidence (Lunt and Carrera, 2010). This lack of reliability, data and policies may be partly due to a lack of a theoretical foundation regarding medical tourism as a phenomenon.

According to Reed (2008), there are two definitions to the term "medical tourism" that can be found in literature or the internet. One refers to travel for the purpose of receiving health care services, and the other is a more general term used in the corporate and media fields, which is also appearing in both medical and tourism literature. The former definition is related to medical travel where doctors or nurses travel to developing countries in order to provide health services voluntarily, while the latter is the definition that matches up with the phenomenon discussed today in academia and the industry. Discussion on the concept of medical tourism thus far has placed it on an equal level with health tourism or subsumed it as a part of health tourism. Smith and Puczko (2009) classifies health tourism into medical tourism and wellness tourism, placing these two concepts under a broader term of health

tourism. Health tourism refers to tourist destinations attracting tourists by using medical facilities or services outside of traditional tourist attractions (Goodrich and Goodrich, 1987). As it can be seen, health tourism and medical tourism can both overlap and be mutually exclusive. Lunt and Carrera (2010) offer a more concrete explanation of the relationship between medical and health tourism. According to their research, medical tourism, when viewed broadly, is a derivative of health tourism. They see the two as a combined phenomenon, though with different weight levels of each. Health tourism has been seen as a planned trip away from one's home with the purpose of improving, maintaining and recovering individual wellbeing. Therefore, health tourism includes medical tourism which is planned travel away from one's domestic health service system to another nation in order to improve or maintain one's health. As Connell (2006) claims, there is a tendency for some researchers to place all health-related tourism under the term health tourism, but tourism involving specific medical treatments or procedures are better served by being seen as medical tourism.

As examined above, there are differences in perceptions of the concepts of medical tourism by the stakeholders involved. In particular, the tourism industry and the medical industry share different views. While the tourism industry views medical tourism as a combination of medical services and tourism services (Connell, 2013; Mathijsen, 2019), the medical industry is less optimistic on the combination of medical and tourism services (Balaban and Marano, 2010; Gaines and Lee, 2019; Lunt and Carrera, 2010). The reason behind this that each side approaches the concept from their own areas of specialization, which produces observations that are not fully-rounded. The concept of medical tourism differs according to which perspective is taken, and an all-inclusive definition lacks persuasive power. Thus, a systemic and comprehensive observation of the medical tourism phenomenon is required for an accurate understanding of the concept.

## 2.2. System Theory (Approach)

This paper's research approach is centered on 'system theory' or 'system approach' in order to form a medical tourism system that can comprehensively explain the medical tourism phenomenon. As a concept and method, system theory has been used in a variety of contexts to articulate a feasible common purpose. According to Bell and Morrison (1998, p. 81), "a system is perceived whole whose elements 'hang together' because they continually affect each other over time and operate toward a common purpose." System theory started in the 1930s, but Bertalanffy was the first to systemize this theory and attempt to link it to other fields of study (Leiper, 1979). Bertalanffy believed that contact with theories of other academic fields was required to further understanding of his field of work, biology. He observed those that were considered ignored or bypassed in the past and systemized system theory. System theory begins from the assumption that even the most complex phenomenon can be conceptualized into a mutually connected system. The advantage of this system approach is that it can clearly define complex phenomena. Because of this, system theory was adopted in many academic fields, including tourism. Capra (1983, 1881, 1996) is one of the explorers of this approach. He attempts to mix traditional Western science (matter) and Eastern Mysticism (mind and soul), arguing all components, including matter and mind, in the universe are connected within a web. Ten Brink, Hosper, and Colijin (1991) used this approach in order to describe and assess marine ecosystem sustainability with an AMOEBA model. Cuervo was the first to utilize system theory in tourism (Leiper, 1979).

Leiper (1979/ 1995) explains tourism phenomena with five components of the tourism industry: tourists as a subject of travel; tourist generating regions, transit route, and tourist

destination region where tourists move; and the tourism industry who provides relevant services required by tourists. Furthermore, political, economic, socio-cultural, environmental factors which impact the tourism industry are also incorporated in the tourism system. His research contribution is to suggest a first holistic system model which is effective in explaining the phenomena of tourism industry with a spatial framework, presenting the relationships between the components, and incorporating political, economic, socio-cultural, environmental factors which impact the tourism industry.

The tourism industry is made up of a combination of various industries, and as a result system theory is emphasized by many researchers (Goeldner and Ritchie, 2008; Gunn and Var, 2002; Leiper, 1979, 1995; Mill and Morrison, 2009). The system theory can be applied to medical tourism, as it is useful for understanding the roles, mutual connections and relationships among the various suppliers and customers participating in the medical tourism industry. Taking into account that the medical tourism industry is a complex composite industry with a common goal of attracting medical tourists, the system approach may be useful in studying and understanding the various phenomena in the medical tourism industry.

## 2.3  Components of the Medical Tourism Industry

The components that make up the medical tourism industry are the medical tourists, the medical tourist generating regions (MTGR), medical destination regions (MTDR), and the service-providing medical tourism industry, which includes medical tourism products, suppliers, intermediaries and related services.

### 2.3.1. Medical Tourists

Medical tourists, who are the consumers of medical tourism products and related services, can be divided into a variety of types, all of which have distinct qualities. Medical tourists are the core of the medical tourism system and have considerable influence on the system. The types of medical tourists can be divided differently according to the researcher's goals (type of treatment/procedure, motivation for travel, length of stay, travel budget and so on). According to the American Medical Tourism Association (MTA), there are six types of medical tourists according to different medical tourism products (Cormany, 2008). Major surgery tourists are those that require major surgery on the heart, spine, joints, and other parts of the body. Minor surgery tourists are those that require dental work or other minor surgeries. Cosmetic or plastic surgery tourists are those that desire these kinds of aesthetic procedures, while diagnostic service tourists are those that do not have a specific illness but wish to receive a general appraisal of their health. Tourists for alternative therapy treatments are those involved in alternative treatments such as Ayurveda or traditional Chinese medicine. Finally, wellbeing tourists travel in order to receive services regarding wellbeing or lifestyle remodeling.

If patients are classified according to motivation for receiving treatment in another country, they are grouped into the following six categories (Horowitz et al., 2007): Price-oriented: This type of medical tourist avoids the high costs of domestic medical care and looks for low-cost services in other countries. Many are not covered by insurance or have a low coverage rate. A recent report by the Gallup National Health and Well-being Index revealed that 13.7 percent of American adults were uninsured in the last quarter of 2018 (Edelheit, 2019). This implies that more than 30 million American adults do not have health insurance (Edelheit, 2019). Non-insured treatments: These medical tourists seek procedures that are not covered by their domestic insurance policy, such as birth control treatments (Sethna and Doull, 2012) or

gender reassignment surgery (Aizura, 2010; Wilson, 2011). Displeased with medical policy: Dissatisfied with the public health care systems in countries such as Canada and the United Kingdom, some patients choose to receive treatments overseas to avoid long wait times or low quality of health care services (Medhekar, Wong, and Hall, 2019). Controversial issue related: There are medical tourists who wish to receive certain treatments or procedures but cannot because of legal, moral, cultural, and social restrictions. This is especially true in developed nations such as the United States, where stem cell treatments are of great issue (Caplan, 2019; Cohen and Cohen, 2010). Countries such as the United Kingdom forbid abortion, and as a result couples seeking to abort a baby must travel overseas (Connell, 2006). In vitro fertilization (Horowitz, 2007) is another of such procedures and an even more extreme case is traveling to a country where euthanasia is allowed (Connell, 2006). Switzerland, the Netherlands, and some States of the USA have been attractions for so-called "death tourists" for their policies regarding euthanasia (Gautier et. al., 2015; Pratt, Tolkach, and Kirillova, 2019). Protection of privacy: The protection of privacy can also spur medical tourism. Patients that require secrecy regarding certain procedures such as birth overseas (Jaramilo, Goyal, and Lung, 2019), gender reassignment, drug addiction therapy (Crush and Chikanda, 2015; Kavenská and Simonová, 2015), and hair regrowth therapy (Cohen and Cohen, 2010) have an option to receive treatment overseas, where they will not be spotted by someone they know. Tourism and leisure: Some patients relish the opportunity to spend their vacation at a resort in a foreign country, and thus elect to receive certain medical procedures overseas (Connell, 2006). Although the tourism aspect is emphasized by travel agencies to potential tourists, oftentimes it is still the medical procedure that is of priority.

### 2.3.2. Medical Tourist Generating Region (MTGR)

Medical tourist generating regions refer to the countries or cities that produce medical tourists. This means that MTGRs become importing countries of medical tourism products. Medical tourism agencies and insurers or corporations naturally form relationships to send medical tourists to medical tourist destination regions (MTDRs). Because of this, MTGRs become target markets for MTDRs and are subject to marketing and promotion. Before the 2000s, the medical tourism phenomenon was largely comprised of the wealthy classes in developing countries that were seeking high quality health care services in the United States or Europe that were not available in their homelands (Goodrich and Goodrich, 1987).

However, this trend has now been reversed, and customers from developed countries are seeking health care, and sometimes tourism and leisure services, in developing countries (Horowitz et al., 2007). It is not only those from developed countries that are seeking medical tourism services. Surprisingly, many medical tourists hail from developing countries with high purchasing power (Connell, 2006). The wealthy from regions such as Africa, Asia and the Middle East are also major customers in medical tourism. This diversity in MTGRs indicates that the medical tourism industry is undergoing rapid globalization.

Other factors also contribute to the increasing numbers of medical tourists. As Garcia-Altes (2005) points out, medical tourism is most accessible to the baby boom generation, which has the highest income rates and the highest tendencies to take vacations. They are less sensitive to price and are more interested in the various factors such as destination, quality, and secrecy that make up marketing strategies (Garcia-Altes, 2005). The lifestyle of this generation is promoting the demand for aesthetic clinics, spas, retirement communities, fitness centers and rehabilitation clinics (Edelheit, 2019). In addition, those in developed countries today already tend to have experience in tourism, and many are seeking out new and differentiated tourism products.

### 2.3.3. Medical Tourist Destination Region (MTDR)

Medical tourist destination regions refer to the country or city attracting medical tourists from overseas markets. This means that MTDRs become exporting countries of medical tourism products. MTDRs must select target markets from various MTGRs and conduct appropriate marketing promotions. An incorrect choice of target market could bring about a waste of budget, time and manpower. Therefore, marketing strategies must be formed with great effort and precision in analysis of market opportunities, market segmenting, targeting, and positioning with marketing mix and promotion mix.

Currently many nations are supporting their medical tourism industries in order to target MTGRs. In terms of region, Asia, the Americas and Europe are the most active in this business (Horowitz et al., 2007). In Asia, the primary MTDRs are India, Israel, Jordan, Malaysia, Singapore, South Korea, the Philippines, Thailand, and the United Arab Emirates. The competition among these nations has been increasing, especially among India, Singapore, South Korea, and Thailand. The Asian medical tourism market is anticipated to cross US$ 14 billion mark by 2022 (Market and Research, 2019b). In the Americas, Argentina, Barbados, Brazil, Canada, Costa Rica, Cuba, Jamaica, Mexico, and the United States are the well-known destinations. The United States in particular has been a primary MTGR market, but at the same time has utilized its traditionally strong medical care quality to remain one of the most desired MTDRs. In Europe, Belgium, the Czech Republic, Germany, Hungary, Italy, Poland, Portugal, and Spain are noted MTDRs. For example, Sopron in Hungary is famous for drive-in and out dental services. Eastern European nations such as Hungary are pursuing price-competitiveness in order to attract patients from Western Europe. Germany receives many wealthy patients from the Middle East. In the other regions, South Africa and Tunisia are the notable MTDRs, and Australia and New Zealand are the largest medical tourism markets in Oceania.

Despite the growth of medical tourism industry, there remains many obstacles to the export of medical services by MTDRs. Garcia-Altes (2005) identifies the following as the main obstacles to the growth of the global medical tourism industry: restrictions on foreign hospitals' entry into markets, restrictions on direct foreign investment in medical services, regulations on the medical industry, lack of facilities, capacity limitations, manpower and excessive competition.

### 2.3.4. Medical Tourism Products and Product Providers

Medical tourism products can be divided into groups based on the patient's goals or type of service offered by the suppliers of medical tourism services. The MTA separates products according to the types of service offered by suppliers of medical services (Cormany, 2008): major surgeries, minor surgeries, cosmetic/plastic surgeries, diagnostic services, alternative therapy treatments, and wellbeing/lifestyle services. The first three services are called surgery style services, whereas the last three services are called non-surgery services. The first four services are called hospital style services, whereas the last two services are called non-hospital style services. As well as hospital style products, non-hospital style products are also rapidly growing. The market is set to grow 4.9% from 2017 to 2021, with total inbound spending reaching US$ 310.5 million by 2021(Market and Research, 2019c).

There are a variety of models dealing with how the medical tourism industry provides patients with medical services in MTDRs. The MTA lists the following medical service models (Cormany, 2008). The hospital service model is the most standard model that involves the patient receiving diagnosis and treatment at a hospital, then recovering and resting at the hospital, a hotel or a resort. Examples include Thailand's Bumrungrad International Hospital, Singapore's Raffles Hospital Group, and India's Apollo Hospital Group. The medi-resort

service model involves treatment and recovery occurring in a resort that is equipped with medical facilities. Malaysia's Palace of the Golden Horses and Thailand's Chiva-som Spa Resort are the more well-known facilities. The fly-in & airport service model involves treatment at a hospital inside the airport at which the patient lands, such as M-Hospital in Munich International Airport in Germany. Patients do not have to travel long distances, but such facilities are limited in capacity. The cruise ship model involves treatment and rest inside a cruise ship. Renaissance Cruises is an example of such a model. Oftentimes a patient can receive all the necessary treatments and recovery procedures during the same cruise but can also board the cruise after receiving treatment at a nearby hospital. Johns Hopkins Hospital offers such linked services with cruises. The drive-in and out model involves driving to a neighboring country to receive simple treatments (e.g. dental clinics) or to buy certain pharmaceuticals and then returning. Los Algodones, Mexicali, and Tijuana are located on the US-Mexico border, and are a prime example of such a model. Sopron in Hungary is another destination for dental clinic treatment for Western patients. The airline-hospital joint model involves receiving diagnoses during the flight on an appropriately equipped airplane, and the results of the diagnoses are directly sent to the hospitals in the MTDR before the patient arrives, speeding up the treatment process. Emirates Airlines offers such services, but only on certain routes.

### 2.3.5. Medical Tourist Intermediaries

Intermediaries serve as a link between the specialists of various fields involved in medical tourism. The government forms policies on medical tourism, improves systems, and supports budgets to intervene in the medical tourism industry, and can even send its own citizens to overseas hospitals, as is done by the British Healthcare Service (Horowitz et al., 2007). This is done to minimize wait times and costs that would be required for expanding medical infrastructure and relevant human resources. Since 2005, BHS has subsidized medical costs for citizens traveling overseas (within five hours by air) to receive treatments (Horowitz et al., 2007). Insurers and labor unions can also play the role of intermediary. Insurance companies and corporations with their own insurance policies are examining outsourcing medical services as a way to reduce costs and are offering incentives to those who travel overseas for treatments (Reed, 2008). Reduced insurance rates, cashbacks, travel cost subsidies for even traveling companions are also offered (Reed, 2008). Tourism-related associations and groups are also important intermediaries. The MTA provides a broad range of information for potential consumers, contributing to the growth of the global medical tourism market. For this development to occur, intermediaries must play an important role in connecting suppliers and consumers. Whether they receive commissions or provide free services, intermediaries introduce and connect a wide range of services to the medical tourist.

In particular, agencies play a large role for both consumers and suppliers by planning medical tourism products and engaging in marketing promotions. Medical tourism agencies are those that provide specialist services for overseas consumers who wish to receive medical treatment (Woodman, 2008). They may also be called medical(health) travel(tourism) agents, medical travel planners, medical travel facilitators, medical travel brokers, and medical travel expediters. Medical tourism agencies have many different roles, with some being part of a large corporation, while others are mom-and-pop operations (Woodman, 2008). Some specialize in a certain type of procedure or product and are located in a country that is known for such products, while others deal with multiple types of services in many different countries (Woodman, 2008).

### 2.3.6. Medical Tourism Services

The components of medical tourism services can be largely divided into four groups. These may change according to the researchers, but the MTA identifies four categories that the (American) consumers of medical tourism take into account when selecting overseas MTDRs (Table 1, Cormany, 2008). These categories must be taken into consideration by the service suppliers in MTDRs when forming marketing strategies or products. Medical facilities and related services, accommodations and F & B (food and beverage) services, tourist facilities and services, and government policies and sociocultural elements are such categories. Each of the four major groups have many subcategories. Only MTDRs that can prepare accordingly to supply these services to medical tourists will be able to succeed in attracting customers and grow.

**Table 1.** Factors of each destination mechanism which may boost or weaken an MTDR's appeal toward the medical tourists

| Types of Services | Services Required by Medical Tourists |
| --- | --- |
| Medical Facilities and Services | Costs-medical; Labor available-medical; Facilities: capacity, accreditation, licensure of staff, specializations, staff vs patient ratio, ambulance service; Training available - medical (medical schools, nursing programs); Medications: availability, safety of medication quality, parallels to US medication; English commonly spoken among medical staff; Equipment available for rental (e.g., oxygen and wheelchair); Ease of medical record transfer back to the home country; Private nurses available for hire; Privately operated facilities; Operation of "aftercare" facilities; Indigenous disease threats |
| Hotel and Food/Beverage Services | Costs-lodging; Costs-food and beverage; Hospitality labor availability; Number of 3/4/5 diamond rooms available; Hospitality training available; English commonly spoken among hospitality staff; Dietary accommodations available (gluten-free, low-sodium, and doctor-prescribed); Internet availability; Availability of potable water in facilities; Reliability of electricity in facilities; Licensure & regulation for: hotel accommodations, food & beverage operations, and spa facilities; Hotel accommodations: disability and special services accommodations, room service availability (24 hours), private baths, elevators, proximity to hospitals, heat/air conditioning. Value for services provided ratio; Presence of spa services: spa treatments, medical personnel associated with spa, traditional treatments, instruction in relaxation, diet and wellness programs, diagnostic services, exercise/workout facilities |
| Tourism Support Facilities and Services | Costs-general labor; Availability of educated translators; Commonality of spoken and written English; Airport: direct service from major cities in MTGRs, frequency of flights, airfare rates, airline servicing area, accommodations for disabilities; Local transportation: safety of available transport options, availability of taxis and limos, buses and other public transport types; Accommodation for disabled available; Reliability of infrastructure: public service, electric service, waste management; Local political stability; Safety from crime; Distribution of service for: the Internet, cell phones; Ease of limited mobility maneuverability (e.g., wheelchair, pedestrian-friendly areas); Destination appeal: city offerings, sightseeing, relaxation, culture, education, traditional medicine as supplement/alternative; Weather appeal for recovery and vacation |
| Governmental Services | Political stability of country; Currency fluctuations; Access to money/credit; Stability of labor force -union strike potential; Safety of country; Respect of individual rights: protection of disabled, culture of tolerance, freedom from unreasonable arrest, gender equality; Legal system: protection of patients, established laws, evenness of enforcement, malpractice recognized, legal recourse, accounting and tax system, financial disclosure; Ease of access: need for visa, visa access, visa processing time; Type of market: capitalism, privatization, regulation/deregulation of areas impacting healthcare and tourism; Cultural strain: host country's citizens' attitudes toward source country, likeness of source and host country culture, current awareness/image of locale by visitors |

**Source:** Modified from Cormany (2008: 36).

Because the primary purpose of medical tourism is receiving medical services, how a

MTDR is able to reinforce trust and safety of its medical care services in medical tourists' minds becomes one of the most important aspects (Kunwar, 2019). In particular, medical tourists are always apprehensive of the standard of medical technology of MTDRs, and thus additional levels of care and detail are required in this area when compared to the other three categories. Along with the fame of its medical staff, the level of medical facilities is of most importance to medical tourists (Nikbin et. al., 2019). The bed capacity, the presence of JCI (Joint Commission International) certification and other international standards, registration of doctors and nurses, level of expertise in certain areas, doctor-patient ratio, and ambulance services are some of the factors that customers take into account (Watson, 2008). With the growth of the global medical tourism industry hospitals all around the world are increasing international marketing activities. Medical tourists, when subjected to this, are curious about how these international hospitals compare to those in their home country. One way for overseas hospitals to prove their high standards is receiving certification from the International Society for Quality in Healthcare (ISQua) (Watson, 2008).

The accommodation and food, and the related services, are also of great importance for an MTDR when it meets the needs of sensitive and vulnerable medical tourists. Because medical tourists also are restricted in mobility and diet during treatment and recovery, additional attention must be paid to these customers, and the following factors can be taken into account by medical tourists when choosing a MTDR (Sadeh and Garkaz, 2019): placement of medical staff at the spa facility, possibility of a health diagnosis, treatment programs inside the spa, traditional treatment methods (yoga, acupuncture and so on), rest, diet, well-being education (tai chi, yoga and so on), and exercise facilities. Facilities that can meet the dietary requirements recommended by doctors to patients are also required.

Tourism and leisure facilities and services are also very important for medical tourists. Aside from the medical tourists that receive services related to their surgeries, medical tourists and their companions have a high possibility of pursuing recreational activities after their medical care. A survey of patients at Thailand's Bumrungrad Hospital revealed that 85% of patients or their companions experienced at least one kind of tourism service during their stay (Medical Tourism Association, 2010). Utilizing local travel agencies or travelling to famous tourist spots, shopping and other culture activities by oneself is also possible. Therefore, tourist and leisure facilities and services must also be developed continually to attract medical tourists (Zarei and Maleki, 2019).

Finally, political and social circumstances as well as government policies regarding visas, and the attitude of the local population to foreigners are also important factors in MTDR choice. In particular, visa policies have a great effect on MTDR selection (Chinai and Goswami, 2007).

Human resources in medical tourism services are also required in order to offer appropriate services to customers. There are four major categories of specialists: medical service specialists, accommodation and F & B service specialists, tourism service specialists, and government related service specialists. More specifically, medical service specialists include international doctors, nurses, physical therapists, medical coordinators etc. Accommodation and food services require the expertise of floor services, room services, food services, leisure and sports specialists, therapists, and lifestyle remodelers. Tourism service specialists include coordinators, guides, operators, interpreters, and translators. Government service specialists include customs officers.

## 3. Research Methods

The starting point of this study design is to develop a tool to easily explain to medical tourism stakeholders how various industries come together to provide complex inter-related services through the visualization of the spatial and temporal structure. The author determined that the system approach reviewed in the literature review was optimal for explaining the interests of stakeholders with the common goal of attracting medical tourists and enhancing the level of satisfaction with the services provided. Therefore, a research framework was developed as follows. First, use the system approach. Second, select a tourism system approach that deals with tourists from the system approach. Third, apply the tourism system approach to medical tourism. Finally develop two models using the medical tourism system approach: a medical tourism system framework (MTSF) and a medical tourism service provision framework (MTPSF).

According to this research model, Leiper (1991)'s tourism system model (Fig. 1) was applied as a conceptual research framework to develop the first model of the medical tourism system framework (MTSF). Leiper explains the tourism system by using the concept of geographic space composed of tourist generating regions (TGR), where tourists originate, tourist destination regions (TDR), where tourists arrive at their destinations, and transit routes. For this system to exist, there must be at least one tourist, at least one TGR, one TDR, and a tourism industry that provides tourist services. The system is also influenced by political, economic, socio-cultural, legal and institutional, and natural environmental factors.

**Fig. 1.** Tourism System Model
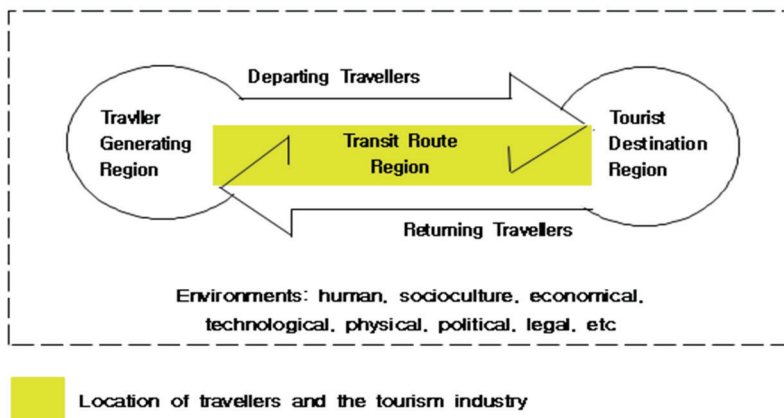


Source: Leiper (1995, p. 25).

Applying an existing model and creating another new model is a research method commonly used in qualitative research (Veal, 1999). This research method is mainly used to study cases with similar structures and characteristics to those studied using the existing model. In particular, when new industries emerge, this research method is often used to apply existing useful models to explain their structure and phenomena (Veal, 1999). Therefore, the structure and phenomenon of the medical tourism industry, which is attracting attention as a new power industry, can be explained more easily with the application of the existing tourism system model.

Since medical tourists are also tourists for medical treatment purposes, the types of medical tourists, their route of travel, and the type of medical tourism services they require can be

spatially placed on the figure (see Fig. 2). Based on the concept of the Leiper model (Fig. 1), it is possible to display the type of medical tourist, the type of service, the intermediary, and the place of marketing promotion. This systemic framework allows us to describe the structure and phenomenon of medical tourism between two specific regions (TGR and TDR) in one geographical and spatial model. The medical tourism phenomenon can be easily understood by using this framework because it is created by the combined action of the four components of the medical tourism system, that is medical tourists, generating regions (MTGR), medical tourist destination regions (MTDR), and the medical tourism industry. These four elements were placed on this framework (see Fig. 2) by considering their characteristics and roles. The medical tourism industry was divided into four types of services (in MTDR) and agencies (in both MTGR and MTDR separately). According to this model, medical tourists, MTGR, MTDR, and the medical tourism industry are the basic components of the medical tourism system. A detailed description of the nature and role of these components is provided in detail in 'system components of the medical tourism industry' (see II. Literature Review).

The second model (Table 2), the medical tourism service provision framework (MTSPF), was conceived by integrating Leiper's travel system model with the concept of time of travel in the work manual used in the international patient centers of medical tourism hospitals. Leiper did not directly mention the concept of time in his model other than the concept of geographic space, but the traveler's 'travel' inherently implies the attribute of the 'flow of time'. The flow of medical tourism service, therefore, may be classified into three steps (step 1: MTGR → step 2: MTDR → step 3: MTGR) in line with the time stages of travel of medical tourists (see Table 2).

As shown in Table 2, this MTSPF model provides an overview of medical tourists over time by organically connecting the services needed by medical tourists according to the stage of travel, relevant industries that provide the services, and the service personnel. The linkage among them was presented to provide a comprehensive view of services. The MTSPF model was designed to fulfill the role of complementing the MTSF model (Fig. 2), which explains the structure and phenomenon of medical tourism as a spatial concept. Therefore, when these two models are used at the same time, the role and linkage between the spatial arrangement of medical tourism components and the time sequential movements of medical tourists can be more easily understood.

In-depth interviews with experts in medical tourism industry were conducted to pretest both models. In the model development process, the two models were tested through in-depth interviews with industry experts from the first stage of development to completion of the models. There were three interviewees, each interviewed twice. The interviewees were two team managers at the international patient centers of hospitals in Seoul and a team manager of a medical travel agency in Seoul; interview locations were the team managers' offices. The test period was from October 1, 2017 to September 30, 2018. The interviews continuously improved the models by addressing vulnerabilities and resolving problems until completion. They identified several weaknesses and suggested valuable comments in order to improve the quality of the models.

## 4. Research Result 1: Medical Tourism System Framework

The medical tourism system framework (MTSF) can be drawn as presented in Fig. 2, using the concepts of Leiper's tourism system (Fig. 1) and the components of medical tourism mentioned in the literature review. MTSF is a diagram designed to explain the relationships

between the components of the system by placing them on the same plane and showing the services and their suppliers according to the routes of the medical tourists. The medical tourism phenomenon can then be explained using four components of the medical tourism system: medical tourists, medical tourist generating regions (MTGR), medical tourist destination regions (MTDR), and medical tourism services supplied by the medical tourism industry, including medical tourism agencies. Each component is mutually connected and interdependent in their mechanisms.

The relationships of each component are as follows (See Fig. 2). The first step is in which a medical tourist contacts an agency in MTGR. At the second step, the agency contacts and sends his/her customer to an agency in MTDR. On the third step, the agency in MTDR contacts the relevant service providers and coordinates the services required by his/her customer with the providers. During the fourth stage, the four service providers (medical service, accommodation and food service, tourism service, and government service) supply the relevant services to their customer. After completing medical treatment the medical tourist returns to MTGR, completing the fifth stage. When attracting customers in MTGR, the agency in MTDR should consider various marketing activities towards agencies or insurance companies in MTGR. In addition, political, economic, socio-cultural, environmental factors are closely related to these medical tourism system components.

The ability of a country or city to attract medical tourists in the medical tourism system is influenced not only by these direct components but also other external circumstances (Leiper, 1979/1995). The political, economic, social and cultural situation can all play a role, as can environmental changes, exchange rates, visa policies, labor markets, openness towards foreigners, and outbreaks of diseases (Cormany, 2008). Fundamentally, the tourism industry is sensitive to political and social factors (UNWTO, 2018). For example, the difficulty of gaining entry into the United States for those from the Middle East after the September 11 attacks forced many of these people to change their MTDR to Singapore, Thailand and other Southeast Asian nations (Connell, 2006). Hong Kong's mass protests that occurred during 2019 lead to many tourists avoiding the country.

Furthermore, various financial setbacks and crises such as the Asian financial crisis in 1997 and the global economic depression in 2008 have made many tourists less likely to travel (UNWTO, 2018). The fact that medical tourists take into account the local attitudes towards foreigners or sociocultural similarity when selecting MTDRs indicates that social and cultural factors do play a role in decision making. Environmental factors also play a role, as seen with the 2004 tsunami in Indonesia having a heavy impact on tourism in the region. The 2010 volcanic eruptions in Iceland forced the cancellation of most air traffic in Europe for a period of time and caused significant economic damage to the European tourism industry (Bird, Gisladottir, and Dominey-Howes, 2010). The movement of tourists, as a part of services provided by the tourism industry, is thusly affected by environmental factors.

In terms of exchange rate, if the currency of the MTDR falls, or if the currency of the MTGR rises, the number of medical tourists increases (Export increase effect) (Bull, 1992; Dogru, Isik, and Sirakaya-Turk, 2019). Furthermore, if the visa application process in the MTDR is difficult or time-consuming, tourists tend to select other destinations (Chinai and Goswami, 2007). Issues with labor movements and strikes that can affect airports and public transportation systems are also detrimental to medical tourists, as are outbreaks of diseases such as SARS and H1N1 influenza. The Asian tourism industry was greatly affected by the SARS outbreak in 2003, and the global tourism market shrunk as a result of the H1N1 influenza outbreak (UNWTO, 2017).

**Fig. 2.** Medical Tourism System Framework
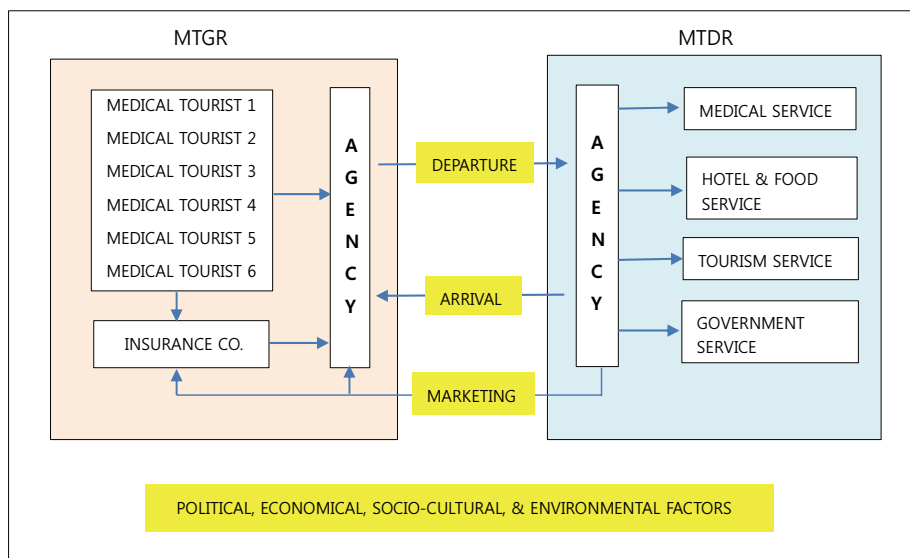


*MTGR: Medical Tourist Generating Region
*MTDR: Medical Tourist Destination Region
*medical tourist 1 - 6: medical tourists for major surgeries, manor surgeries, plastic surgeries,
  diagnostic services, alternative treatments, and well -being therapies.

To summarize, the medical tourism system includes the following  components: at least one medical tourist, a MTGR, a MTDR, and the medical tourism industry that provides the related services. In addition to these components, external factors mentioned above can greatly affect the trends and flexibility of this system.

## 5. Research Result 2: Medical Tourism Service Provision Framework

MTSPF (Table 2) is developed to complement the weakness of MTSF (Fig. 2), transferring the spatial framework of the medical tourism components and their relationships to a time sequential framework. As presented by the MTSPF, at each phase of the medical tourist's travels from the MTGR (the 1st Step) to MTDR (the 2nd Step) and back to the MTGR (the 3rd Step), the services demanded and supplied are different. Much preparation is required before initially leaving the MTGR, which entails many different services. Before departure, the selection of a medical travel agency, destination, treatment options, companions, hospitals and doctors are required, as is the organization of medical records, whether the patient will engage in tourism activities, and airline and accommodation arrangements. Specialists aiding in this process include local doctors and travel agents. At this stage, MTDRs must form efficient marketing strategies towards their target markets.

**Table 2.** Medical Tourism Service Provision Framework

| Travel path of medical tourists | Services required by medical tourists | Services provided by suppliers | Relevant human resources | Reference points |
|---|---|---|---|---|
| 1st S Step: MTGR: | consulting & selecting of treatment option | support for treatment option | Doctor in MTGR | marketing promotion is needed |
| | selecting of MTDR | consulting for selection of MTDR | Doctor/Agency in MTGR | |
| | selecting agencies | consulting for selection of agencies | Doctor/Agency | |
| | selecting of travel partners | consulting for selection of travel partners | Doctor/Agency | more than 75% of medical tourists travel with partners in Thailand (MTA, 2010) |
| | search for Drs in MTDR | support for searching a Dr. | Doctor/Agency | on-line marketing promotion is needed |
| | search for hospitals in MTDR | support for searching hospitals | Doctor/Agency | |
| | search for information of Drs in MTDR | support for information of Drs | Doctor/Agency | |
| | preparation of patients medical record | support for preparation of patients medical record | Agency | |
| | planning for treatment, recovery, recuperation | support for planning of treatment, recovery, recuperation | Agency | establishment of a communication channel between Drs in MTGR and MTDR |
| | planning for travel | support for planning of travel | Agency | |
| | reservation for an airline & a hotel | support for reserving & ticketing of an airline & a hotel | Agency | |
| | confirm of relevant papers & materials | support for relevant papers & materials | Agency | |
| | moving to an airport & depart procedure | support for transport to an airport & depart procedure | Agency | |
| | boarding & travel to MTDR | service of an airline | airline staff | |

**Table 2.** (Continued)

| Travel path of medical tourists | Services required by medical tourists | Services provided by suppliers | Relevant human resources | Reference points |
|---|---|---|---|---|
| 2nd Step: MTDR | arrival to an airport | reception of patients | coordinator | translator in case |
| | moving to a hotel | support for local transport | coordinator | some hospitals support transport in Asia. translator in case |
| | arrival to a hotel | support for check-in | coordinator/hotelier | |
| | departure & arrival to a hospital | support for local transport | coordinator | |
| | check-in | support check-in | hospital staff/medical coordinator/coordinator | some hospitals have medical coordinators in Asia. translator in case |
| | interview with a Dr. | support for interviews with a Dr. | Dr./Nurse/medical coordinator/coordinator | translator in case |
| | treatment or surgery | support for treatment or surgery | Dr./Nurse/medical coordinator/coordinator | communication between Drs in MTGR and MTDR |
| | check-out | support check-out | hospital staff/coordinator | translator in case |
| | recovery in hospital | interview with a Dr./nursing/care/rehabilitation etc | Dr./Nurse/medical coordinator/ coordinator/therapist /nutritionist | tourism plan for a long-term patient's partners |
| | change of stay place after surgery | support for local transport | coordinator | translator in case |
| | recovery & recuperation in a hotel, spa, or resort | support for check-in, nursing, care, rehabilitation etc | (personal)nurse/coordinator/therapist/nutritionist/hotel, spa, resort staff | tourism plan for a long-term patient's partners |
| | tourism or leisure activities | support for tourism or leisure activities | coordinator/travel agency/ tourism or leisure service staff | Dr.'s permission is required |
| | personal businesses | support for personal businesses | coordinator | translator in case |
| | final Dr. interview & check-out | support for final Dr. interview & check-out | Dr./Nurse/medical coordinator/coordinator | communication between Drs in MTGR and MTDR |
| | moving to an airport, check-in procedure | support for transport & check-in | coordinator | translator in case |
| | boarding & departure | airline service | airline staff | |

**Table 2.** (Continued)

| Travel path of medical tourists | Services required by medical tourists | Services provided by suppliers | Relevant human resources | Reference points |
|---|---|---|---|---|
| 3rd Step: MTGR | reception in an airport | support for transport | agency in MTGR | |
| | interview with a Dr. in MTGR | support for an interview with a Dr. | Dr. in MTGR | communication between Drs in MTGR and MTDR |
| | after treatment (in case of side effect) | support for treatment or surgery | Dr./nurse | |
| | in case of medical accidents | support sue procedure | lawyer/agency | MTGR or MTDR |

Even more specialists and services are required as the patient arrives at the MTDR. Unlike regular tourists, medical tourists are in states of physical and mental weakness and additional attentive services should be provided. Services required at this phase include airport pickups, hotel check-in, transportation to hospitals and check-in, diagnosis and treatment by doctors, recovery and rest, check-out procedures, tourism activities (when possible), and departure process. Specialists here include coordinators, translators, hotel resources, local doctors and nurses, other medical staff, therapists, nutritionists, spa and resort staff, and tour guides.

Once treatment is finished, the patient returns to the MTGR. Even after returning, the medical tourist requires careful attention and service. Consulting with a local doctor regarding the treatment received overseas is required, as is further rest and recovery. Return trips to the destination for additional treatments may be required in the case of side effects, infections or complications resulting from the treatments, which requires more support from the medical travel agency. In the case of legal issues, local and overseas legal services may be required (Deora, 2019).

## 6. Conclusion

This study was conducted in order to describe and explain medical tourism phenomena with a systemic approach and resulted in the development of MTSF (Fig. 2) and MTSPF (Table 2). Findings of this study are as follows. MTSF, as a spatial framework, interprets the medical tourist in MTGR as consumer and MTDR as supplier to build the basic structure, and categorizes the six types of medical tourists and four types of services within this framework. Additional focus has been placed on the agency as an intermediary between consumer and supplier. MTSPF, as a time sequential framework, systematically presents the relationship between the services, suppliers and specialists required at each phase of a medical tourist's trip, complementing the weakness of MTSF. According to these two models, it is evident that services required by medical tourists are not provided by a single business but multiple entities. This implies that the medical tourism industry is a complex composite industry. In conclusion, these models support the purpose of this research which sought to observe medical tourism phenomena with a systemic approach and to contribute to a theory-building process of medical tourism.

The author suggests the following theoretical contributions of these two models. Firstly,

the MTSF and MTSPF can be used as a theoretical framework for discussion or analysis of medical tourism. As mentioned above, there is a lack of theoretical models that can comprehensively and systematically explain the medical tourism phenomenon. As a result, there is potential for unwarranted misunderstandings and conflicts between various stakeholders. These models can also be used to resolve these problems and understand other industries connected to the medical tourism industry. Secondly, the models are not only for the theoretical use in the tourism field but can also be of relevance to other academic fields for interdisciplinary research and study. For example, these models can apply to system theory, economics, business management, geography, medicine, medical businesses. As the medical tourism industry continues to grow, these related fields can utilize the theoretical resources in this study to investigate how the phenomena impacts them.

Further practical contributions of these two models are as follows. Firstly, the MTSF describes the geographical nature of the industry, and any country or city interested in medical tourism can play the role of MTGR and MTDR. Therefore, the model can be used to comprehensively and systematically explain the medical tourism phenomenon occurring between two countries or cities. Secondly, the MTSF and MTSPF can be used to understand the medical tourism phenomenon from a different perspective from existing research. Studies up until now have primarily focused on the MTDR but taking the perspective of the MTGR is also important in identifying issues and precedents in attracting medical tourists on the part of MTDRs. In particular, these models may be of help in identifying target market MTGRs and forming related marketing strategies.

Introduction of these two models implicates that the stakeholders in the medical tourism industry should make a consensus to produce the best satisfaction level of their customers, medical tourists. To achieve this, it is important to understand that medical tourism providers have to supply the best medical tourism programs and their customers have a positive patient experience. Therefore, the providers must understand the whole structure of these two models, the functions of stakeholders, and the relationships between them in order to accomplish their business goals. Medical tourists not only have their own individual reasons for travelling to foreign countries to receive medical tourism services, but also their own individual expectations (Stephano and Edelhet, 2010). Those expectations need to be understood by the medical tourism service providers. The medical tourism providers need to understand why each individual medical tourist is travelling for medical services and what their individual expectations are in order to have a successful medical tourist experience (Stephano and Edelhet, 2010). The providers also need to understand what political, economic, socio-cultural, environmental, and governmental issues are in effect to meet the needs and requirements of customers. These two models introduced in this paper will lead the medical tourism providers to their successful business goals.

Clayton and Redcliffe (1996, p. 211) has claimed that "models are servants, not masters." This indicates that one specific model cannot perfectly explain a complex and dynamic social phenomenon. The MTSF and MTSPF are no exception, in that they cannot offer complete solutions to the issues facing the medical tourism industry, although they are designed to aid comprehensive understanding of these issues. Instead, they may be used as a complementary tool to the fundamental management systems of the medical tourism industry. There are many issues that cannot be explained by one or two models in the medical tourism phenomenon. The experiences and knowledge attained by the people working in this industry may be even more effective in explaining or resolving such issues.

There is much potential for future studies using these models. Studies on the relationship between the suppliers and consumers of the medical tourism industry, or those on the formation of marketing strategies according to target market or consumer group. Studies on

the business situations between MTGR agencies and MTDR agencies, between agencies and insurers and employers would also have significance. Furthermore, strategies of affiliation between the four service subtypes in MTDRs could provide fruitful subjects for future studies.

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# Brand Personality of Global Automakers through Text Mining

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## Abstract

***Purpose*** – This study aims to identify new attributes by analyzing reviews conducted by global automaker customers and to examine the influence of these attributes on satisfaction ratings in the U.S. automobile sales market. The present study used J.D. Power for customer responses, which is the largest online review site in the USA.

***Design/methodology*** – Automobile customer reviews are valid data available to analyze the brand personality of the automaker. This study collected 2,998 survey responses from automobile companies in the U.S. automobile sales market. Keyword analysis, topic modeling, and the multiple regression analysis were used to analyze the data.

***Findings*** – Using topic modeling, the author analyzed 2,998 responses of the U.S. automobile brands. As a result, Topic 1 (Competence), Topic 5 (Sincerity), and Topic 6 (Prestige) attributes had positive effects, and Topic 2 (Sophistication) had a negative effect on overall customer responses. Topic 4 (Conspicuousness) did not have any statistical effect on this research. Topic 1, Topic 5, and Topic 6 factors also show the importance of buying factors. This present study has contributed to identifying a new attribute, personality. These findings will help global automakers better understand the impacts of Topic 1, Topic 5, and Topic 6 on purchasing a car.

***Originality/value*** – Contrary to a traditional approach to brand analysis using questionnaire survey methods, this study analyzed customer reviews using text mining. This study is timely research since a big data analysis is employed in order to identify direct responses to customers in the future.

**Keywords**: Automaker, Brand Personality, Customer Review, Topic Modeling
**JEL Classifications**: C45, D12, M52

## 1. Introduction

The automotive industry is one of the world's largest economic sectors today. Even if people around the world have different languages and cultures, they have the widest range of demand in that automobile is a typical consumer product. Since the invention of automobiles in the 19th century, competition for automobile production and sales has been fierce as a representative consumer product, and companies has been running with various ideas. The automobile sales researches  have been conducted in various ways to the extent that most of the management strategies and marketing strategies are mobilized.

In general, consumers use various methods in the process of processing information to judge products or make decisions (Mantel and Kardes, 1999). When purchasing a car, consumers' decision is made according to their preference, and many studies have paid attention to grasping the factors affecting their purchasing intention (Lave and Train, 1979; Erickson, Johansson and Chao, 1984; Baltas and Saridakis, 2013).

It has traditionally been known that an automobile's price, size, power, operating cost, transmission type, reliability, and body type were important factors to consider in

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determining preference. However, Erickson, Johansson, and Chao (1984) revealed that Multi-Attribute Product Evaluations take place as image variables of automobiles influence beliefs and attitudes. This is not limited to car purchases, it has to do with the brands used in most products. This is because a product or brand satisfies or fills a need of a consumer, and gives benefits such as convenience through its use. The brand's image plays an important role in a company's sales, profits, and market share, and has a positive effect on car purchases (Hocherman, Prashker, and Ben-Akiva, 1983; Berkovec and Rust, 1985; Mannering and Winston, 1985; Mannering, Winston and Starkey, 2002, Train and Winston, 2007).

For successful automobile sales, it is important to form a positive consumer attitude. Brands have a comprehensive and broad impact on product evaluation. Brands with high recognition have been associated with positive purchasing evaluations in the past and serve as an influential clue when consumers evaluate the quality of products (Maheswaran, Mackie, and Chaiken, 1992; Richardson, Dick, and Jain, 1994). Therefore, recent marketing strategists and brand planners of manufacturers are setting strategies to enhance brand image to succeed in the competition for preference against competing products or competitors (Aaker, 1997; Kotler, Keller, Brady, Goodman, and Hansen, 2009).

The measurement of intangible brand associations is often operationalized using measures of brand personality; such an approach has attracted controversy while it has proven helpful to both academics and practitioners in accounting for the results of brand associations (Eisend and Stokburger-Sauer, 2013). Content analysis is a well-established research methodology commonly used in social sciences to analyze communications (Holsti, 1969). Over the past three decades, content-analysis research has greatly benefited from the exponentially increasing volume of electronic data, including various types of media messages, interview transcripts, discussion boards in virtual communities, and texts from Web sites (Neuendorf, 2002; Rainer and Hall, 2003; Romano et al. 2003; Wickham and Woods, 2005).

On the other hand, post-purchase satisfaction or post-purchase evaluation has affected potential customer purchase intentions. Word-of-mouth (WOM) communication has been found to have a great impact on that intention as well. Online word-of-mouth is a non-commercial information transmission voluntarily delivered among consumers, such as advice and complaints about services that have been used or experienced, and has higher credibility than commercial information. Voss (1984) said that despite active marketing activities, more than 80% of consumers purchase products from the recommendations of a specific person rather than frommass media. When consumers evaluate a product, oral communication with reference groups such as family, relatives, and friends has a strong influence on purchasing attitude.

Consumers search for information on products or services through the Internet, and are proactive in providing information, clarifying their experiences through bulletin boards and comparison sites, and asking for help. Online word-of-mouth communication, which has anonymity, and transcends space and time, is free and convenient communication compared to traditional word-of-mouth (Chevalier and Mayzlin, 2003; Henning-Thurau, Gwinner, Walsh, and Gernler, 2004).

The present paper focuses on an issue related to brand personality (Aaker, 1997). Our main aim is to identify dimensions of brand personality that can be truly generic and applicable across all contexts by using the frequency of brand personality of customer reviews in big data and topic modeling. The author will examine whether brand personality can be used appropriately in measuring the automotive brand personality scale. Data was collected from Customer Reviews through J.D. Power in the U.S. using a web data mining crawler. Collected reviews were analyzed through text analysis.

The present study proposes a new methodological approach to conduct content analysis of electronic text data in a more efficient way. Text data are processed iteratively through software tools such as topic modeling SW, WordSmith Tools, and SPSS. This approach smooths the survey responses of the original text data, identification of the variables of interest, and the counting of the occurrences of these variables in the corresponding texts. It also permits the storage of word-frequency data derived from statistical packages.

## 2. Theoretical Background

### 2.1. Consumer Automotive Purchasing Behavior

Table 1 summarizes influential vehicle type choice models found in previous studies. In each study, a brief presentation of the explanatory variables entered the models, along with sample size, and the main findings have been provided.

Classically, in purchasing a car, the properties of furniture, vehicle characteristics, and gas prices have been considered as the influential variables. Lave and Train (1979) suggested purchase price, operating cost, number of seats, weight, horsepower to weight, and fuel efficiency as factors that American consumers consider when purchasing a vehicle. The relationship between consumer characteristics suggested that if the consumer's income is high, a large and expensive vehicle is purchased, and the second vehicle purchased has a tendency to be smaller than the existing vehicle.

Depending on the circumstances, major considerations for purchase have changed. In the second oil crisis of the 1970s, fuel economy became the most important consideration. For this reason, Japanese cars with better fuel economy than American cars sold explosively in the United States. In a study by Manski and Sherman (1980), above all, household income and income level were important considerations when purchasing a vehicle. It was confirmed that households with low incomes will hesitate to buy a car that requires extensive operating costs.

Vehicle fuel considerations were extended by Brownstone, Bunch, and Train (2000). By expanding the consideration of simple fuel costs, the relationship between the factors of preference for car purchase have been found by considering electric cars, natural gas cars, and methanol cars.

According to a consumer classification by Campbell, Ryley, and Thring (2012) early adopters preferentially paid attention to alternative fuels such as hybrids, biofuel, solar, and zero emission electric cars, and as countermeasures against global warming were implemented in the automotive industry, interest in alternative fuels also grew.

A study tried to demonstrate that factors considered in purchasing a vehicle varied depending on consumer preferences and styles, rather than on the mere selection of performance. Choo and Mokhtarian (2004) presented a study indicating that the designs of vehicles owned in a neighborhood may influence the purchase of vehicles. Since consumers usually select vehicles according to personal characteristics and lifestyles, those reluctant to travel were likely to buy luxury vehicles. On the contrary, consumers that often traveled long distances were likely to buy compact vehicles.

In the same vein as this opinion, Cao, Mokhtarian, and Handy (2006) showed that the designs of neighborhood vehicles may have an effect on purchase . Moreover, they also suggested that the types of vehicles were determined by considering commute distances, the size of yards, and off-street parking availability.

**Table 1.** Summary of Automotive Purchase Models

| Reference | Sample Size | Vehicle Characteristics Examined | Main Findings |
|---|---|---|---|
| Lave and Train (1979) | 541 new car buyers | Purchase price, operating cost, number of seats, weight, horsepower to weight, fuel efficiency | (a) Larger households are more likely to choose subcompact vehicles. (b) Households with longer driving distances are more likely to select larger vehicles. (c) Older people tend to choose larger vehicles. (d) Households with higher incomes are likely to select larger and more expensive vehicles. (e) Vehicle price negatively affects the selection of each of vehicle types. (f) Households possessing more than two vehicles have a tendency to select smaller vehicles when they buy another. |
| Manski and Sherman (1980) | 1,200 Households from a consumer panel survey | Purchase price, operating cost, number of seats, weight, luggage space, acceleration time, vehicle age, turning radius, braking distance, noise level, scrappage rate, search cost, country of origin | (a) Both seating and luggage space had positive effects on the selection of vehicle type, especially in households with larger single-vehicles. (b) Scrappage rates (a proxy for the probability of mechanical failure in vehicles) had a negative effect on the selection of vehicles. (c) Heads of households older than 45 tended to consider weight in selecting the types of vehicles. (d) Households with lower incomes were less likely to select vehicles with higher operating costs. (e) Acceleration time has a significantly positive effect on the selection of vehicle type. |
| Hocherman et al. (1983) | A sample of 500 households that did not buy a car, and 800 households that bought a car in 1979 | Purchase price, operating cost, vehicle size, engine size, luggage space, horsepower to weight, transaction cost, vehicle age | (a) Purchase price, operating cost, and vehicle age negatively influenced the selection of vehicle type. (b) The size of vehicle negatively affected the selection of vehicle types in urban areas as opposed to rural areas. (c) The values of horsepower were higher for the age group of 45 or younger. (d) Ford and foreign manufacturers were significantly positively valued; other domestic vehicle brands were significantly negatively valued. |
| Berkovec and Rust (1985) | 237 single-vehicle households | Purchase price, operating cost, number of seats, vehicle age, turning radius, horsepower to weight, manufacturer, transaction | (a) Operating cost, purchase price, and vehicle age had negative effects on the selection of vehicle type. (b) The size of vehicle negatively affected the selection of vehicle type in urban areas as opposed to rural areas. (c) The value of horsepower was higher for those aged 45 or younger. (d) Ford and foreign manufacturers were significantly positively valued; other domestic vehicle brands were significantly negatively valued. |
| Mannering and Winston (1985) | Sample of 3,842 single-vehicle and two-vehicle households | Purchase price, operating cost, vehicle age, shoulder room, luggage space, horsepower to engine, displacement | (a) The variables of household brand loyalty had positive effects on the selection of particular vehicle makers. (b) Capital and operating costs negatively affected the selection of vehicle type. |

**Table 1.** (Continued)

| Reference | Sample Size | Vehicle Characteristics Examined | Main Findings |
|---|---|---|---|
| Brownstone et al. (2000) | Sample of 4,747 Households that successfully completed a vehicle-choice experiment | Vehicle range, purchase price, home and service station refueling time, home and service station refueling cost, service station availability, acceleration time, top speed, tailpipe emissions, vehicle size, luggage space | (a) The resulting preference data appeared to be critical for understanding selected body type and scaling information, but there were problems in both multicollinearity and difficulties with measuring vehicle attributes. (b) The preference data were critical for obtaining information regarding attributes which cannot be used in the market place. (c) The use of the preference models alone may result in implausible forecasts |
| Mannering et al. (2002) | 654 households that bought new vehicles between 1993 and 1995 | Purchase price, operating cost, passenger side airbag, horsepower, turning radius, vehicle reliability, vehicle residual value, vehicle size | (a) Regardless of acquisition type, house-holds were more likely to select vehicles with higher brand loyalty and residual values. (b) When households decide to obtain vehicles via leases, they tended to put greater value on vehicle attributes such as passenger side airbags and horsepower, but were also are more likely to select larger vehicles or SUVs |
| Choo and Mokhtarian (2004) | Sample of 1,904 respondents | Choice among 9 alternatives based on size and body type | (a) Travel attitudes, personality, and lifestyle were important in the selection of vehicle type. (b) People that resided in very dense urban areas were more likely to drive luxury vehicles or SUVs. (c) Unwillingness for travel in general was associated with driving a luxury vehicle (a luxury vehicle would probably be selected to change an undesirable activity into more pleasant one). (d) People who found they often traveled long distances were likely to drive compact vehicles |

**Source:** Baltas and Saridakis (2013).

Brand loyalty is an important factor in purchasing vehicles. Hocherman, Prashker, and Ben-Akiva (1983), Berkovec and Rust (1985), Mannering and Winston (1985), and Mannering, Winston, and Starkey (2002) have continuously supported brand loyalty as a factor considered important in purchasing vehicles after the 1980s. The brand of a vehicle has been increasingly important as vehicle-related technology advances and competition among automobile companies intensifies. Automobile brands have diversified enough to represent consumer personalities and social statuses. In order to differentiate from competitors, brands try to win consumer trust through a variety of identity factors, and by sharing culture. Automobile makers spend a huge amount of money and make great efforts to establish strong brands today.

Brand loyalty is a positive for automakers. Not only does it mean a person is more likely to return and spend more money with the original equipment manufacturer (OEM), it

means that a repeated buyer is also likely to be a cheerleader that introduces others to the brand. For that reason, J.D. Power[1] (2019) has started tracking automotive brand loyalty, and the results of its first study have just been published. J.D. Power unveiled the results of its first automotive brand loyalty study (see Table 2). The group calculated the percentages in its study based on transactions from June 2018 to May 2019, including all model years of trade-in vehicles. The resulting values represent the percentage of buyers that bought or leased a new vehicle from an automaker after trading in an existing car.

**Table 2.** Automotive Brand Loyalty Study

| Luxury Automotive Brand | | Mass Market Automotive Brand | |
|---|---|---|---|
| **Brand** | **Loyalty Percentage** | **Brand** | **Loyalty Percentage** |
| Lexus | 47.6% | Subaru | 61.5% |
| Mercedes-Benz | 44.2% | Toyota | 59.5% |
| BMW | 43.6% | Honda | 57.7% |
| Porsche | 43.5% | RAM | 56.2% |
| Audi | 43.3% | Ford | 54.0% |
| Land Rover | 40.3% | Kia | 49.4% |
| Maserati | 38.0% | Chevrolet | 49.0% |
| Acura | 36.1% | Nissan | 45.8% |
| Lincoln | 35.5% | Hyundai | 44.8% |
| Cadillac | 34.1% | Jeep | 40.9% |
| Volvo | 33.3% | Volkswagen | 38.1% |
| Infiniti | 32.1% | Mazda | 38.0% |
| Jaguar | 20.6% | GMC | 37.5% |

**Source:** J.D. Power (2019).

## 2.2. Brand Personality

Brands, designed by companies to identify products, and regarded as images in the mind of consumers and other target groups, change based on consumer demand (Grönroos, 1996, 1997; Kotler, Keller, Brady, Goodman, and Hansen, 2009). In this line of thought, Kotler et al. (2009) strengthened the importance of preserving existing customers through relationships, saying that a "relation is a focus on building long-term relationships with consumers rather than a focus on new customers as the growth potential." Understanding the meaning of customer brand relationships and how to manage these relationships is a success-factor. Swaminathan, Page, and Gürhan-Canli (2007) argued that "consumer-brand relationships can be formed based on individual- or group-level connections." To illustrate the meaning of customer brand relationship, Swaminathan et al. (2007) took Mercedes as an example, arguing that customer relationships with this brand might be based on a desire to express an individual-level of uniqueness and an exclusive identity. Palmatier (2008) gives another example of the luxury market segment, stating that firms that offer poor interactions with contact employees should recognize that some efforts may be wasteful in building customer relationships (expensive advertising, loyalty points, and rebate programs) from a relationship viewpoint.

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[1] J.D.Power is an American-based data analytics and consumer intelligence company founded in 1968 by James David Power III. The company is now a global leader in consumer insights, data, analytics, and advisory services to help clients drive growth and profitability. The company's industry benchmarks and reputation have established this company as one of the world's most well-known and trusted brands.

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It is up to consumers to vote with their wallets. They can influence not only what they buy but also what others buy. With the help of social networks and digital devices, consumers can increasingly dictate when, where, and how they engage with brands. Consumers show how both critics and creators are requesting more personalized services. When a voice has been given to consumers, they make that voice heard. They are willing to share their opinions and experiences with others.

In personality studies, Goldberg (1993) created the Big Five model through empirical research, and suggested more specific personality traits. This model derives 35 variables of personality structure, as suggested by Cattell (1943), and the consequent personality work of many researchers (Fiske, 1949; Tupes and Christal, 1961; Norman, 1967). Later, the 35 personality variables were consolidated into five categories. Goldberg (1993) named the model "the Big Five". The application of the Big Five to brands may be found in advertising and marketing literature (Aaker, 1997; Aaker, 1999; Caprara, Barbaranelli, and Guido, 2001). Although earlier literature suggested that brand personality operates differently from human personality (Aaker, 1997), the application of human personality traits to brands still appear valid.

Table 3 shows brand personality dimensions and typical items the author identified in 21 studies conducted from 1997 to 2016. They were derived in various contexts of respondent types (customers, consumers, students, commercial buyers and sellers, and employees and potential employees); branded entity types (consumer brands, company/corporate brands, cities, and countries); and country/culture (USA, UK, Spain, Japan, Holland, Canada, Germany, Croatia, Turkey, India, Brazil, Belgium, and China).

**Table 3.** Brand Personality Dimensions

| Dimensions (and typical items) | Study Reference Number | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| Sincerity (honest, genuine, and cheerful) | X | X | X | | X | X | X | X | X | X | X | X | X | | | X | X | ? | X | X | ? | X |
| Competence (reliable, dependable, and efficient) | X | | X | X | X | X | X | | | X | X | X | | | X | X | X | ? | X | | X | X |
| Excitement (daring, imaginative, and up-to-date) | X | X | X | X | X | X | X | | | X | X | X | ? | X | X | X | ? | X | X | X | X | X |
| Sophistication (glamorous, charming, and romantic) | X | X | X | | X | ? | X | X | | X | | ? | | | | X | X | | | X | |
| Ruggedness (tough, strong, and rugged) | X | | | X | ? | ? | | X | | | | | | ? | | | | | | | |
| Ruthlessness (controlling and aggressive) | | | | | X | | | | X | ? | | ? | | X | | | | ? | | | |
| Thrift (poor, sloppy, and low-class) | | X | | | | X | | | | | | | | | | | | | | | |
| Peacefulness (gentle, mild, and peaceful) | | X | X | X | | | | | | | | | | X | | | | | | | X |
| Unpleasant (annoying, irritating, and outmoded) | | | | X | | | X | | | | | | X | | | | | | | | |
| Simplicity (ordinary and simple) | | | | | | ? | | | | | | X | | | | | | | | | |

**Table 3. (**Continued)

| Dimensions (and typical items) | Study Reference Number | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| Sensitivity (delicate, sensitive, and romantic) | | | | | | | | ? | | | | | | | | | X | | | | |
| Conformity (religious, spiritual, and traditionalist) | | | | | | | | | | X | | | | | | | | | | | |
| Prestige (reputable and successful) | | | | | | | | | | | | | | | | | | | X | X | X |
| Cosmopolitan (international and cosmopolitan) | | | | | | | | | | | | | | | | | X | | | | |
| Materialism (selfish, materialistic, and pretentious) | | | | | | | | | | | | | | | | | | | | X | |
| Conspicuousness (special and extravagant) | | | | | | | | | | | | | | | | | | | | | X |

**Notes:** X indicates that the dimension is apparent in the study; ? means that it may be present; and a blank indicates that it was not present. Studies: 1 = Aaker (1997); 2 = Aaker et al. (2010); 3 = Aaker et al. (2001); 4 = Smit et al., 2002; 5 = Davies et al. (2004); 6 = Slaughter et al. (2004); 7 = d'Astous and Levesque (2003); 8 = Venable et al. (2005); 9 = Bosnjak et al. (2007); 10 = d'Astous and Boujbel (2007); 11 = Milas and Mlačić,Mlarcic (2007); 12 = Geuens et al. (2009); 13 = Chen and Rogers (2006); 14 = Kaplan et al. (2010); 15 = Herbst and Merz (2011); 16 = Das et al. (2012); 17 = Muniz and Marchetti (2012); 18 = Rojas-Méndez et al. (2013a, 2013b); 19 = Rauschnabel et al. (2016); 20 = Sung et al. (2015); and 21 = Willems et al. (2011).
**Source:** Davies, Rojas-Méndez, Whelan, Mete, and Loo (2018).

## 2.3. Word of Mouth

On the basis of customer reviews on online sites, customers engage in more reliable purchase decision-makings of goods by securing more credible information through external searches for word-of-mouth information, and therefore aim for more reasonable consumption. Word-of-mouth includes positive and negative information, and the latter have a negative effect on purchase (Brister, 1991).

Word-of-mouth has a direct effect on customer behavior. Most behavior-related models, including the Theory of Reasonable Action, demonstrate that word-of-mouth behavior corresponds with purchase intention. Online word-of-mouth is therefore a measure used to easily and rapidly spread much more information than traditional word-of-mouth (Chatterjee, 2001; Schindler and Bickart, 2005). Online word-of-mouth not only contributes to building trust in internet commerce but also has a huge effect on products and their images, so companies must pay attention to the efficient management and activation of word-of-mouth. The word-of-mouth effect is a factor helping consumers reliably purchase products, and is an important measure in forming trust.

Most studies on the effect of online word-of-mouth depend on results from questionnaire surveys of customers with purchase experience on online sites. Although studies examining multi-factors with plural questions have high external validity, they precisely analyze only the effects of variables that researchers attempts to analyze. Qualitative studies using questionnaire surveys were previously valid, but they had limitations in finding variables that researchers could not discover.

Text data mining, a new study method for understanding all themes contained in customer reviews, is therefore required. As Chatterjee (2001) indicated, big data analysis is adequate, as a large amount of positive and negative information is necessary given the characteristics of online word-of-mouth.

Customer reviews are very important as they influence customer trust in companies, regardless of whether they are positive or negative. The reliability of any information can be determined by agreement (Schindler and Bickart, 2005). In general, it can be evaluated by the number of 'Likes' and reviews with similar opinions.

Since customers think that online sites with customer reviews are more reliable, they are very important marketing means, regardless of whether of positivity. These days, most buyers check related customer reviews before purchasing vehicles, so these are important sources of information for companies. Companies may maximize the effect of word-of-mouth by strategically managing customer reviews. Different from traditional offline word-of-mouth, online word-of-mouth is characterized by exchanging information via online sites. Online word-of-mouth is the act or process of communication in which positive or negative information derived from direct and indirect consumer experiences with certain products or services via e-mail or hypertext (Nguyen, Calantone, and Krishnan, 2020).

Some studies for enhancing customer satisfaction have been conducted recently using user reviews expressing satisfaction, dissatisfaction, and needs. Text mining to extract relationship data refined with natural language processing and a morphological analysis of atypical data in the large scale form of text has emerged as an analysis method for customer reviews.

Coughlan (2013) indicated a limit of existing questionnaire methods. Questionnaire surveys via e-mail, a widely used data gathering method, could not easily collect a variety of samples because of low response rates and offline customers.

The use of user reviews increased to complement the efficiency of previous questionnaire surveys, which were limited to responses to various questions, and review crawling has been established as an area of research (Mudambi and Schuff, 2010; Archak, Ghose, and Ipeirotis, 2011; Kostyra, Reiner, Natter, and Klapper, 2016).

Studies on reviews search keywords by conducting a content analysis, or discriminate positive opinions from those negative using a sentiment analysis (Mudambi and Schuff, 2010).

Kim Yong-Hwan, Kim Ja-Hee, Park Ji-Hoon, and Lee Seung-Jun (2016) conducted a partial least squares (PLS) regression analysis of important main factors discovered with content analysis. In this regard, others have also tried to conduct a Latent Dirichlet Allocation (LDA) topic analysis by introducing text mining (Chae Seung-Hoon, Lim Jay-Ick, and Kang Ju-Yong, 2015; Kim Kwang-Kook, Kim Yong-Hwan, and Kim Ja-Hee, 2018).

## 3. Methodology and Hypothesis

### 3.1. Text mining

A central idea of quantitative content analysis is that "many words of text can be classified into much fewer content categories" (Weber, 1990). The methodology of extracting content categories from the text, counting occurrences in sampled text blocks, and analyzing associations between categories using a frequency matrix was developed in the mid-20th century, primarily by a group of Harvard researchers, and is often referred to as contingency analysis (Pool, 1959; Roberts, 2000). George (1959), one of the pioneers of content analysis, criticized the use of contingency analysis, saying that the contingency

method was not sensitive enough for the intended meaning. Indeed, contingency analysis assumes that "what an author says is what he means" (Pool, 1959), and it cannot take into account such text features as figures of speech or irony. George's opinion was supported by Shoemaker and Reese (1996), who argued that the process of reducing large volumes of text to quantitative data "does not provide a complete picture of meaning and contextual codes, since texts may contain many other forms of emphasis besides sheer repetition." Newbold, Boyd-Barrett, and Van den Bulck (2002) agreed that "there is no simple relationship between media texts and their impact, and it would be too simplistic to base decisions in this regard on mere figures obtained from a statistical content analysis." Moreover, quantitative content analysis does not always account for source credibility, the political or social context of the messages being examined, and audience characteristics such as age, sex, or education (Macnamara, 2003). However, despite its limitations, quantitative content analysis has long been employed in social studies due to its clear methodological reasoning based on the assumption that the most frequent theme in the text is the most important, as well as to the ability to incorporate such scientific methods as "a priori design, reliability, validity, generalizability, replicability, and hypothesis testing" (Neuendorf, 2002).

Text mining has become an exciting research field as it aims to discover valuable information from unstructured texts. Computers cannot simply use unstructured texts in further processing. Thus, exact processing methods, algorithms, and techniques are vital in order to extract this valuable information, which is completed by text mining. Text mining has become an important research focus. A large amount of information is stored in different places in unstructured compilations. Approximately 80% of the world's data is in unstructured text (Ramanathan and Meyyappan, 2013). This unstructured text cannot be easily used by computers in deeper processing. Therefore, there is a need for a technique that is useful in extracting valuable information from unstructured text. These pieces of information are then stored in a text database format that contains structured and a few unstructured fields. The raw text data can be sited in mails, chats, short message service (SMS) records, newspaper articles, journals, product reviews, and organizational records (Vidya and Aghila, 2010). Key information is stored in electronic form by almost every institution, government sector, organization, and industry. There are a variety of names for text mining, such as text data mining, knowledge discovery (Gupta and Lehal, 2009), and retrieved from textual databases. Analysis of intelligent text refers to extracting or retrieving valuable information from unstructured text. Text mining discovers new pieces of information from text data that was previously unidentified or unknown information by extracting it via different techniques. Text mining is a multidisciplinary field concerning the retrieval of information, analysis of text, extraction of information, categorization, clustering, visualization, mining of data, and machine learning.

Text mining is the process of analyzing a large collection of unstructured texts for the purpose of exploring interesting and significant patterns and behaviors. There are many domain specific applications of text mining. For example, companies use text mining to locate occurrences and instances of key terms in large blocks of text such as articles, Web pages, customer reviews, or complaint forums (Godbole and Roy, 2008). Unstructured data formats are converted into topic structures and semantic networks by data drilling tools. By studying a semantic network, one can learn the general tone of complaints, as well as and the reasons for these complaints. It also finds common words used in complaints and their relationships to other words in the text via semantic weight (Chen, 2009).

A certain set of words or terms that are commonly used by respondents can been analyzed to describe the pros and cons of product or service. As per the responses of

customers, industries take advantage of this for marketing (Grimes, 2005).

## 3.2. Topic Modeling and Hypothesis

Topic modeling is a machine learning technique to automatically analyze text data in order to cluster words for a set of documents. Topic modeling is a text-mining tool to dig out hidden semantic structures in a text body. Intuitions are the big idea behind latent Dirichlet allocation. As seen in Fig. 1 (far left ), a number of "topics" are distributions over words. Each document is assumed to be grouped as follows. First, a distribution is chosen from the topics, as seen in Fig. 1 (the histogram at right). For each word, a topic assignment is chosen as seen in Fig. 1 (the colored coins). Finally, a word from the corresponding topic is selected.

**Fig. 1.** Explanation of the  LDA Process
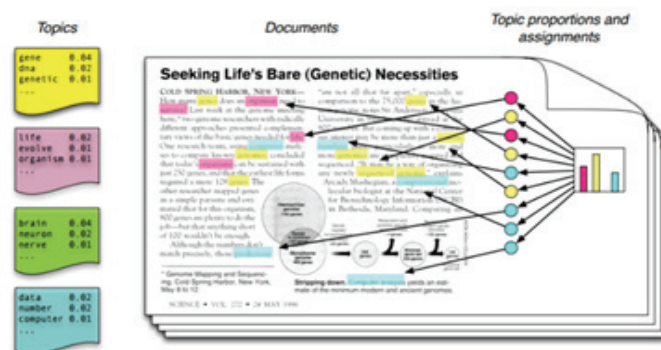


**Source**: Blei (2011).

Latent Dirichlet allocation (LDA), the most common topic model currently in use, is a generalization of probabilistic latent semantic analysis (Blei 2011). In natural language processing, LDA is frequently used to classify text in a document in accordance with a particular topic. LDA is an instance of a topic model. It belongs to the machine learning toolbox as well as to the artificial intelligence toolbox in a wider sense.

Plate notations are often used to represent probabilistic graphical models. They concisely capture dependencies among many variables. The boxes are "plates" representing replicates, which are repeated entities. The outer plate represents documents, while the inner plate represents repeated word positions in a given document; each position is associated with a choice of topic and word. Variable names are defined as follows (see Fig. 2, Blei, Ng, and Jordan, 2003):

$M$ denotes the number of documents
$N$ is the number of words in a given document (document $i$ has $N_i$ words)
$\alpha$  is the parameter of the Dirichlet prior on per-document topic distributions
$\beta$  is the parameter of the Dirichlet prior on the per-topic word distribution
$\theta$  is the topic distribution for document $i$
$\varphi$  is the word distribution for topic $k$
$z_{ij}$ is the topic for the $j$-th word in document $i$
$w_{ij}$ is the specific word.

**Fig. 2.** Plate Notations Representing the LDA Model
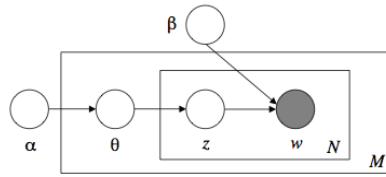


**Source**: Blei, Ng, and Jordan (2003).

Seo Min-Kyo, Yang Oh-Suk, and Yang Yoon-Ho (2020) examined the relationship between consumer ratings and user reviews, both of which are posted on the Google Play store. The study demonstrated that user reviews were related with positive ratings based on a big data analysis using a Neural Network Model. In addition, it was suggested that customer reviews play the most important role in spreading word-of-mouth. Customer reviews can serve the most significant role in vehicle sales.

A large amount of text-based customer reviews provide opportunities for marketers to grasp customer thoughts. An analysis on customer reviews used to predict consumer purchasing behaviors can be used as a main approach from the perspective of text-mining. Kim, En-Gir, and Se-Hak Chun (2019) analyzed reviews of vehicles with text-mining based on the occurrence frequency of determinants of purchasing vehicles by brand. This study it compared satisfaction with dissatisfaction using frequently occurring words by brand. Such words are, however, were often associated with the performance factors of vehicles, so their use alone is limited in understanding brand image as stressed by the automobile industry.

Topics such as brand personality extracted from customer experience after buying a car seem to have an effect on the overall evaluation of customer reviews. It is meaningful to identify topics like brand personality because automakers have traditionally managed brands competitively. In this research, brand reputation is used as an important clue when consumers evaluate a product or service (Nguyen and Leblanc, 2001). The following is the postulation of the null hypothesis.

*Hypothesis: Customer reviews on brand personality with attributes by topic will have a significant impact on overall satisfaction.*

## 4. Topic Modeling Results

### 4.1. Data Collection and Description

To secure data, materials provided by J.D. Power (http://www.jdpower.com) were used as shown in Fig. 3. The data derived from the reviews include purchase time, driving distance, time of review, and the ratings of four factors: reliability, interior, exterior and driving by vehicle model. This study attempts to consider the relationship between reviews and total ratings, where detailed reviews are qualitatively presented. Moreover, an analysis of the reviews with data mining was also attempted, as it is supposed that they contain brand personality.

The data used in this study were 2,998 evaluations by vehicle brand, which were secured from J.D. Power as the source of customer reviews. Table 4 evaluates 1,440 reviews on luxury automotive brands, including 288 reviews of BMW, which accounts for 48% of the total. It also analyzes 1,558 reviews on mass market automotive brands, including 281 reviews of

Hyundai, which accounts for 52% of the total. The data were used in analysis as they were not biased in favor of a certain brand, and the quantity was adequate to be used.

**Fig. 3.** Research Data via J.D. Power
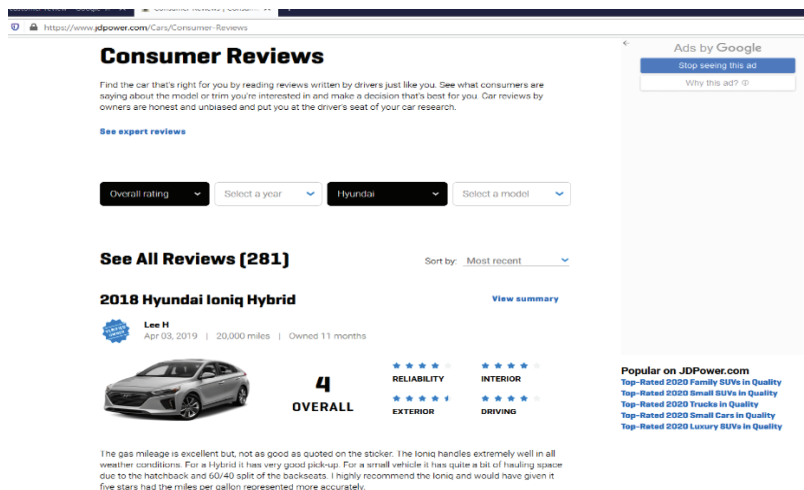


**Table 4.** Descriptive Statistics

| Luxury Automotive Brand | | | Mass Market Automotive Brand | | |
|---|---|---|---|---|---|
| **Brand** | **N** | **%** | **Brand** | **N** | **%** |
| Acura | 131 | 4.4 | Chrysler | 93 | 3.1 |
| Audi | 203 | 6.9 | Honda | 279 | 9.3 |
| BMW | 288 | 9.6 | Hyundai | 281 | 9.4 |
| Genesis | 79 | 2.6 | Kia | 331 | 11.0 |
| Infiniti | 169 | 5.6 | Mazda | 192 | 6.4 |
| Lexus | 251 | 8.4 | Mitsubishi | 156 | 5.2 |
| Lincoln | 146 | 4.9 | Subaru | 226 | 7.5 |
| Volvo | 168 | 5.6 | | | |
| Sub total | 1,440 | 48.0 | Sub total | 1,558 | 52.0 |

**Note**: Author accessed http://www.jdpower.com on May 1 to 25, 2020.

The recent interest in corpus linguistics has created a need for software packages that allow researchers to conduct corpus-based investigations. These corpus-based investigations can be used to provide evidence for the quality of products so that customers are exposed to real language rather than artificial text (Biber, Conrad and Reppen, 1998; McEnery, Xiao, and Tono, 2006).

WordSmith Tools is, along with several other software products similar in nature, an internationally popular program for work based on the corpus-linguistic methodology. WordSmith Tools is a software package primarily for linguists, in particular for work in the field of corpus linguistics (Reppen, 2001).

This present study uses 2,998 automotive customer reviews conducted by J.D. Power that have uniquely complex customer experiences. The 2,998 automotive customer reviews

consist of 171,589 tokens and 7,598 different types (see Table 5). Here, token is used to refer to running words, and type is used to refer to different words.

**Table 5.** Automotive Customer Review General Statistics

| Number of Reviews | Tokens | Types | TTR | STTR | Sentences | Mean in Words |
|---|---|---|---|---|---|---|
| 2,998 | 171,589 | 7,598 | 4.43% | 41.42% | 11,764 | 14.59 |

**Note**: TTR as type/token ratio; STTR as standardized type/token ratio.

Keywords are typical traits of any text or group of texts. They are extracted by statistically calculating which words are more or less frequent than expected according to some norm. That is, they are usually calculated using two word lists, one from the study corpus that the author investigates, and the other from the normally larger reference corpus that acts as a standard of comparison with the study corpus, or provides background data for keyword calculation. A keyword normally indicates a significant word from a title or document used as an index for the content. In corpus-based linguistic studies, however, the notion is defined as a word "whose frequency is unusually high in comparison with some norm" (Scott, 1997; 2016)[2].

This paper used The Open American National Corpus (OANC) as a reference corpus. The OANC is a large electronic collection of American English of spoken and written data collected from 1990 onward. OANC contains roughly 15 million words of contemporary American English with automatically-produced annotations for a variety of linguistic phenomena.

In the keyword list, the BIC Score is effectively an alternative to P scores. It uses the log-likelihood score and the size of the two corpora in its formula. BIC scores will help, especially where the comparison corpus is fairly small, as it tends to note more negative keywords reflecting the nature of the comparison corpus. Gabrielatos (2018) suggested that BIC scores can be interpreted as follows: below 0 = not trustworthy, 0-2 = only worth a minimal mention, 2-6 = positive evidence, 6-10 = strong, and more than 10 = very strong.

Table 6 lists the top 20 keywords sorted by the higher BIC and groups of per 100 keywords up to 500 keywords. The top 20 keywords covered 12.92% of cumulative frequency occurring 22,175 times in the customer reviews as the study corpus, while the same words covered 1.36% occurring 211,037 times in OANC as the reference corpus. The top 500 keywords occurred 121,207 times and covered 70.64% in the study corpus, while the same words occurred 1,055,841 times and covered 6.78% in the reference corpus. Content words out of the top 20 keywords are listed as country names of global automakers, such as JAPAN, KOREA, and GERMANY, brands such as KIA and BMW, automotive performance evaluation such as VEHICLE, DRIVE, DRIVING, MILEAGE, FEATURES, INTERIOR, GAS, and SEATS, and complimentary adjectives, verbs, and adverbs such as POPULAR, GREAT, COMFORTABLE, LOVE, and VERY. These content words allow interferences about of automotive customer reviews.

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[2] This keyword analysis is called a traditional keyword analysis. Most recently, Egbert and Biber (2019) proposed that text dispersion keywords can be computed by comparing the number of texts where each word is found in both the study corpus and the reference corpus. In this study, we followed the traditional keyword analysis as proposed by Scott (2016).

**Table 6.** Keywords Extracted from Automotive Customer Reviews

| Keywords | Freq. | % | RC. Freq. | RC. % | BIC | Probability |
|---|---|---|---|---|---|---|
| 1 POPULAR | 1,727 | 1.01 | 1,882 | 0.01 | 10,636.66 | 6.68053E-22 |
| 2 JAPAN | 1,405 | 0.82 | 875 | 0.01 | 9,664.44 | 8.91069E-22 |
| 3 VEHICLE | 1,123 | 0.65 | 428 | 0.00 | 8,315.02 | 1.40034E-21 |
| 4 GREAT | 1,375 | 0.80 | 5,962 | 0.04 | 5,461.90 | 4.95704E-21 |
| 5 MY | 2,243 | 1.31 | 24,598 | 0.16 | 5,366.75 | 5.22628E-21 |
| 6 KOREA | 690 | 0.40 | 250 | 0.00 | 5,136.17 | 5.96486E-21 |
| 7 DRIVE | 957 | 0.56 | 1,853 | 0.01 | 5,068.58 | 6.20754E-21 |
| 8 LOVE | 1,025 | 0.60 | 2,785 | 0.02 | 4,871.27 | 6.99574E-21 |
| 9 COMFORTABLE | 707 | 0.41 | 486 | 0.00 | 4,771.20 | 7.44687E-21 |
| 10 MILEAGE | 534 | 0.31 | 104 | 0.00 | 4,244.60 | 1.05911E-20 |
| 11 FEATURES | 748 | 0.44 | 1,403 | 0.01 | 3,995.27 | 1.27101E-20 |
| 12 VERY | 1,378 | 0.80 | 11,244 | 0.07 | 3,980.35 | 1.28541E-20 |
| 13 I | 4,949 | 2.88 | 155,911 | 1.00 | 3,927.11 | 1.33865E-20 |
| 14 INTERIOR | 550 | 0.32 | 483 | 0.00 | 3,537.17 | 1.83467E-20 |
| 15 GAS | 621 | 0.36 | 988 | 0.01 | 3,471.52 | 1.94127E-20 |
| 16 SEATS | 482 | 0.28 | 256 | 0.00 | 3,392.55 | 2.08075E-20 |
| 17 DRIVING | 572 | 0.33 | 778 | 0.00 | 3,330.22 | 2.20043E-20 |
| 18 GERMANY | 497 | 0.29 | 716 | 0.00 | 2,849.14 | 3.52324E-20 |
| 19 KIA | 321 | 0.19 | 5 | 0.00 | 2,833.01 | 3.58416E-20 |
| 20 BMW | 271 | 0.16 | 30 | 0.00 | 2,238.10 | 7.30532E-20 |
| 1-20th Keywords | 22,175 | 12.92 | 211,037 | 1.36 | | |
| 1-100th Keywords | 41,025 | 23.91 | 334,472 | 2.15 | | |
| 1-200th Keywords | 47,542 | 27.71 | 396,861 | 2.55 | | |
| 1-300th Keywords | 52,279 | 30.47 | 440,173 | 2.83 | | |
| 1-400th Keywords | 55,676 | 32.45 | 479,358 | 3.08 | | |
| 1-500th Keywords | 121,207 | 70.64 | 1,055,841 | 6.78 | | |

**Note:** BIC scores are 0: not trustworthy; 0-2: only worth a bare mention; 2-6: positive evidence; 6-10: strong; and more than 10: very strong.

## 4.2. LDA Analysis Results

Fig. 4 shows the convergence of perplexity versus iteration for the equilibrium distribution using the study corpus as the data set and six topics. For the data set, the author set alpha($\alpha$)=0.1, sigma($\sigma$)=1, beta($\beta$)=0.001, and the number of topics K to 6. The data set was run for 99,999 iterations. As seen in Fig. 3, as a result of machine learning for topic modeling, the increasing iteration continually reduces perplexity, and the perplexity values of the data set generally converge to 2,100 by 10 iterations.

When analyzing a topic model using the LDA algorithm, the author set the number of topics *K* to 6, as shown in Table 7 below.

If topics are identified as brand personality after the author has assembled high-ranking words extracted from each topic, Topic 1 was named "Competence" (reliable, dependable, and efficient) in that several words, such as seat, back, space and room, related to automobile structure occurred in the top 30 ranked words of Topic 1. Topic 2 was named "Sophistication" (glamorous, charming, and romantic) as several words, such as love, vehicle, and drive, related to automobile performance occurred in the top 30 ranked words of Topic 2. Topic 3

was named "Ruggedness" (tough, strong, and rugged) as several words. MPG, power, and turbo, related to automobile performance technology occurred in the top 30 ranked words of Topic 3. Topic 4 was called "Conspicuousness: (special and extravagant) as words like camera, navigation aids, and phone related to automobile options occurred in the top 30 ranked words of Topic 4. Topic 5 was named "Sincerity" (honest, genuine, and cheerful) in that several words, such as reliable, safety, and safe, related to automobile reliability occurred in the top 30 ranked words of Topic 5. Topic 6 was called "Prestige" (reputable and successful) as several words, BMW, LEXUS, AUDI, and VOLVO, related to luxury cars occurred in the top 30 ranked words of Topic 6.

**Fig. 4**. On the Study Corpus Using $K = 6$ Topics through Machine Learning
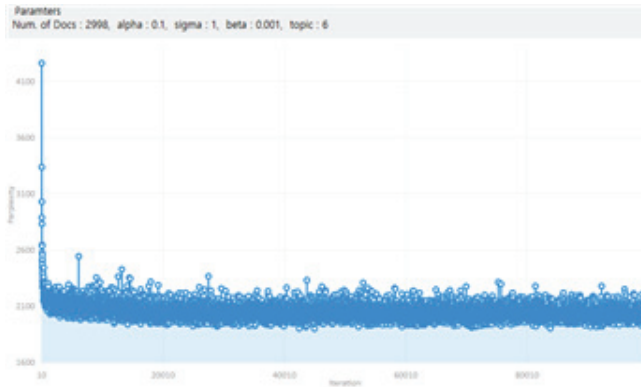
**Table 7.** Topic Results of top 30 Ranked Words

| Topic 1 | | Topic 2 | | Topic 3 | | Topic 4 | | Topic 5 | | Topic 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Word | Proba-bility | Word | Proba-bility | Word | Proba-bility | Word | Proba-bility | Word | Proba-bility | Word | Proba-bility |
| seat | 0.0443 | one | 0.0176 | drive | 0.0230 | feature | 0.0310 | great | 0.0501 | drive | 0.0289 |
| comfort | 0.0299 | purchase | 0.0147 | gas | 0.0198 | system | 0.0224 | very | 0.0438 | vehicle | 0.0235 |
| back | 0.0174 | love | 0.0145 | mileage | 0.0150 | seat | 0.0180 | drive | 0.0358 | very | 0.0181 |
| space | 0.0172 | vehicle | 0.0142 | get | 0.0149 | like | 0.0160 | good | 0.0278 | look | 0.0167 |
| great | 0.0168 | year | 0.0127 | mpg | 0.0128 | camera | 0.0123 | gas | 0.0248 | feature | 0.0166 |
| drive | 0.0167 | time | 0.0111 | power | 0.0124 | control | 0.0122 | love | 0.0245 | comfort | 0.0166 |
| very | 0.0154 | new | 0.0097 | very | 0.0111 | safety | 0.0102 | vehicle | 0.0241 | bmw | 0.0163 |
| love | 0.0152 | will | 0.0096 | handle | 0.0104 | love | 0.0100 | comfort | 0.0241 | great | 0.0147 |
| room | 0.0145 | buy | 0.0092 | mile | 0.0099 | interior | 0.0098 | mileage | 0.0233 | handle | 0.0137 |
| ride | 0.0113 | subaru | 0.0087 | engine | 0.0098 | use | 0.0093 | look | 0.0207 | interior | 0.0134 |
| easy | 0.0108 | kia | 0.0086 | road | 0.0096 | great | 0.0093 | feature | 0.0158 | lexus | 0.0132 |
| vehicle | 0.0103 | because | 0.0084 | use | 0.0096 | sound | 0.0086 | reliable | 0.0158 | best | 0.0119 |
| cargo | 0.0099 | another | 0.0081 | good | 0.0093 | navig | 0.0083 | interior | 0.0142 | quality | 0.0118 |
| need | 0.0092 | first | 0.0081 | accelerate | 0.0090 | rear | 0.0083 | handle | 0.0138 | perform | 0.0117 |
| trip | 0.0090 | just | 0.0079 | highway | 0.0085 | light | 0.0079 | like | 0.0135 | audi | 0.0112 |
| like | 0.0085 | get | 0.0077 | great | 0.0084 | vehicle | 0.0078 | get | 0.0121 | luxury | 0.0112 |
| get | 0.0080 | problem | 0.0076 | can | 0.0076 | also | 0.0076 | well | 0.0121 | love | 0.0111 |
| row | 0.0079 | want | 0.0075 | sport | 0.0076 | heat | 0.0075 | kia | 0.0120 | volvo | 0.0097 |
| road | 0.0079 | only | 0.0075 | well | 0.0074 | wheel | 0.0075 | easy | 0.0102 | style | 0.0097 |
| use | 0.0078 | drive | 0.0074 | like | 0.0074 | cruise | 0.0074 | fun | 0.0102 | reliable | 0.0096 |
| fit | 0.0078 | issue | 0.0073 | little | 0.0071 | spot | 0.0072 | ride | 0.0101 | safety | 0.0094 |
| lot | 0.0078 | honda | 0.0070 | turbo | 0.0071 | side | 0.0066 | nice | 0.0098 | ride | 0.0088 |
| small | 0.0076 | never | 0.0070 | mode | 0.0065 | lane | 0.0066 | price | 0.0091 | technology | 0.0081 |
| can | 0.0073 | reliable | 0.0069 | speed | 0.0065 | blind | 0.0066 | safety | 0.0079 | fun | 0.0079 |
| well | 0.0070 | bought | 0.0069 | overall | 0.0060 | phone | 0.0065 | safe | 0.0077 | feel | 0.0074 |
| passenger | 0.0069 | look | 0.0066 | fun | 0.0060 | only | 0.0065 | recommend | 0.0076 | well | 0.0071 |
| suv | 0.0067 | any | 0.0059 | need | 0.0057 | steer | 0.0064 | suv | 0.0075 | excel | 0.0066 |
| family | 0.0066 | replace | 0.0056 | take | 0.0057 | option | 0.0061 | best | 0.0073 | many | 0.0061 |
| handle | 0.0066 | like | 0.0055 | vehicle | 0.0056 | can | 0.0061 | exterior | 0.0073 | sport | 0.0061 |
| trunk | 0.0066 | service | 0.0053 | bit | 0.0055 | back | 0.0061 | feel | 0.0073 | like | 0.0061 |

From the 2,998 reviews collected, the average of total ratings were estimated to be 4.628, as shown in Table 8. An independent sample t-test showed that there were no differences in the averages between both brands at p=0.001. It is thus possible to examine the portion of each topic extracted from the topic analysis, with the overall ranking as a dependent variable.

**Table 8.** T-test

| | Variable | N | Mean | Std. Deviation | *t* | *p* |
|---|---|---|---|---|---|---|
| Overall | Mass Market | 1,558 | 4.599 | 0.741 | -2.246 | .003** |
| | Luxury | 1,440 | 4.659 | 0.708 | | |
| | Total | 2,998 | 4.628 | 0.725 | | |

*p<0.1, **p<0.05, ***p<0.01

The author set models, as shown in Table 9, in order to verify the hypothesis through regression analysis. Table 10 shows the results of the regression equation as follows: Overall = 4.558 + 0.006 (Topic 1) - 0.007 (Topic 2) - 0.004 (Topic 3) - 0.006 (Topic 4) + 0.010 (Topic 5) + 0.0149 (Topic 6).

According to this analysis, Topic 1 (Competence), Topic 5 (Sincerity), and Topic 6 (Prestige) attributes have a positive effect overall in customer reviews, whereas Topic 2 (Sophistication) and Topic 4 (Conspicuousness) attributes have a negative effect on overall customer reviews. Interestingly, Topic 3 (Ruggedness) did not have any statistical effect in this research.

**Table 9.** Model Summary and ANOVA*

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .183 | .034 | .032 | .71414 |

| Model | | Sum of Squares | df | Mean Square | F. | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 52.923 | 6 | 8.821 | 17.295 | .000** |
| | Residual | 1525.392 | 2991 | .510 | | |
| | Total | 1578.315 | 2997 | | | |

\* Dependent Variable: Overall
\*\*Predictors: (Constant), Topic 1, Topic 2, Topic 3, Topic 4, Topic 5, Topic 6

**Table 10**. Regression Coefficient

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 4.558 | .026 | | 175.121 | .000*** |
| | Topic 1 | .006 | .002 | .058 | 3.179 | .001*** |
| | Topic 2 | -.007 | .002 | -.075 | -4.115 | .000*** |
| | Topic 3 | -.004 | .002 | -.046 | -2.507 | .012 |
| | Topic 4 | -.006 | .002 | -.057 | -3.082 | .002*** |
| | Topic 5 | .010 | .002 | .087 | 4.539 | .000*** |
| | Topic 6 | .014 | .002 | .144 | 7.568 | .000*** |

Dependent Variable: Overall
*p<0.1, **p<0.05, ***p<0.01

The hypothesis was tested to show that automobile reviews state brand personality across 6 topics. Among these, five topics, competence, sophistication, conspicuousness, sincerity, and prestige, influenced the total ratings of vehicles. As demonstrated by a previous study on vehicle purchasing behavior, several factors, including engines, may have no significant effect on purchasing behavior as vehicle performance has improved. The analysis has an academic implication in that it can categorize sentences contained in customer reviews into topics using data mining. Previous studies could respond to customer review variables , set by the researcher, but others that the researcher did not define were excluded from study models. Text mining is useful in discovering variables that researchers might otherwise ignore, as it can extract meaningful types from customer reviews.

As suggested by Schindler and Bickart (2005), the increase of customer reviews contributes to better information, winning customer trust, and creating a positive effect on vehicle

purchasing behavior. It was thus found that online word-of-mouth played a valid role in inducing positive purchasing behavior.

## 5. Results and Conclusion

This paper tried to identify the brand personalities of global automakers using topic modeling analysis through text mining. Lately, global automakers have focused on brand management in order to increase the value of their brands. Automobile brands have attentively been managed through customer reviews for customer satisfaction. Customer reviews seem to have greatly reflected brand personality to provide reliable information for customers that want to buy cars.

The reviews provided by customers are the word-of-mouth method most efficiently used in marketing today. Since the effect of online word-of-mouth has been grown in importance, customer reviews reflecting brand personality have become strong marketing tools.

In the present study, after identifying attributes of brand personality using customer reviews, the author investigated whether or not such attributes had an effect on the overall evaluation of customer satisfaction. The author postulated a hypothesis and verified it using large and sophisticated datasets consisting of customer reviews from J.D. Power in the USA. Contrary to a traditional approach to brand analysis using questionnaire survey methods, this present study analyzed customer reviews using text mining.

Existing questionnaire surveys were designed based on variables researchers grasped in advance with items adjusted to study models. Other variables that researches could not define, despite level of importance, were not reflected. Text mining as a big data analysis method overcomes this limit. Word-of-mouth data, such as reviews written by customers, can be understood with topic modeling analysis.

This study is timely research a big data analysis is employed in order to identify direct responses to customers in the future. This study, however, has research limitations that should be supplemented since it did not distinguish brands and extracted attributes of brand personality from the dataset.

This study conducted text mining of all customer reviews without distinguishing mass market automotive brands from luxury automotive brands.

In future studies, there is a need to subdivide brands of automakers into luxury and mass market automotive brands, and then compare and analyze these brands. According to Choo and Mokhtarian (2004), it is necessary to reflect the differences between the two groups, as there are separate characteristics influencing the purchase of luxury vehicles.

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# The Impact of Cross-Cultural Differences on Human Resource Management in Korean-Invested Enterprises in China

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## Abstract

*Purpose* – In terms of human resource management, many Korean enterprises in China have experienced problems such as frequent resignations of Chinese employees and labor disputes. This can be mainly attributed to the fact that Chinese employees are not consistent with Korean vertical management methods, which is closely related to the national culture theory proposed by Hofstede, specifically the dimension of power distance and long- versus short-term orientation (LTO). Therefore, this research aims to investigate cultural differences between Korea and China from these two dimensions, and the impact on the human resource management of Korean-invested enterprises in China.

*Design/methodology* – This research first utilizes the latest data (Wave 7) of the World Values Survey (WVS) to verify the difference in power distance and long- versus short-term orientation between Korean and Chinese cultures using responses from Korea and China, and then uses case analysis to analyze the impact of this cultural difference on the human resource management of Korean enterprises in China.

*Findings* – Our main findings can be summarized as follows. Korea and China have significant differences in power distance and long- versus short-term orientation. In terms of power distance, Korean respondents show higher power distance compared to Chinese respondents. In the dimension of long- versus short-term orientation, it was found that Chinese respondents showed a shorter-term orientation, whereas Korean respondents showed a longer-term orientation.

*Originality/value* – Previous studies put focus on the power distance and individualism-collectivism dimensions to explain cultural differences between Korea and China, and generated contradictory results. This research further confirms the cultural differences between Korea and China from the dimensions of power distance and long-versus short-term orientation using secondary data. The comparative studies from this perspective have long been underexplored and lack empirical confirmation.

**Keywords**: Cross-Cultural Differences, Human Resource Management, World Value Survey (WVS)
**JEL Classifications**: D12, M14, M54

## 1. Introduction

Foreign entry approach from a cultural aspect is incredibly critical, regardless of which country an enterprise targets. As cross-border interactions grow at a rapid pace, it is increasingly important to be aware of the existence of cultural differences in perception and understanding, not only to avoid conflict and failure that have been reported in the area of cross-national joint ventures (Warner, 1995) but also to leverage these cultural differences to

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realize mutual gains. Minimizing cross-cultural risks is the first step toward successful overseas expansion. For Korean-invested enterprises in China, employees from Korea and China often show distinct understanding and attitudes in terms of communication and human resource management methods due to the different cultural values they possess, which may cause certain cultural conflicts. If a cultural conflict intensifies, it further increases the social and interpersonal distance between managers and employees, affects communication and collaboration within the enterprise, reduces organizational efficiency, and causes management difficulties.

China is Korea's largest market for exports, and the second-largest foreign investment destination. Since Korea and China formally established diplomatic relations in 1992, a large number of Korean-oriented enterprises have begun to invest in China, making full use of China's abundant labor resources and vast market, and have achieved economic benefits.

However, many Korean enterprises have encountered cultural conflicts caused by cultural differences between Korea and China during the management process, especially in human resource management, which often triggers varying degrees of labor disputes. In 2006, the Samsung Economic Research Institute of China conducted a survey of 507 Korean firms investing in China, and found that the biggest problem encountered by Korean companies was human resource management (14.8%), followed by rising costs (13.4 %), recovery payment (11.1%), purchase raw materials (10.5%), local financial services (10.1%), insufficient infrastructure (9.2%), and the development of domestic demand markets (8.5%). In addition, the survey results show that among the causes of labor disputes, wages and treatment issues accounted for the most at 31.2%, followed by cultural differences and cultural conflicts at 18.1%.

**Fig. 1.** Difficulties of Korean-Invested Enterprises in China
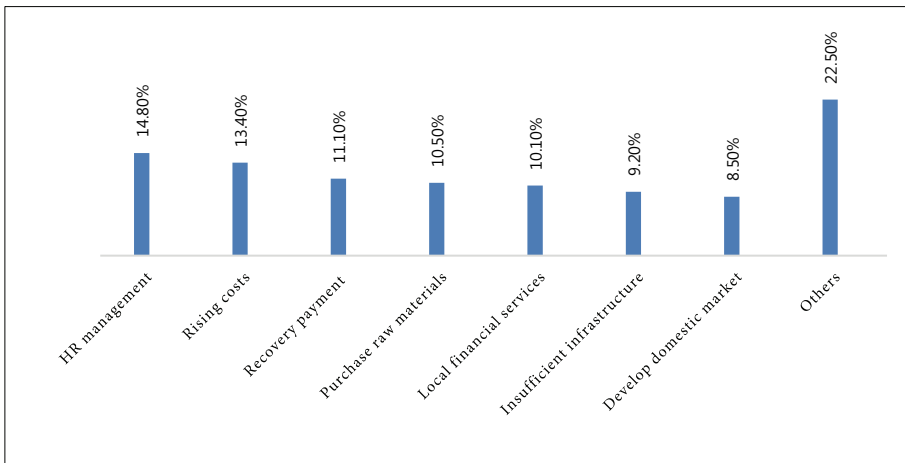


**Source**: Samsung Economic Research Institute of China, *Investigation report on the operating conditions of Korean-invested companies in China* 16, 2006.

In addition, in January 2008, the Korean Chamber of Commerce and Industry conducted a business environment survey on 350 Korean companies in China; the results also indicated that the biggest obstacles Korean enterprises encountered in the process of operation was labor and human resource management, such as employment and wages (43.1%), among

which 12.5% of large enterprises, and nearly half of small and medium-sized enterprises (46.1%), encountered human resource management obstacles during the localization process.

**Fig. 2**. Labor Dispute Causes of Korean-Invested Companes in China
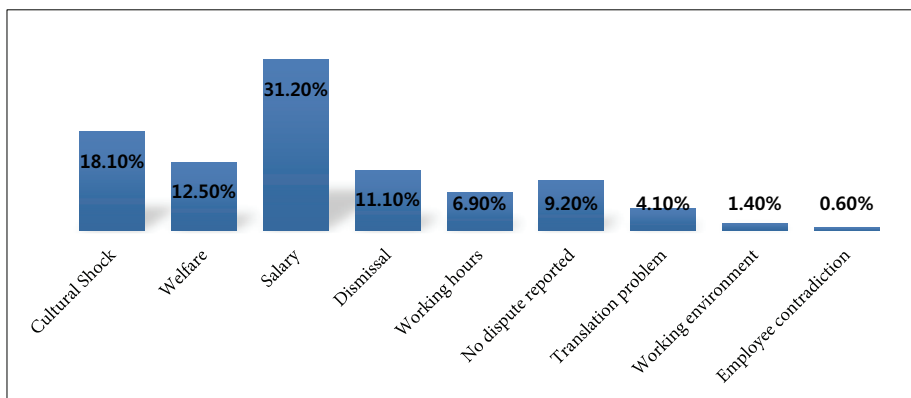


**Source:** KCCI, *Investigation report on the Management Environment of Korean-invested companies in China*, 2008.

Both Korea and China have many shared similarities and a common cultural background of broadly defined Confucianism. Despite cultural and geographic proximity, however, close ties between Korea and China make differences easily ignored. Korea and China have undergone different historical development processes in modern times; specifically, as China gradually sheds its communist ideology and shiftsto a more market-oriented economic development strategy since Reform and Opening, Korean has experienced institutional changes from strong traditions of centralized formal authority to personalized authority (Lee, 2008). As a result, there have been significant differences in politics, economy, culture, and values between the two East Asian countries. Many Korean-invested enterprises have not realized this difference, and still use the original management methods of headquarters to manage Chinese employees with distinct cultural values, which in turn leads to many problems.

In this study we first reviewed literature to analyze cultural differences between Korea and China and the associated factors, and then, building on Hofstede's cultural dimension theory, the World Value Survey (WVS) database was employed to analyze the differences in power distance and long- versus short-term orientation in Korean and Chinese cultures. Finally, we investigated the impact of cultural differences on the human resource management of Korean-invested enterprises in China using case analysis based on the above, and targeted practical impactions were provided for the successful localization of multinational companies under the background of globalization.

## 2. Literature Review

### 2.1. Cross-Cultural Differences and Cultural Dimensions

Hofstede (1991) defined culture as a concept that can distinguish a group of members from different groups of other groups. Bartels (1982) also believed that the culture of a country or

a society often influenced and shaped the patterns of behavior in a region. Following this line of research, Markus and Kitayama (1991) further identified cultural differences as the main factors that lead to differences in individual and organizational behaviors, and believed that normative awareness and belief support cultivated by individuals in a culture are the key reasons that affect perception, character, and behavior. Integrating cultural dimension and organizational behavior in their research, Kedia and Bhagat (1988) elaborated on the idea that management-related issues were caused by cultural differences in different countries. A large amount of literature in organizational theory argues that firms incorporate into their decision-making not only past experience but also the immediate cultural environment (Abrahamson and Rosenkopf, 1993; Miner and Haunschild, 1995). According to Yao's survey in 2007, almost all foreign-invested enterprises in Shenzhen, China, reported a certain degree of cultural conflict, which negatively affected the harmonious relationship among employees from different cultural backgrounds, thus leading to inefficiency in work and affecting the achievement of corporate performance goals.

Hofstede's theory of cultural dimensions is frequently used when studying cultural differences across different countries. Hofstede collected more than 116,000 samples from IBM's branches in 72 countries to construct questionnaires. After rigorous research design and systematic data collection, Hofstede (1991) examined similarities and differences in the four core dimensions of power distance, masculinity-feminism, uncertainty avoidance, and individualism-collectivism. Further, Hofstede added long- versus short-term orientation (LTO) as the fifth dimension.

This research employs the most related cultural dimensions of Hofstede's theory, power distance and long- versus short-term orientation, to examine cultural differences between Korea and China that belong to the same Confucian cultural circle. Power distance refers to the degree to which people in a society accept the phenomenon of the unequal distribution of power in a society (Hofstede, 1980). Prior research (Smith and Hume, 2005) also found that power distance affects employee acceptance of inappropriate behaviors by senior employees at higher levels; specifically, employees from high power distance backgrounds are more likely to accept and obey authority (Smith and Hume, 2005; Kirkman et al., 2009; Brockner et al., 2001), and believe that hierarchical stratification in society is inevitable and even reasonable (Zhang et al., 2010; Winterich and Zhang, 2014). The long- versus short-term orientation dimension can reflect the degree of employment stability to a certain extent. Long-term orientation focuses on long-term benefit planning and investment, whereas short-term orientation concentrates more on the current short-term input-output ratio from a myopia view, and tries to obtain returns (e.g., wages) as soon as possible. This dimension can be used to analyze the high turnover rate in Korean-invested companies in China. Although many studies have shown that East Asian countries are relatively close in these two dimensions (Cheng and Stokdale, 2003), this study tries to further investigate whether there are cultural differences between the two Confucius-impacted countries, and the influence of such differences on the human resource management in Korean-invested enterprises.

## 2.2. Cross-Cultural Differences of Korea vs. China and Human Resource Management

Lee Hoon-Sup (1998) indicated that Korean culture has significant characteristics of a community or familial culture, which emphasizes respect and obedience to elders. Affected by the hierarchical cultural environment, Korean corporate culture also put an emphasis on obedience to a boss or superiors. In some traditional Korean enterprises, employees are accustomed to a paternalistic vertical management method with strong up-and-down

concepts, and can strictly obey and follow the instructions of superiors. Piao Xue-Hao (2014) also suggested that Korea's corporate culture emphasizes a clear distinction between superiors and subordinates. However, although originally influenced by Confucian teaching, China attaches great importance to the equality of interpersonal relations in the socialist system of China, suggesting that there are only differences in the division of labor, and no hierarchical differences. The cross-cultural differences between Korea and China in this regard are very significant, and have triggered many cultural conflicts. In addition, although Korea's strong hierarchical corporate culture is evolving and is being challenged by the rapid emergence of startups, from the perspective of Chinese employees, the core corporate values of Korea still overemphasizes etiquette and obedience to superiors, which causes personal thinking to be largely ignored. Although Korean firms have attempted to break away from traditional HRM practices based on Confucianism and have experimented with Western style HRM practices, such as performance-based appraisal and compensation, the prevalent Korean management style is still largely characterized as paternalistic and authoritarian-benevolent (Miles, 2008). Korean companies often transplanted original human resources systems characterized as top-down vertical decision-making in overseas expansion, which contradicts Chinese employee cultural values; hence, dissatisfaction toward Korean companies may be intensified.

According to research on a Samsung SDI Shanghai subsidiary conducted by Li Hong-Hua (2019), Korea and China have obvious differences in the dimension of power distance. Korean employees generally serve the management of a superior unconditionally, while Chinese employees will usually complete the task according to the instructions based on personal consciousness, which can cause Korean manager dissatisfaction and feelings that their status has been challenged.

Chang Yeong-Seok (2007) investigated the human resources management of large Korean corporates and subsidiary small and medium-sized enterprises that entered China in the automotive and electronics industries from 2004 to 2006. The results of the investigation showed several specific problems compared with other foreign-invested enterprises. First, the high turnover rate of Chinese employees was a common problem encountered by almost all Korean-invested companies in China, especially the turnover rate of administrative staff and senior technical personnel. The second was that local Chinese employees disagreed with, or were even dissatisfied with Korean management's vertical business operation methods.

As mentioned above, the human resource management problems encountered by Korean firms seeking localization in China mainly included two aspects. First, wages do not meet the expectations of employees. Second, they do not agree with the vertical management and strong hierarchical corporate culture of Korean firms. Both have contributed to the high turnover rate of Chinese employees.

## 3. Empirical Analysis

### 3.1. Data Collection

To understand the cultural differences between the two countries and the impact on human resource management, we investigate the differences in the most related cultural dimensions, power distance and long-versus short-term orientation, between Korea and China from a macro level. This paper draws on the latest dataset (Wave-7) from the World Values Survey (WVS). In this study, World Value Survey data was collected from the mid-2017 to early 2020. Korean and Chinese data were employed to identify differences in power distance and LTO levels.

The World Value Survey is a survey monitoring cultural values, attitudes, and beliefs toward gender, attitude, poverty, education, health, security, family, religion, trust issues, attitudes toward multilateral institutions, and cultural differences and similarities between regions and societies. Data from World Value Survey has been collected and released seven times from 1981 to 2020 (http://www.worldvaluessurvey.org). The seventh wave of the World Value Survey employed nationwide random probability representative sample designs with a sample size of more than 3,200 respondents.

This study used data from Korean and Chinese respondents, and data that did not correspond to the survey questions were excluded from the analysis. The use of World Value Survey data is challenging since Minkov and Hofstede (2014a) argued that the WVS does not contain all items necessary to replicate all four dimensions. In light of these data limitations, this study has chosen measurement items related to power distance and long- versus short-term orientation between Korea and China based on previous literature support.

## 3.2. Measurement

Power distance refers to the acceptance of unequal power distribution in society (Hofstede, 1980). Compared to those with low power distance, societies with high power distance are more inclined to stratify people based on power and status. Because they admire higher power and status more than individuals with low power distance, the differences they perceive between people of different status levels are greater and more obvious (Hofstede, 1980; Gaertner et al., 1994). Individuals with high power distance tend to accept unequal distribution of power more easily, and believe that social hierarchical stratification is inevitable, and even reasonable (Zhang et al., 2010; Winterich and Zhang, 2014). Based on this assumption, this paper creates a measurement item for income equality (item with 10-scale; 1: Incomes should be made more equal, 10: There should be greater incentives for individual effort) from the economic value section of the World Value Survey.

The LTO dimension was defined by Minkov (2007) using items in the World Value Survey that measured various types of pride, which Minkov (2007) interpreted as similar to a concern for face, and measurement items about religiousness, which Minkov (2007) interpreted as similar to personal stability. Minkov and Hofstede (2012) replicated the LTO dimension at a national level using items from World Value Survey data, and confirmed these items were theoretically similar to the original LTO items, although perfect validity would be impossible to achieve (Minkov and Hofstede, 2014b).

None of the available WVS items directly address the concept of tradition, but many of the items do so indirectly. Religion, parental pride, and national pride can be seen as traditional values (Inglehart and Baker, 2000). Little literature has perfromed empirical research involving the LTO dimension. Even meta-analysis conducted by Taras et al. (2010) did not include the LTO dimension for the lack of empirical studies.

Recent studies have attempted to overcome this limitation using the WVS to capture cultural dimensions of LTO. Minkov and Hofstede (2012) developed a scale that replicates the LTO dimension using WVS items, and first picked ten items in the WVS that replicated the original Confucian dynamism factor conceptually; however, they identified that the dimension would be best represented by seven items. Two of the items were not included and captured in the newest wave of the WVS; therefore, five items were used and developed specifically for the WVS by Minkov and Hofstede (2012). Each of the five items was carefully selected to map a specific domain of the LTO construct. For instance, the concept of thrift is represented by the "thrift" item, which asked respondents how desirable thrift was as a quality for children. The domain of perseverance is represented by the item "perseverance", which

asked respondents how desirable perseverance was as a quality for children. Finally, the concepts of personal stability and consistency are represented by three other items: "religion", "make parents proud", and "nation pride".

### 3.3. Results

Income equality was measured using a 1-10 scale (1: Incomes should be made more equal, 10: There should be greater incentives for individual effort). The economic values of Korean respondents showed a greater tendency toward lager income differences being accepted (M=6.66), whereas Chinese respondents were more likely to believe income equality should be achieved (M=5.53; p<0.05).

**Table 1.** Mean Statistics for Power Distance Dimension

| Country Code | | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Income Equality vs Larger Income Differences | ROK | 1245 | 6.66 | 1.644 | 0.047 |
| | CHN | 3029 | 5.53 | 2.665 | 0.048 |

Drawing on previous research suggesting that those with higher power distance were more likely to accept income and power inequality (Zhang et al., 2010; Winterich and Zhang, 2014), the results of Table 1 and Table 2 indicate that people in Korea show a higher level of power distance than people in China.

**Table 2.** Significance Test for Power Distance Dimension

| UPPER: Equal variance assumed LOWER: Equal variancenot assumed | Levene's Test for Equality of Variances | | T-test for Equality of Means | | | | | | 95% Confidence Interval of the Difference | |
|---|---|---|---|---|---|---|---|---|---|---|
| | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | | Lower | Upper |
| Income Equality | 491.014 | 0.000 | 13.917 | 4272 | 0.000 | 1.130 | 0.081 | | 0.971 | 1.290 |
| | | | 16.821 | 3638.139 | 0.000 | 1.130 | 0.067 | | 0.999 | 1.262 |

Consistent with what this research proposes, Korean respondents at the aggregate level more indicated thrift as a desirable trait for children (M=1.55) than Chinese respondents (M=1.60; p<0.05). Moreover, in terms of perseverance, Korean respondents also considered perseverance more as a critical quality for children (M=1.50) compared to respondents in China (M=1.79; p<0.05).

For religious faith, there also exists a significant difference between Korean and Chinese values, in that Korean respondents thought religious faith an important quality for children (M=1.90), whereas Chinese respondents mentioned it less (M=1.99; p<0.05). However, the difference concerning the "make parents proud" items between Korea and China did not achieve a significant level.

In the last aspect of the LTO dimension, national pride, the difference between Korea and

China was significant. Specifically, Chinese respondents showed more national pride (M=1.65) than Korean respondents (M=2.09; p<0.05).

**Table 3.** Mean Statistics for the LTO Dimension

| Country Code | | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Thrift | ROK | 1245 | 1.55 | 0.498 | 0.014 |
| | CHN | 3022 | 1.60 | 0.491 | 0.009 |
| Perseverance | ROK | 1245 | 1.50 | 0.500 | 0.014 |
| | CHN | 3022 | 1.79 | 0.404 | 0.007 |
| Religious Faith | ROK | 1245 | 1.90 | 0.300 | 0.008 |
| | CHN | 3022 | 1.99 | 0.105 | 0.002 |
| Make Parents Proud | ROK | 1245 | 2.01 | 0.615 | 0.017 |
| | CHN | 3028 | 2.03 | 0.737 | 0.013 |
| National Pride | ROK | 1245 | 2.09 | 0.549 | 0.016 |
| | CHN | 3003 | 1.65 | 0.634 | 0.012 |

Among all the five items representing LTO, four of the items showed that there exists a significant difference between Korea and China national culture. Although previous research assumed the LTO level to be similar among East Asian countries (Hofstede, 2011), the results of this research show that Korea and China still have significant differences in the LTO aspect; specifically, this represents that in the dimension of long- versus short-term orientation, Chinese respondents showed a shorter-term orientation, whereas Korean respondents showed a longer-term orientation.

**Table 4.** Significance Test for the LTO Dimension

| UPPER: Equal variances assumed LOWER: Equal variances not assumed | Levene's Test for Equality of Variances | | T-test for Equality of Means | | | | | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|---|---|
| | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std.error Difference | Lower | Upper |
| Thrift | 22.097 | 0.000 | 2.73 | 4265 | 0.006 | -0.045 | 0.017 | 0.078 | 0.013 |
| | | | 2.71 | 2289.55 | 0.007 | -0.045 | 0.017 | 0.078 | 0.013 |
| Perseverance | 658.992 | 0.000 | 19.86 | 4265 | 0.000 | -0.291 | 0.015 | 0.319 | 0.262 |
| | | | 18.19 | 1945.82 | 0.000 | -0.291 | 0.016 | 0.322 | 0.259 |
| Religious Faith | 896.399 | 0.000 | 14.22 | 4265 | 0.000 | -0.088 | 0.006 | 0.101 | 0.076 |
| | | | 10.15 | 1372.49 | 0.000 | -0.088 | 0.009 | 0.105 | 0.071 |
| Make Parents Proud | 66.776 | 0.000 | 0.90 | 4271 | 0.368 | -0.021 | 0.024 | 0.068 | 0.025 |
| | | | 0.97 | 2752.78 | 0.332 | -0.021 | 0.022 | 0.064 | 0.022 |
| National Pride | 316.913 | 0.000 | 21.47 | 4246 | 0.000 | 0.442 | 0.021 | 0.401 | 0.482 |
| | | | 22.78 | 2663.93 | 0.000 | 0.442 | 0.019 | 0.404 | 0.480 |

## 4. Discussion and Implications

Previous research showed that human resource management problems encountered by Korean-invested enterprises in China during localization operations mainly included two aspects: the dissatisfaction of local employees with regard to wages, and the disagreement of local employees with the vertical management methods of Korean firms.

The inconsistency between Chinese employee expectations and real wages may cause conflicts. In order to reduce labor costs, many companies set wage standards in accordance with local average wages, or even minimum wage. However, employees who apply for foreign-companies expect a higher level of wage over local companies. Although many Korean-invested enterprises employ incremental wages emphasizing incentives, expectations of local employees pursuing short-term goals are not fully achieved, which contributes partly to the high turnover rate of Chinese employees.

The second problem addresses the focus of current research, which is associated with the vertical management approach and hierarchical corporate culture emphasizing obedience to superiors. Although the strong corporate culture of Korean companies used to be considered a strength, it may not be fully compatible with an increasingly diverse workforce. Chinese employees are increasingly attaching greater importance to the equality of interpersonal relationships in the workplace. For example, if superiors reprimand the subordinates with a strict attitude, which Korean employees may be accustomed to, it may be regarded by many Chinese as a personal insult due to cultural differences. This can possibly lead to cultural conflicts.

Cultural conflicts caused by cultural differences and the impact on human resource management have become an increasingly important topic of discussion for Multinational Corporations (MNCs). For example, when a French-based medical supply manufacturing company, Companie General de Radiologie (CGR), was acquired by General Electric (GE), it experienced severe cultural conflicts caused by cultural differences. Unaware of these cultural differences, French employees of CGR could no longer identify with the core values of GE. According to Hutnek (2016), this conflictual phenomenon can be partly attributed to the fact that power distance in the French view was not well matched with the power distance concept in American national culture.

The academic implications of this research are that it contributes to the comparative literature, and suggests that despite similar Confucian cultural backgrounds and historical ties between Korea and China, there exist very distinct cultural differences along two critical dimensions. In this study, we applied Hofstede's cultural dimension theory on human resource management and investigated cultural influences on the dimensions of long- versus short-term orientation and power distance between Korea and China. Generally, Chinese respondents showed a shorter-term orientation than Korean respondents. In the aspect of power distance, Koreans show a higher level of power distance than Chinese respondents.

This research also provides several practical implications for Korean enterprises for international-level HRM strategies. Global expansion can be both a challenge and an opportunity. To achieve successful expansion into the international environment, cultural differences need to be first fully understood before any specific strategy can be adopted. Many Korean companies in China are mainly affected by the corporate culture of headquarters; the resource management methods adopted in different branches should be adjusted to cater to varied cultural backgrounds. Adler (1983) indicated that the successful human resource management of multinational companies requires an initial examination of cross-cultural management under different cultural backgrounds, and the understanding of different cultural values, motivations, and behavioral intentions is the first step. Specifically, it is critical

to focus on the various activities of human resource management from the perspective of culture and values by analyzing the similarities and differences of cultural values and the resulting behavioral value characteristics; effective cross-cultural human resource management can be achieved in this manner. To pursue long-term and stable development in China, Korean enterprises should first fully understand the cultural characteristics and values of Chinese employees. Establishing a targeted corporate culture that is consistent with the recognition, mutual understanding, and respect of employees of the two countries is in line with corporate interests. This will also help to establish mutual trust with Chinese employees. Evidence suggests that Korean enterprises are now facing a decreasing speed of economic growth, especially in the Chinese market, which is related to the corporate cultures of Korean enterprises that can be characterized as strictly hierarchical, having paternalistic leadership styles, and collectivist with longer working hours (Froese, 2020).

Second, Korean enterprises should consider providing targeted strategies for Korean and Chinese employees. As the workforces in Korean firms are becoming increasingly diverse, Korean enterprises in China can consider reducing headquarter culture-centric thinking, and give Chinese employees opportunities for opinion expression and decision-making, which would not only enhance the satisfaction level of local employees with diverse backgrounds but also can stimulate innovation. For example, a stream of literature has cited localization of management a crucial element during the global expansion process. For example, the Korean enterprise LG has documented a plan to localize management strategies in all of its China ventures. Many Western international enterprises have also utilized the strategy of developing local talents to avoid cultural conflict problems. Meanwhile, developing local talent can be more beneficial in saving on expatriate costs. However, the 'glass-ceiling' phenomenon exists in many international enterprises (Gamble, 2000). Therefore, Korean enterprises need to develop targeted strategies to retain, disseminate, and institutionalize local talents within the organization. Korean enterprises can also enhance mutual trust and efficient human resource management by improving vertical management methods and creating an equal atmosphere through cross-cultural training and cross-cultural communication.

This research is not without limitations and shortcomings. Although this study confirmed cultural differences between Korea and China at the national level along two cultural dimensions, it did not empirically test the impact in actual organizational settings. Therefore, future research may utilize empirical hypotheses for comparison based on literature. Other than quantitative methods, they may also use interviews or other qualitative techniques to systematically examine the influence of cultural differences and the underlying mechanisms of how cultural differences affect workplace performance.

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# Research on Embodied Carbon Emission in Sino-Korea Trade based on MRIO Model

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## Abstract

*Purpose* – This paper research on the embodied carbon emission in Sino-Korea trade. It calculates and analyzes the carbon emission coefficient and specific carbon emissions in Sino-Korea trade from 2005 to 2014.

*Design/methodology* – This paper conducted an empirical analysis for embodied carbon emission in Sino-Korea trade during the years 2005–2014, using a multi-region input-output model. First, direct and complete $CO_2$ emission coefficient of the two countries were calculated and compared. On this basis, combined with the world input-output table, the annual import and export volume and sector volume of embodied carbon emission are determined. Then through the comparative analysis of the empirical results, the reasons for the carbon imbalance in Sino-Korea trade are clarified, and the corresponding suggestions are put forward according to the environmental protection policies being implemented by the two countries.

*Findings* – The results show that South Korea is in the state of net trade export and net embodied carbon import. The carbon emission coefficient of most sectors in South Korea is lower than that of China. However, the reduction of carbon emission coefficient in China is significantly faster than that in South Korea in this decade. The change of Korea's complete $CO_2$ emission coefficient shows that policy factors have a great impact on environmental protection. The proportion of intra industry trade between China and South Korea is relatively large and concentrated in mechanical and electrical products, chemical products, etc. These sectors generally have large carbon emissions, which need to be noticed by both countries.

*Originality/value* – To the best knowledge of the authors, this study is the first attempt to research the embodied carbon emission of ten consecutive years in Sino-Korea Trade. In addition, In this paper, some mathematical methods are used to overcome the error problem caused by different statistical caliber in different databases. Finally, the accurate measurement of carbon level in bilateral trade will provide some reference for trade development and environmental protection.

**Keywords**: Embodied Carbon Emission, Environmental Protection, MRIO Model, Sino-Korea Trade
**JEL Classifications**: F18, R15

## 1. Introduction

China and South Korea are geographically close. Since the establishment of diplomatic relations in 1992, political relations have been stable and the economy has developed rapidly. While international trade improves the welfare of the two countries, the consumption of natural resources, energy and environmental capacity cannot be avoided.

Significant progress was made in the bilateral trade between South Korea and China in 2005. The scale of bilateral trade broke through the $100 billion mark for the first time, reaching $100.56 billion. After 15 years of development, the total volume of Sino-Korea trade

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has increased greatly, reaching $243.43 billion in 2019, with an overall growth rate of 142%. Although China's economy has grown several times, South Korea has always been a stable trade partner of China. Since 2008, China has become the largest trading partner, export destination and import source of South Korea. Apart from the sharp decline in trade between China and South Korea, which resulted from political factors such as the THAAD event in 2015 and 2016, China has always been Korea's largest trading partner. The detailed data are shown in Table A of appendix.

Different from China's overall foreign trade surplus, China has been in a deficit position in bilateral trade between China and South Korea for many years. But the study found that the embodied carbon emission is a surplus for China in Sino-Korea trade. This problem is worthy of further study. As a developed country, South Korea had also faced the problems of energy shortage and environmental pollution in the process of rapid economic development, so it has accumulated a lot of advanced technology about energy-saving, emission reduction, pollution control. South Korea is the first country in East Asia to establish a national carbon market. As early as 2009, the South Korean parliament passed the *RAMEWORK ACT ON LOW CARBON, GREEN GROWTH* and formally implemented in the following year. As a developing country, in the 13th Five Year Plan of 2015, China also explicitly proposed to take a low-carbon development path. Therefore, it is of great significance for the future economic development of the two countries to accurately calculate the carbon level of bilateral trade and reasonably adjust the trade structure of the two countries.

However, there is little research about embodied carbon emission in Sino-Korea trade. And Due to the complex calculation of MRIO model, the different statistical caliber of several world input-output databases, to the best knowledge of the authors, this study is the first attempt to research the embodied carbon emission of ten consecutive years in Sino-Korea Trade based on MRIO Model. The accurate measurement of carbon level in bilateral trade will provide some reference for Sino-Korea trade development and environmental protection.

The rest of this paper is organized as follows. Section 2 reviews extant literature on the technical means of Embodied Carbon estimation, the measurement of Embodied Carbon based on MRIO model, and the study of Embodied Carbon emissions in bilateral trade. Section 3 explains the methodologies and the dataset employed in this paper. Section 4 presents the direct and complete $CO_2$ emission intensity in the two countries, the annual import and export volume and sector volume of Embodied Carbon and discusses possible explanations. Finally, Section 5 presents the conclusions and suggestions of this research.

## 2. Literature Review

### 2.1. Technical Means of Embodied Carbon Estimation

In 1974, the concept of "embodied" first appeared at the Energy Group Meeting of the International Federation of Institutes for Advanced Study. After that, the names of resources such as water and land could be added to measure the resources consumed by products or services during the entire production process. Later, it was thought, "embodied" can be followed by not only the name of resources, but also the name of pollutants such as $CO_2$, $SO_2$, which could be used to represent the emission of pollution gases such as $CO_2$ during the whole production process (Brown and Herendean, 1996). Then the word ""embodied carbon" was produced.

At present, the calculation of embodied carbon emissions can be summarized into three

types: IPCC accounting method, Life Cycle Assessment (LCA) and Input-Output Analysis (IOA). Each of the three methods has its own advantages and disadvantages. The Input-Output Analysis has more advantages in the comprehensiveness of statistics and the stability of calculation. Therefore, now it is the most basic and common method for the Embodied Carbon in international trade.

The Input-Output Analysis was first proposed by Wassily W. leontiel. Originally, this method was used to analyze the relationship between inputs and outputs in economic field (Leontief, 1936/1941). By the 1960s, some research began to use this method to energy and environmental field (Daly, 1968; Isard et al., 1968; Ayres and Kneese, 1969; Leontief, 1970). The input-output table reflects the balance between supply and demand of products among different departments. The outstanding advantage of this method is that it can use the input-output table to reflect the relationship between carbon emissions of various industries, and calculate the direct and indirect energy consumption of inputs in each stage of production by using the direct consumption coefficient and the complete demand coefficient in the input-output table, and then obtain the complete embodied carbon behind the product trade. This is a macro analysis method, which has been proved to be an important analysis method in the field of energy and environment research in the 20th century (Wright, 1974; Bullard and Herendeen, 1975; Hannon et al., 1983).

The Input-Output Analysis can be divided into single-region input-output(SRIO) model(Shui and Harriss, 2006; Dietzenbacher and Mukhopadhyay, 2007; Li and Hewitt, 2008) and multi-region input-output (MRIO) model (Kanemoto et al., 2012, 2013; Kanemoto, Moran and Lenzen, 2013; Feng et al., 2013; Liu et al., 2015;Young Yoon et al., 2020). The MRIO model is based on the technology of origin, and the calculation results are more accurate(Lenzen and Pade, 2004). SRIO model is usually used to study the carbon emissions of one country's export trade to another or more countries. However, the homogeneity technology assumption of the model is not necessarily valid, which may cause large deviation in the calculation. If there is a big difference in the production technology level between countries, the error of complete carbon emission coefficient will be relatively large (Chen Hongmin, 2011).

## 2.2. Measurement of Embodied Carbon Based on MRIO Model

Due to the complexity of the model, the difficulty of data acquisition and processing, the development and application of MRIO model is slow. Until recent years, with the development of big data technology, MRIO model has been widely used.

The carbon emissions of international trade of 24 countries, which accounted for 80% of global emissions and GDP in 1995, were measured by MRIO model. It is found that there are embodied carbon imports in most of OECD countries, and China is the largest exporter of implied carbon in OECD countries (Ahmad and Wyckoff, 2003). United States, Japan and other developed countries are the net importers of carbon---similar results were obtained by calculating the embodied carbon in the world's major trading powers by using the MRIO model (Zhou Xin, 2010). According to the calculation of MRIO model, China's carbon emission caused by production increased from 2.92 billion tons to 7.08 billion tons from 2005 to 2009, while the carbon emission caused by consumption increased from 2.47 billion tons to 6.18 billion tons, which provided evidence for the separation of consumption and production in the current international carbon emission accounting system (Yan Yunxiu and Zhao Zhongxiu 2013).

## 2.3. Embodied Carbon Emissions in Bilateral Trade.

At present, there are three scales to measure trade carbon: single country scale, bilateral scale and multilateral scale.

On the scale of bilateral trade, there are the following studies in recent years. Through the research on embodied carbon transfer between two developed countries in Japan and Canada, it is found that the carbon emission of manufacturing products exported from Japan to Canada is low due to its high technological advantages, while the carbon emission of manufacturing products exported to Japan from Canada is also relatively low due to its high production efficiency (Hayami and Nakamura, 2002). During 1997-2004, the United States reduced its carbon emissions by 3% - 6% through imports from China, while China increased its carbon emissions by 7% - 14%. And the overall carbon emissions of the two countries increased due to bilateral trade (Hyun-Jae Rhee, 2016). Through the research of the transmission effect of $CO_2$ emissions resulting from bilateral international trade between China, Japan and South Korea, proved that South Korea has successfully reduced its pollution emissions through international trade with China and Japa(Shui and Harriss, 2006).n. By measuring the embodied carbon in the bilateral trade between China and Japan, it is found that Japan mainly imports products with high carbon emission intensity from China, making China a "pollution haven" (Jin Jihong and Ju Yiyi, 2018).

## 3. Methodology and Data Description

### 3.1. Methodology

MRIO model can be extended from the Input-Output Model of a country.

**Table 1.** Basic Input-output Table

| Input-output | | Intermediate Output | | | | Final Output | Total Output |
|---|---|---|---|---|---|---|---|
| | | Sector 1 | Sector 2 | ... | Sector n | | |
| Intermediate Input | Sector 1 | $X_{11}$ | $X_{12}$ | ... | $X_{1n}$ | $Y_1$ | $X_1$ |
| | Sector 2 | $X_{21}$ | $X_{22}$ | ... | $X_{2n}$ | $Y_2$ | $X_2$ |
| | ... | ... | ... | ... | ... | ... | ... |
| | Sector n | $X_{n1}$ | $X_{n2}$ | ... | $X_{nn}$ | $Y_n$ | $X_n$ |
| Value Added | | $Z_1$ | $Z_2$ | ... | $Z_n$ | | |
| Total Input | | $X_1$ | $X_2$ | ... | $X_n$ | | |

For a country, all industry sectors that comprise the national economy carry out production activities while finely linked with another, and supply necessary goods and services for final demand. It is reflected from intermediate output and intermediate input. Each point in the input-output table contains both vertical and horizontal economic meanings. Therefore, we can get two relations: horizontal output balance and vertical input balance:

$$\text{Total output = intermediate output + final output} \tag{1}$$

$$\text{Total input = intermediate input + value added} \tag{2}$$

Suppose there are n sectors in the national economy, "i" stands for horizontal sector, "j" stands for vertical sector. According to the horizontal balance of the input-output table, we can get

$$\begin{cases} x_{11} + x_{12} + \cdots + x_{1n} + y_1 = x_1 \\ x_{21} + x_{22} + \cdots + x_{2n} + y_2 = x_2 \\ \qquad\qquad \cdots \\ x_{n1} + x_{n2} + \cdots + x_{nn} + y_n = x_n \end{cases} \qquad (3)$$

It is expressed by matrix

$$AX+Y=X \qquad (4)$$

The above formula is the most basic input-output model. After adjustment, we can get

$$X=(1-A)^{-1}Y \qquad (5)$$

Among them, X is the total output vector of each department, and its element Xi is the total output of the ith department; Y is the final product column vector of each sector, and $Y_i$ is the final product of the ith sector, including domestic final consumption, capital formation and export;

I is n×n-dimensional matrix, $A=\{a_{ij}=x_{ij}/x_j\}$, $a_{ij}$ represents the input of i sector directly consumed by unit output of j sector. $x_{ij}$ represents the direct consumption of the products of department i in the production process of department j. $x_j$ is the total output of sector. If one of the total output vector X or the final product vector y is known, according to the input-output table, the direct consumption coefficient matrix A can be found, and another unknown term can be calculated.

The direct consumption coefficient plus the total indirect consumption coefficient is the complete consumption coefficient, which represents the sum of direct consumption and indirect consumption of unit product produced by department j and the input of department i, which is recorded as $b_{ij}$. The complete consumption coefficient matrix is represented by B.

The relationship between the direct consumption coefficient matrix A and the complete consumption coefficient matrix B can be expressed as

$$B=(I-A)^{-1}-I. \qquad (6)$$

$(I-A)^{-1}$ is the complete demand coefficient matrix, that is, the Leontief inverse matrix.

In the calculation of embodied carbon emission in Sino-Korea trade, the bilateral input-output table of China and South Korea is constructed in Table 2.

When calculating the carbon emission coefficient of each sector, the direct $CO_2$ emission coefficient is $E=\{ E_j/E \}$. Complete $CO_2$ emission coefficient of China is $E_c(I-A_c)-1$, complete $CO_2$ emission coefficient of South Korea is $E_k(I-A_k)-I$.

**Table 2.** Sino-Korea Input-output Table

| Input-output | | | Intermediate Demand | | | Final Demand | | | Total output |
|---|---|---|---|---|---|---|---|---|---|
| | | | CHN Sector 1,2...n | KOR Sector 1,2...n | Row | CHN | KOR | W | |
| Intermediate Input | CHN | Secto1,2...n | $Q_1$ | $Q_2$ | $Q_3$ | $Q_4$ | $Q_5$ | $Q_6$ | $X_i^c$ |
| | KOR | Secto1,2...n | $Q_7$ | $Q_8$ | $Q_9$ | $Q_{10}$ | $Q_{11}$ | $Q_{12}$ | $X_i^k$ |
| | W | | | | | | | | |
| | Value Added | | | | | | | | |
| | Total Input | | $X_j^c$ | $X_j^k$ | | | | | |

**Note**: W Refers to Other Countries.

In the calculation of embodied carbon in Sino-Korea trade, the embodied carbon of South

Korea's export to China is:

$$E_{kc}=E_k(I-A_k)^{-1}Q_7+E_k(I-A_k)^{-1}Q_{10} \qquad (7)$$

The embodied carbon of China's export to South Korea is:

$$E_{ck}=E_c(I-A_c)^{-1}Q_2+E_c(I-A_c)^{-1}Q_5 \qquad (8)$$

## 3.2. Data Description

The data used in this paper is mainly from the WIOD database and the EORA database. There are several Mario database, such as EXIOBASE, EORA, WIOD, FIGARO, OECD, etc. Observing trends in carbon emissions requires time continuity and data stability. Because of the great difference of statistical methods and statistical caliber, the data from different sources will lead to serious deviation. Therefore, this paper selects two databases which are compiled continuously according to the year. The WIOT(World Input-Output Table) in the WIOD database is recognized to be more systematic, accurate, standardized and easy to use. Based on WIOT, this paper compiles the non competitive input-output table of China and South Korea from 2005 to 2014, and according to the needs of this paper, the original 56 sectors are integrated into 18 sectors as Table 3.

**Table 3.** Classification of Sectors

| No. | Sector | No. | Sector |
|---|---|---|---|
| 1 | Agriculture, Hunting, Forestry and Fishing | 10 | Other Non-Metallic Mineral |
| 2 | Mining and Quarrying | 11 | Basic Metals and Fabricated Metal |
| 3 | Food, Beverages and Tobacco | 12 | Machinery, Nec. |
| 4 | Textiles and Leather | 13 | Electrical and Optical Equipment |
| 5 | Wood and Products of Wood | 14 | Transport Equipment |
| 6 | Pulp, Paper, Paper, Printing and Publishing | 15 | Manufacturing, Nec.; Recycling |
| 7 | Coke, Refined Petroleum and Nuclear Fuel | 16 | Electricity, Gas and Water Supply |
| 8 | Chemicals and Chemical Products | 17 | Construction |
| 9 | Rubber and Plastics | 18 | Service |

The $CO_2$ emissions from 2005 to 2009 come from the environment account of WIOD. Because this account is only counted until 2009, so the 2010-2014 $CO_2$ data were extracted from the EORA database. Unlike WIOD databases by sector, EORA databases directly statistics products. Therefore, according to the WIOD database sectors integration standard,123 products of China and 78 products of Korea in EORA database are classified and merged into 18 sectors. Because of the statistical differences, the unit carbon emissions of EORA are obviously different from the statistics in the WIOD when measuring individual products. Therefore, it is not scientific to directly compare the implied carbon emissions of the two databases. For the direct coefficient and complete coefficient of carbon emissions in ten years, the annual growth rate is compared to replace the specific coefficient, which is more

scientific for the embodied carbon change trend of the two countries. For the total amount of carbon emissions in Sino-Korea trade, this paper divides the ten years into two periods of 2005-2009, 2009-2104 for comparative study. This division also perfectly fits the division of environmental protection stage of the South Korean government. For the sector carbon embodied in Sino-Korea trade, this paper selects 2005, 2008, 2010,2014 as the samples to analyze and grasp the change trend of each department as a whole. The above methods make up for the imperfection of the data to the greatest extent, and can objectively and truly reflect the actual situation

## 4. Empirical Results

### 4.1. Direct CO₂ Emission Intensity

Direct $CO_2$ emission coefficient indicates the amount of $CO_2$ directly emitted by a unit of product produced by a sector. It represents the level of environmental protection in the production technology of a sector. Through the model calculation, we get the following direct $CO_2$ emission coefficient as Table 4.

**Table 4.** Annual Direct $CO_2$ Emission Coefficient

| Sector | 2005 WIOT | 2006 WIOT | 2007 WIOT | 2008 WIOT | 2009 WIOT | 2009 EORA | 2010 EORA | 2011 EORA | 2012 EORA | 2013 EORA | 2014 EORA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Panel A: China | | | | | | | | | | | |
| 1 | 0.29 | 0.27 | 0.21 | 0.14 | 0.13 | 0.14 | 0.13 | 0.12 | 0.11 | 0.11 | 0.11 |
| 2 | 0.53 | 0.44 | 0.42 | 0.34 | 0.36 | 0.38 | 0.33 | 0.26 | 0.25 | 0.22 | 0.19 |
| 3 | 0.18 | 0.15 | 0.12 | 0.10 | 0.09 | 0.09 | 0.08 | 0.07 | 0.06 | 0.06 | 0.06 |
| 4 | 0.15 | 0.12 | 0.10 | 0.09 | 0.08 | 0.26 | 0.25 | 0.23 | 0.21 | 0.19 | 0.18 |
| 5 | 0.12 | 0.10 | 0.07 | 0.08 | 0.06 | 0.14 | 0.16 | 0.13 | 0.11 | 0.10 | 0.09 |
| 6 | 0.35 | 0.31 | 0.27 | 0.30 | 0.25 | 0.64 | 0.66 | 0.60 | 0.53 | 0.48 | 0.45 |
| 7 | 0.62 | 0.51 | 0.35 | 0.29 | 0.30 | 0.47 | 0.32 | 0.26 | 0.24 | 0.23 | 0.22 |
| 8 | 0.58 | 0.55 | 0.45 | 0.39 | 0.36 | 0.50 | 0.46 | 0.37 | 0.32 | 0.28 | 0.26 |
| 9 | 0.15 | 0.12 | 0.10 | 0.10 | 0.08 | 0.46 | 0.44 | 0.39 | 0.35 | 0.31 | 0.29 |
| 10 | 3.62 | 2.81 | 2.14 | 2.08 | 1.61 | 0.29 | 0.30 | 0.24 | 0.21 | 0.18 | 0.17 |
| 11 | 0.90 | 0.72 | 0.59 | 0.45 | 0.51 | 0.33 | 0.31 | 0.26 | 0.23 | 0.20 | 0.19 |
| 12 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.22 | 0.16 | 0.14 | 0.13 | 0.11 | 0.11 |
| 13 | 0.10 | 0.08 | 0.07 | 0.06 | 0.05 | 0.65 | 0.67 | 0.58 | 0.56 | 0.50 | 0.47 |
| 14 | 0.09 | 0.07 | 0.05 | 0.05 | 0.04 | 0.31 | 0.24 | 0.22 | 0.20 | 0.17 | 0.16 |
| 15 | 0.07 | 0.05 | 0.04 | 0.05 | 0.05 | 0.65 | 0.83 | 0.74 | 0.59 | 0.51 | 0.48 |
| 16 | 6.69 | 6.10 | 5.16 | 5.75 | 5.79 | 5.61 | 5.54 | 5.27 | 4.98 | 4.55 | 4.01 |
| 17 | 0.12 | 0.10 | 0.08 | 0.05 | 0.05 | 0.38 | 0.34 | 0.28 | 0.26 | 0.24 | 0.22 |
| 18 | 0.18 | 0.17 | 0.14 | 0.12 | 0.12 | 0.07 | 0.07 | 0.06 | 0.06 | 0.05 | 0.05 |
| | | | | | | | | | | | |
| Panel B: Korea | | | | | | | | | | | |
| 1 | 0.26 | 0.23 | 0.21 | 0.20 | 0.23 | 0.12 | 0.11 | 0.10 | 0.10 | 0.10 | 0.10 |
| 2 | 2.54 | 2.21 | 1.91 | 2.17 | 2.98 | 0.19 | 0.20 | 0.19 | 0.19 | 0.17 | 0.17 |
| 3 | 0.05 | 0.05 | 0.04 | 0.04 | 0.04 | 0.11 | 0.10 | 0.09 | 0.09 | 0.08 | 0.08 |
| 4 | 0.12 | 0.10 | 0.08 | 0.07 | 0.07 | 0.13 | 0.11 | 0.09 | 0.08 | 0.08 | 0.08 |
| 5 | 0.07 | 0.06 | 0.06 | 0.06 | 0.08 | 0.09 | 0.08 | 0.07 | 0.07 | 0.07 | 0.07 |
| 6 | 0.22 | 0.19 | 0.17 | 0.15 | 0.18 | 0.13 | 0.11 | 0.10 | 0.10 | 0.10 | 0.10 |

**Table 4. (**Continued)

| Sector | 2005 WIOT | 2006 WIOT | 2007 WIOT | 2008 WIOT | 2009 WIOT | 2009 EORA | 2010 EORA | 2011 EORA | 2012 EORA | 2013 EORA | 2014 EORA |
|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Panel B: Korea | | | | | | | | | | | |
| 7 | 0.32 | 0.27 | 0.25 | 0.21 | 0.31 | 0.17 | 0.14 | 0.10 | 0.09 | 0.09 | 0.10 |
| 8 | 0.12 | 0.11 | 0.11 | 0.10 | 0.11 | 0.10 | 0.08 | 0.07 | 0.07 | 0.06 | 0.06 |
| 9 | 0.16 | 0.14 | 0.15 | 0.14 | 0.15 | 0.29 | 0.29 | 0.29 | 0.28 | 0.27 | 0.25 |
| 10 | 3.54 | 3.39 | 3.28 | 3.39 | 3.13 | 0.28 | 0.27 | 0.27 | 0.26 | 0.25 | 0.24 |
| 11 | 0.48 | 0.44 | 0.39 | 0.39 | 0.42 | 0.10 | 0.09 | 0.07 | 0.07 | 0.08 | 0.08 |
| 12 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.11 | 0.10 | 0.09 | 0.09 | 0.09 | 0.09 |
| 13 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.13 | 0.11 | 0.10 | 0.09 | 0.09 | 0.09 |
| 14 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.09 | 0.08 | 0.07 | 0.07 | 0.07 | 0.06 |
| 15 | 0.08 | 0.06 | 0.06 | 0.06 | 0.06 | 0.21 | 0.14 | 0.13 | 0.13 | 0.12 | 0.12 |
| 16 | 3.39 | 3.04 | 2.83 | 2.95 | 3.87 | 4.40 | 3.70 | 3.40 | 3.11 | 2.76 | 2.09 |
| 17 | 0.05 | 0.05 | 0.04 | 0.05 | 0.05 | 0.41 | 0.40 | 0.37 | 0.37 | 0.34 | 0.29 |
| 18 | 0.15 | 0.12 | 0.11 | 0.12 | 0.14 | 0.20 | 0.18 | 0.16 | 0.16 | 0.15 | 0.13 |

Comparison of direct $CO_2$ emission coefficient between China and South Korea, obviously, the direct carbon emission coefficient of South Korea was lower than that of China in most sectors. This shows that South Korea's production was more environmentally friendly, and the direct emissions of $CO_2$ from various sectors were relatively small. But compared to the data in 2009, there are some differences between a few sectors of the WIOT and EORA databases. This paper uses the 2005-2009 coefficient calculated by WIOT database to calculate the growth rate from 2005 to 2008, and uses the 2009-2014 coefficient calculated by EORA database to calculate the growth rate from 2009 to 2013. This method ensures that under the condition of consistent statistical methods, the annual coefficient increase range can be accurately calculated, and the time series comparison can be carried out. We use DCI to express direct $CO_2$ emission intensity, annual DGI growth rate=$DCI_n$-$DCI_{n-1}$/$DCI_{n-1}$(n means the year). According to the Chinese and Korean annual DGI growth rate Table B in the appendix, we can get the the Fig.1. By comparison, the direct $CO_2$ emission coefficient of China decreased faster than that of South Korea in this decade. This shows that during this period, China has made great progress in technology and significantly improved energy efficiency.

**Fig. 1.** Ten Years' Average Change Rate of Direct $CO_2$ Emission Coefficient (2005-2013)
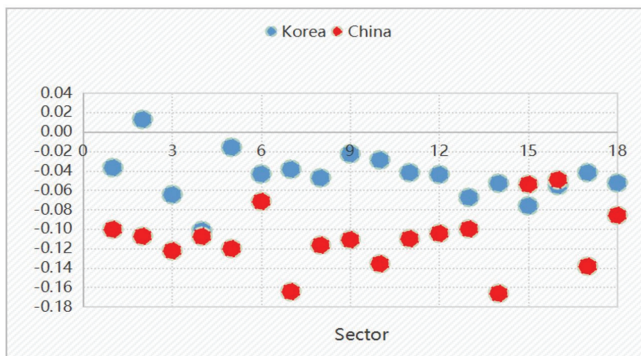


## 4.2. Complete $CO_2$ Emission Intensity

Complete $CO_2$ emission coefficient indicates the amount of $CO_2$ completely emitted by a unit of product produced by a sector. It includes direct emission and indirect emission. This coefficient shows the total pollution level of a sector's products to the environment.

It can be seen from the comparison of the complete $CO_2$ emission coefficient in Table 5, the real technology gap between China and South Korea was relatively large. As of 2014, only one sector in South Korea had a relatively high coefficient. It was Electricity, Gas and Water Supply sector, which was also the sector with the largest coefficient for China. And China's figures is more than double that of Korea.

Considering the use of two databases, we observe the trend of numerical change in the two time periods from 2005 to 2009, 2009 to 2014. During these two five-year periods, the coefficient of each sector in China had been declining. For South Korea, the coefficient of each sector generally increased slightly in 2009. This indicates that Korea was greatly affected by the 2008 financial crisis.

**Table 5.** Annual Complete $CO_2$ Emission Coefficient

| Sector | 2005 WIOT | 2006 WIOT | 2007 WIOT | 2008 WIOT | 2009 WIOT | 2009 EORA | 2010 EORA | 2011 EORA | 2012 EORA | 2013 EORA | 2014 EORA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Panel A: China | | | | | | | | | | | |
| 1 | 1.02 | 0.89 | 0.72 | 0.65 | 0.66 | 0.93 | 0.87 | 0.75 | 0.73 | 0.67 | 0.63 |
| 2 | 3.86 | 3.30 | 2.56 | 3.11 | 2.90 | 2.95 | 2.80 | 2.73 | 2.41 | 2.26 | 2.12 |
| 3 | 0.61 | 0.54 | 0.46 | 0.48 | 0.52 | 0.62 | 0.58 | 0.53 | 0.56 | 0.53 | 0.50 |
| 4 | 0.51 | 0.45 | 0.39 | 0.41 | 0.47 | 0.95 | 0.84 | 0.73 | 0.71 | 0.66 | 0.62 |
| 5 | 0.45 | 0.38 | 0.31 | 0.30 | 0.31 | 0.64 | 0.61 | 0.54 | 0.48 | 0.46 | 0.42 |
| 6 | 0.97 | 0.81 | 0.66 | 0.68 | 0.64 | 1.25 | 1.21 | 1.07 | 0.95 | 0.85 | 0.79 |
| 7 | 1.56 | 1.38 | 1.20 | 1.11 | 1.16 | 1.40 | 1.45 | 1.34 | 1.23 | 1.07 | 0.96 |
| 8 | 2.11 | 1.81 | 1.53 | 1.51 | 1.46 | 2.03 | 1.84 | 1.68 | 1.59 | 1.46 | 1.34 |
| 9 | 0.60 | 0.49 | 0.39 | 0.41 | 0.42 | 1.04 | 0.94 | 0.82 | 0.75 | 0.68 | 0.63 |
| 10 | 4.44 | 3.48 | 2.68 | 2.60 | 2.13 | 0.68 | 0.61 | 0.53 | 0.48 | 0.45 | 0.41 |
| 11 | 3.05 | 2.50 | 2.09 | 1.91 | 1.90 | 2.14 | 1.86 | 1.67 | 1.59 | 1.47 | 1.32 |
| 12 | 1.29 | 1.15 | 0.98 | 1.05 | 1.10 | 1.53 | 1.68 | 1.56 | 1.50 | 1.41 | 1.24 |
| 13 | 0.89 | 0.79 | 0.67 | 0.65 | 0.69 | 1.51 | 1.38 | 1.22 | 1.10 | 1.02 | 0.94 |
| 14 | 0.52 | 0.46 | 0.44 | 0.38 | 0.40 | 0.87 | 0.77 | 0.63 | 0.53 | 0.51 | 0.47 |
| 15 | 0.20 | 0.20 | 0.13 | 0.11 | 0.12 | 0.74 | 0.89 | 0.79 | 0.63 | 0.56 | 0.52 |
| 16 | 12.40 | 11.63 | 10.09 | 9.69 | 9.86 | 9.68 | 9.26 | 8.53 | 8.03 | 7.37 | 6.63 |
| 17 | 0.18 | 0.14 | 0.12 | 0.11 | 0.13 | 0.48 | 0.45 | 0.40 | 0.38 | 0.36 | 0.33 |
| 18 | 4.97 | 4.10 | 3.31 | 3.18 | 3.45 | 3.93 | 3.52 | 3.10 | 3.08 | 2.94 | 2.85 |
| Panel B: Korea | | | | | | | | | | | |
| 1 | 0.37 | 0.33 | 0.31 | 0.30 | 0.37 | 0.27 | 0.22 | 0.19 | 0.20 | 0.20 | 0.19 |
| 2 | 2.69 | 2.31 | 2.00 | 2.24 | 3.10 | 0.28 | 0.25 | 0.22 | 0.22 | 0.20 | 0.20 |
| 3 | 0.17 | 0.16 | 0.16 | 0.17 | 0.22 | 0.25 | 0.21 | 0.18 | 0.19 | 0.19 | 0.18 |
| 4 | 0.20 | 0.19 | 0.17 | 0.18 | 0.22 | 0.28 | 0.23 | 0.20 | 0.19 | 0.20 | 0.19 |
| 5 | 0.12 | 0.10 | 0.10 | 0.10 | 0.12 | 0.14 | 0.12 | 0.11 | 0.11 | 0.11 | 0.10 |
| 6 | 0.48 | 0.41 | 0.37 | 0.34 | 0.41 | 0.27 | 0.22 | 0.19 | 0.19 | 0.19 | 0.18 |
| 7 | 0.92 | 0.85 | 0.79 | 0.77 | 0.88 | 0.47 | 0.41 | 0.39 | 0.38 | 0.36 | 0.32 |
| 8 | 1.05 | 1.00 | 1.01 | 0.95 | 1.09 | 0.75 | 0.67 | 0.63 | 0.61 | 0.56 | 0.52 |
| 9 | 0.20 | 0.19 | 0.20 | 0.19 | 0.21 | 0.34 | 0.33 | 0.32 | 0.31 | 0.29 | 0.28 |

**Table 5.** (Continued)

| Sector | 2005 WIOT | 2006 WIOT | 2007 WIOT | 2008 WIOT | 2009 WIOT | 2009 EORA | 2010 EORA | 2011 EORA | 2012 EORA | 2013 EORA | 2014 EORA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Panel B: Korea | | | | | | | | | | | |
| 10 | 3.79 | 3.63 | 3.51 | 3.60 | 3.36 | 0.33 | 0.32 | 0.31 | 0.30 | 0.29 | 0.27 |
| 11 | 1.06 | 1.02 | 1.02 | 1.02 | 1.12 | 0.60 | 0.58 | 0.56 | 0.52 | 0.47 | 0.41 |
| 12 | 0.21 | 0.26 | 0.29 | 0.27 | 0.41 | 0.48 | 0.41 | 0.33 | 0.33 | 0.31 | 0.30 |
| 13 | 0.19 | 0.20 | 0.22 | 0.21 | 0.25 | 0.32 | 0.31 | 0.29 | 0.26 | 0.23 | 0.21 |
| 14 | 0.24 | 0.26 | 0.27 | 0.22 | 0.25 | 0.23 | 0.22 | 0.21 | 0.20 | 0.18 | 0.17 |
| 15 | 0.09 | 0.09 | 0.09 | 0.10 | 0.11 | 0.25 | 0.19 | 0.17 | 0.16 | 0.16 | 0.15 |
| 16 | 4.26 | 3.83 | 3.59 | 3.69 | 4.83 | 5.16 | 4.39 | 4.06 | 3.77 | 3.42 | 2.77 |
| 17 | 0.11 | 0.11 | 0.10 | 0.10 | 0.11 | 0.45 | 0.43 | 0.40 | 0.39 | 0.37 | 0.31 |
| 18 | 3.29 | 2.99 | 2.89 | 2.99 | 3.56 | 1.99 | 1.74 | 1.57 | 1.50 | 1.37 | 1.18 |

Considering the use of two databases, we observe the trend of numerical change in the two time periods from 2005 to 2009, 2009 to 2014. During these two five-year periods, the coefficient of each sector in China had been declining. For South Korea, the coefficient of each sector generally increased slightly in 2009. This indicates that Korea was greatly affected by the 2008 financial crisis.

By comparing the growth rate of the complete coefficient between China and South Korea in the two periods, Table 6 can be obtained.

In the two five-year period, different from the continuous and stable decline in China, the pollution index of most sectors in South Korea even increased during 2005-2009. In addition to the impact of the 2008 financial crisis, the policy of the South Korean government during this period was also an important reason for this rise. Although from the late 1990s, South Korea had entered the peak of environmental protection legislation. However, from 1988 to 2006, South Korea's investment in new and renewable energy R & D was only 4% of that of the United States and 7% of that of Japan. The neglect at the national level led to little improvement in the complete $CO_2$ emission coefficient of various sectors in South Korea during this period. In 2008, then President Lee Myung Bak put forward the idea of "green growth", increasing investment in new energy and renewable energy research, so as to develop renewable energy industry and improve employment rate. South Korea's energy structure began to gradually transform into a "low energy consumption" structure. In 2009, the South Korean parliament passed the RAMEWORK ACT ON LOW CARBON, GREEN GROWTH and formally implemented in the following year. Then, from 2009 to 2014, the complete $CO_2$ emission coefficient of South Korea decreased significantly. Although the initial coefficient is far lower than that of China, it has reached the same decline rate as China. This group of comparison shows that in addition to technological factors, policy factors also have a great impact on environmental protection.

**Table 6.** Growth Rate of Complete $CO_2$ Emission Coefficient

| Sector | CHN 2005-2009 | CHN 2009-2014 | KOR 2005-2009 | KOR 2009-2014 |
|---|---|---|---|---|
| 1 | -0.35 | -0.32 | 0.01 | -0.29 |
| 2 | -0.25 | -0.28 | 0.15 | -0.30 |
| 3 | -0.15 | -0.19 | 0.30 | -0.30 |
| 4 | -0.09 | -0.34 | 0.08 | -0.31 |

**Table 6.** (Continued)

| Sector | CHN 2005-2009 | CHN 2009-2014 | KOR 2005-2009 | KOR 2009-2014 |
|---|---|---|---|---|
| 5 | -0.31 | -0.35 | 0.07 | -0.26 |
| 6 | -0.34 | -0.36 | -0.13 | -0.33 |
| 7 | -0.26 | -0.31 | -0.04 | -0.32 |
| 8 | -0.31 | -0.34 | 0.03 | -0.30 |
| 9 | -0.29 | -0.39 | 0.04 | -0.19 |
| 10 | -0.52 | -0.40 | -0.11 | -0.18 |
| 11 | -0.38 | -0.38 | 0.05 | -0.31 |
| 12 | -0.15 | -0.19 | 0.95 | -0.38 |
| 13 | -0.22 | -0.38 | 0.31 | -0.32 |
| 14 | -0.23 | -0.45 | 0.04 | -0.24 |
| 15 | -0.41 | -0.30 | 0.28 | -0.38 |
| 16 | -0.21 | -0.32 | 0.13 | -0.46 |
| 17 | -0.26 | -0.30 | 0.01 | -0.33 |
| 18 | -0.31 | -0.27 | 0.08 | -0.41 |

## 4.3. Total Carbon Embodied in Sino-Korea Trade

Through the MRIO model, this paper calculates the embodied carbon emission in the Sino-Korea trade from 2005 to 2014, and the results are shown in Table 7.

From 2005 to 2014, South Korea had been in the state of net trade export and net embodied carbon import. Due to the decrease of the complete $CO_2$ emission coefficient, although the bilateral trade volume in 2014 increased to 2.3 times of 2005, the growth of implied carbon was relatively small. From the perspective of South Korea, the embodied carbon export increased by 1.61 times, and the embodied carbon import increased by 1.67 times. On the premise of increasing trade volume and improving people's welfare of the two countries, slowing down the growth of $CO_2$ emissions is of positive significance to world environmental protection.

The same five-year interval is used to analyze. Excluding the abnormal data affected by the financial crisis in 2009, the embodied carbon trading volume of the two countries shows the same trend as the complete $CO_2$ emission coefficient. From 2005 to 2008, the import trade volume of South Korea from China increased by 1.99 times, while the import embodied carbon net value only increased by 1.44 times, indicating that China had significantly improved its internal technology in environmental protection. Over the same period, South Korea's export trade increased by 1.48 times, while its net embodied carbon export increased by 1.56 times. This is consistent with the fact that the carbon emission coefficient of South Korea did not decrease during this period. From 2010 to 2014, the growth ratio of trade volume and embodied carbon between China and South Korea was similar. The growth rate of trade volume is greater than that of carbon emissions.

**Table 7.** Embodied Carbon Emission in Sino-Korea Trade (South Korea)

Unit: Million Tons, Billion Dollars

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Imp | 68.9 | 71.5 | 75.9 | 99.1 | 83.5 | 106.9 | 132.3 | 121.6 | 123.2 | 115.0 |
| Trade Imp | 386.5 | 485.6 | 630.3 | 769.3 | 542.5 | 715.7 | 864.3 | 807.8 | 830.5 | 900.7 |

**Table 7. (**Continued)

Unit: Million Tons, Billion Dollars

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Exp | 41.2 | 44.6 | 55.4 | 64.1 | 54.0 | 60.3 | 65.6 | 67.2 | 67.6 | 66.2 |
| Trade EXP | 619.2 | 695.5 | 819.9 | 913.9 | 867 | 1168.4 | 1342 | 1343.3 | 1458.7 | 1453.3 |
| $CO_2$ Net | -27.7 | -26.9 | -20.5 | -35.0 | -29.5 | -46.6 | -66.7 | -54.4 | -55.6 | -48.8 |
| Trade Net | 232.7 | 209.9 | 189.6 | 144.6 | 324.6 | 452.6 | 477.8 | 535.5 | 628.2 | 552.6 |

## 4.4. Sector Carbon Embodied in Sino-Korea Trade

Through the MRIO model, this paper calculates the sector embodied carbon emission in the Sino-Korea trade from 2005 to 2014 and Select 2005, 2008, 2010, 2014 to form the Table 8.

**Table 8.** Sector Embodied Carbon Emission

Unit: Million Tons

| Sector | CHN 2005 | CHN 2008 | CHN 2010 | CHN 2014 | KOR 2005 | KOR 2008 | KOR 2010 | KOR 2014 |
|---|---|---|---|---|---|---|---|---|
| 1 | 1256 | 533 | 625 | 485 | 13 | 8 | 12 | 12 |
| 2 | 7227 | 5705 | 2122 | 1035 | 11 | 61 | 23 | 10 |
| 3 | 1877 | 2548 | 3101 | 3286 | 96 | 188 | 177 | 298 |
| 4 | 3705 | 3949 | 5629 | 6545 | 1753 | 1359 | 1246 | 1527 |
| 5 | 233 | 328 | 515 | 676 | 7 | 9 | 7 | 13 |
| 6 | 364 | 320 | 640 | 987 | 591 | 611 | 327 | 241 |
| 7 | 941 | 1657 | 2273 | 2664 | 7620 | 14246 | 7140 | 4733 |
| 8 | 4758 | 7675 | 10610 | 11379 | 11101 | 15952 | 10974 | 10181 |
| 9 | 664 | 873 | 1325 | 1679 | 594 | 646 | 633 | 663 |
| 10 | 935 | 1472 | 2552 | 4140 | 225 | 205 | 154 | 237 |
| 11 | 12855 | 23523 | 15114 | 15788 | 3788 | 4533 | 3555 | 2271 |
| 12 | 10980 | 17479 | 34625 | 42473 | 19154 | 28557 | 25591 | 30542 |
| 13 | 1521 | 4014 | 5666 | 6282 | 2267 | 4442 | 4072 | 2821 |
| 14 | 1284 | 2599 | 4349 | 3432 | 3755 | 3368 | 2481 | 2955 |
| 15 | 1594 | 2105 | 2564 | 3820 | 629 | 421 | 339 | 923 |
| 16 | 247 | 186 | 150 | 155 | 1 | 23 | 22 | 23 |
| 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | 5504 | 7993 | 9304 | 9064 | 3902 | 5613 | 3562 | 6525 |

For South Korea, 1,2,3,5,6,10,16 were types of sectors which were resource-intensive or labor-intensive ones, due to less exports, lead to less embodied carbon exports. Mechanical and electrical products (12,13), chemical products (8) have always been the top two exports of South Korea to China. Although the $CO_2$ emission coefficient of these sectors decreased, the amount of embodied carbon continued to increase significantly due to the sharp increase of trade volume.

For China, carbon emissions from exports of natural resource intensive industries such as agriculture (1) and mining (2) decreased significantly. There are two reasons for this: one is

the reduction of $CO_2$ emission coefficient caused by technological progress; the other is the sharp decrease of export volume caused by China's adjustment of industrial structure. Mechanical and electrical products (12,13), chemical products (8) and base metals (11) had been the top three exports of China to South Korea in the past decade. Although the complete $CO_2$ emission coefficient of these sectors had been greatly reduced, it was still the highest in China until 2014, which was about three times that of South Korea.

From the perspective of implied carbon transfer, there is a lot of intra industry trade between China and South Korea. These sectors should continue to improve technology to help curb total carbon emissions.

## 5. Conclusions and Suggestions

### 5.1. Conclusions

In this paper, we have calculated the embodied carbon emissions in Sino-Korea trade based on the ARIO Model. Through quantitative calculation and analysis, the direct $CO_2$ emission coefficient, complete $CO_2$ emission coefficient, total carbon emissions and sector emissions in bilateral trade from 2005 to 2014 are determined.

In the trade between China and South Korea, South Korea had been in trade surplus and embodied carbon deficit. From 2005 to 2014, the Embodied Carbon coefficient of various sectors in China continued to decrease significantly, which made a certain contribution to the world environmental protection. During the period of 2005-2009, South Korea had little effect in improving the carbon emission coefficient. However, with the implementation of many environmental protection laws and policies of the government after 2008, the complete $CO_2$ emission coefficient of all sectors in South Korea had decreased significantly. In 2014, the $CO_2$ emission coefficient of most sectors in South Korea was still significantly lower than that in China, indicating that the $CO_2$ emissions of various sectors in South Korea were smaller.

Although the carbon emission coefficient was significantly reduced due to technical factors, the total amount of embodied carbon in Sino-Korea trade still showed an upward trend from 2005 to 2014. This is mainly due to the closer trade cooperation between the two countries and the substantial increased in trade volume. From the perspective of sectors, there was obvious intra industry trade between China and South Korea. The import and export of embodied carbon are also concentrated in several sectors such as Mechanical and electrical sector, chemical sector. How to develop these departments scientifically needs the attention of the two governments.

In order to test the above conclusions, the authors uses SDA model to analyze the influencing factors of embodied carbon emission in Sino-Korea trade. The results show that technology has a significant inhibitory effect on embodied carbon emission, trade scale has a significant role in promoting the growth of embodied carbon emission, and trade structure has a inhibitory effect on embodied carbon emission, but the effect is not significant.

### 5.2. Suggestions

#### 5.2.1. Strengthen Technical Cooperation and Encourage the R&D and Use of Low-carbon Technologies

From the empirical data of this paper, the government behavior has a significant positive impact on the production side to reduce carbon emissions. In 2012, the report of the 18th

National Congress of the Communist Party of China put forward "promoting green development, circular development and low-carbon development" for the first time. In recent years, China's various industries strive to explore a low-carbon green development path. This is a good opportunity for enterprises of the two countries to strengthen technical cooperation and develop environmental protection industry. Low carbon economy is mainly reflected in energy conservation, emission reduction and environmental protection. In terms of improving the level of energy conservation and emission reduction, as a member of developed countries, South Korea has accumulated a lot of experience in improving the legal framework, establishing clear objectives, implementing preferential policies, utilizing market mechanism, developing circular economy and relying on scientific and technological innovation, which has certain reference significance for China to realize energy conservation and emission reduction through environmental protection and governance. South Korea has technological advantages in air pollution prevention, waste treatment, water treatment and contaminated soil remediation. The South Korean government supports South Korea's environmental protection industry to develop China's environmental protection market, constructs a series of mechanisms and platforms for the exchange and cooperation of China's and South Korea's environmental protection industries, and issues the "China's market development strategy". China's enterprises can cooperate with South Korea's excellent environmental protection enterprises to improve the technical level, build China South Korea environmental protection industrial park, and solve the problems of enterprises in environmental protection technology while improving the quality of China's foreign investment. There is a huge space for China and South Korea to cooperate in environmental protection industry and energy conservation and emission reduction.

### 5.2.2. Developing Regional Economy and Leading Global Emission Reduction

On June 1, 2015, China and South Korea officially signed the FTA agreement. This is a free trade agreement signed by China involving the largest amount of trade and the widest range of trade. Geographical advantages and similar cultural traditions give China and South Korea a natural advantage in regional cooperation. In addition to strengthening cooperation and competition between China and South Korea in specific export commodities and sectors, carbon tariff system can also become an area for the two countries to strengthen consultation and cooperation. Under the general trend of carbon tariffs imposed by the EU and the United States, China and South Korea can strengthen exchanges and cooperation in carbon tariff policy research, adopt a consistent attitude towards such unfair carbon tariff policies implemented in disguise by the European Union, the United States and other western countries, and formulate win-win bilateral trade agreements.

On September 22, 2020, China's president Xi Jinping proposed at the seventy-fifth UN General Assembly China will strive to achieve carbon neutralization by 2060. In October 28th, South Korean President moon Jae in the statement said South Korea will realize carbon neutralization by 2050. For both China and South Korea, energy supply will shift from coal to renewable energy. In the process of transformation, on the one hand, it is necessary to continue to play the inhibiting role of technological factors in the embodied carbon emission, and on the other hand, it is necessary to adjust the trade structure and strive for its significant inhibiting effect on the embodied carbon emission.

# Appendices

**Table A.** Volume and Proportion of Sino-Korea Trade (2005-2019)

Unit: Hundred Million US Dollars

| Date | Bilateral Trade | Total Foreign Trade (CHN) | RATIO | Total Foreign Trade (KOR) | RATIO | NET (KOR) |
|------|------|------|------|------|------|------|
| 2005 | 1005.6 | 14219.06 | 7.07% | 5456.6 | 18.43% | 232.7 |
| 2006 | 1180.2 | 17604.38 | 6.70% | 6348.5 | 18.59% | 209.9 |
| 2007 | 1450.2 | 21761.75 | 6.66% | 7277.8 | 19.93% | 189.6 |
| 2008 | 1683.2 | 25632.55 | 6.57% | 8572.8 | 19.63% | 144.6 |
| 2009 | 1409.5 | 22075.35 | 6.38% | 6866.2 | 20.53% | 324.6 |
| 2010 | 1884.1 | 29740.01 | 6.34% | 8916.0 | 21.13% | 452.6 |
| 2011 | 2206.3 | 36418.64 | 6.06% | 10808.9 | 20.41% | 477.8 |
| 2012 | 2151.1 | 38671.19 | 5.56% | 10676.6 | 20.15% | 535.5 |
| 2013 | 2289.2 | 41589.93 | 5.50% | 10752.2 | 21.29% | 628.2 |
| 2014 | 2354.0 | 43015.27 | 5.47% | 10986.5 | 21.43% | 552.6 |
| 2015 | 2273.8 | 39530.33 | 5.75% | 9634.5 | 23.60% | 469.0 |
| 2016 | 2113.9 | 36855.57 | 5.74% | 9015.3 | 23.45% | 374.7 |
| 2017 | 2399.7 | 41071.38 | 5.84% | 10521.3 | 22.81% | 442.6 |
| 2018 | 2686.4 | 46224.44 | 5.81% | 11403.4 | 23.56% | 556.8 |
| 2019 | 2434.3 | 45761.26 | 5.32% | 10455.8 | 23.28% | 289.7 |

**Source**: China Statistical Yearbook, Statistical Korea.

**Table B.** Annual Direct $CO_2$ Emission Coefficient Growth Rate

| Sector | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|------|------|------|------|------|------|------|------|------|------|
| Panel A: China | | | | | | | | | |
| 1 | -0.06 | -0.22 | -0.33 | -0.05 | -0.06 | -0.11 | -0.03 | -0.03 | -0.03 |
| 2 | -0.16 | -0.04 | -0.20 | 0.08 | -0.16 | -0.21 | -0.02 | -0.12 | -0.12 |
| 3 | -0.19 | -0.23 | -0.10 | -0.10 | -0.12 | -0.17 | -0.09 | -0.07 | -0.02 |
| 4 | -0.19 | -0.21 | -0.07 | -0.15 | -0.02 | -0.09 | -0.11 | -0.09 | -0.05 |
| 5 | -0.23 | -0.23 | 0.05 | -0.28 | 0.10 | -0.16 | -0.15 | -0.14 | -0.05 |
| 6 | -0.13 | -0.13 | 0.12 | -0.16 | 0.03 | -0.10 | -0.12 | -0.10 | -0.06 |
| 7 | -0.19 | -0.30 | -0.16 | 0.01 | -0.46 | -0.19 | -0.08 | -0.03 | -0.06 |
| 8 | -0.05 | -0.19 | -0.12 | -0.08 | -0.10 | -0.19 | -0.14 | -0.12 | -0.06 |
| 9 | -0.19 | -0.20 | 0.00 | -0.17 | -0.05 | -0.12 | -0.09 | -0.12 | -0.06 |
| 10 | -0.22 | -0.24 | -0.03 | -0.23 | 0.01 | -0.18 | -0.13 | -0.15 | -0.06 |
| 11 | -0.20 | -0.17 | -0.24 | 0.13 | -0.05 | -0.15 | -0.15 | -0.09 | -0.06 |
| 12 | -0.06 | -0.17 | -0.05 | 0.10 | -0.38 | -0.12 | -0.11 | -0.10 | -0.06 |
| 13 | -0.18 | -0.21 | -0.09 | -0.10 | 0.03 | -0.13 | -0.04 | -0.11 | -0.06 |
| 14 | -0.19 | -0.30 | -0.06 | -0.25 | -0.31 | -0.10 | -0.09 | -0.13 | -0.06 |
| 15 | -0.24 | -0.21 | 0.33 | -0.07 | 0.22 | -0.11 | -0.20 | -0.13 | -0.06 |
| 16 | -0.09 | -0.16 | 0.12 | -0.01 | -0.01 | -0.05 | -0.06 | -0.09 | -0.12 |
| 17 | -0.16 | -0.20 | -0.34 | -0.01 | -0.14 | -0.16 | -0.08 | -0.07 | -0.08 |
| 18 | -0.09 | -0.16 | -0.13 | 0.01 | -0.08 | -0.12 | -0.05 | -0.06 | -0.08 |

**Table B.** Annual Direct CO$_2$ Emission Coefficient Growth Rate

| Sector | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| Panel A: Korea | | | | | | | | | |
| 1 | -0.12 | -0.07 | -0.06 | 0.15 | -0.11 | -0.09 | 0.01 | 0.01 | -0.05 |
| 2 | -0.13 | -0.13 | 0.13 | 0.37 | 0.03 | -0.03 | 0.01 | -0.14 | 0.00 |
| 3 | -0.12 | -0.09 | -0.11 | 0.06 | -0.10 | -0.13 | 0.01 | -0.07 | -0.03 |
| 4 | -0.19 | -0.16 | -0.10 | -0.04 | -0.19 | -0.18 | -0.07 | 0.05 | -0.04 |
| 5 | -0.14 | 0.00 | 0.00 | 0.23 | -0.16 | -0.10 | 0.06 | -0.02 | 0.00 |
| 6 | -0.14 | -0.12 | -0.06 | 0.17 | -0.16 | -0.10 | 0.06 | -0.02 | 0.00 |
| 7 | -0.16 | -0.08 | -0.14 | 0.46 | -0.19 | -0.29 | -0.10 | 0.02 | -0.13 |
| 8 | -0.12 | -0.03 | -0.02 | 0.10 | -0.13 | -0.15 | -0.05 | -0.03 | 0.00 |
| 9 | -0.08 | 0.06 | -0.05 | 0.02 | -0.02 | 0.01 | -0.04 | -0.05 | -0.05 |
| 10 | -0.04 | -0.03 | 0.03 | -0.08 | -0.02 | 0.01 | -0.04 | -0.05 | -0.05 |
| 11 | -0.08 | -0.11 | -0.01 | 0.07 | -0.13 | -0.15 | -0.02 | 0.05 | 0.00 |
| 12 | -0.12 | -0.15 | 0.06 | 0.01 | -0.06 | -0.11 | 0.00 | -0.03 | 0.02 |
| 13 | -0.16 | -0.22 | 0.01 | 0.09 | -0.18 | -0.11 | -0.04 | -0.02 | 0.01 |
| 14 | -0.02 | -0.24 | 0.05 | 0.06 | -0.13 | -0.13 | -0.05 | 0.00 | -0.01 |
| 15 | -0.16 | -0.13 | 0.04 | 0.06 | -0.33 | -0.10 | -0.01 | -0.04 | -0.02 |
| 16 | -0.10 | -0.07 | 0.04 | 0.31 | -0.16 | -0.08 | -0.09 | -0.11 | -0.24 |
| 17 | 0.02 | -0.15 | 0.04 | 0.06 | -0.03 | -0.07 | 0.00 | -0.08 | -0.16 |
| 18 | -0.18 | -0.07 | 0.04 | 0.17 | -0.12 | -0.11 | -0.02 | -0.04 | -0.12 |

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# Research on Participation and Position Evaluation of Korean Manufacturing Global Value Chain: Based on the Comparative Analysis with China and the United States

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## Abstract

*Purpose* – This article will take the Korean manufacturing industry as an example to estimate Korea's global value chain status from the perspective of overall and sub-industry, hoping to provide a theoretical reference for Korean manufacturing to climb the global value chain.

*Design/methodology* – Based on the WIOD data. The data is calculated by using MATLAB (2014a) coding. The data for 6 sectors are classified according to the International Standard Industrial Classification revision 3 (ISIC Rev. 3), the WIOD data are used to calculate and compare the position, participation and dynamics of the Korea, China and USA` manufacturing industry in the 1995-2016.

*Findings* – The empirical results supported conclusions of the theoretical model. In the Korean GVC of electrical and optical sector, while stronger forward linkages than backward linkages to GVC are advantageous for an average advanced country, the benefits of downstream tasks are pronounced for non-advanced countries. And proved the correlation for an index to capture a country's upstream position or downstream position, it makes sense to compare that Korea's exports of intermediates in the same sector that are used by China and USA.

*Originality/value* – The first is to re-examine the characteristics of South Korea's participation in global value chains under a more systematic and accurate theoretical framework, which provides a new empirical reference for related research; the second is to content covers of the manufacturing 6 sectors, so as to more completely describe the characteristics of Korean manufacturing's participation in global value chains; The value of this paper is providing empirical evidence of the effect of Korea's the GVC of manufacturing sectors. In the GVC of 6 sectors, first three have a higher position in the value chain and are in the upper middle and upper reaches of the GVC. The latter two have a low GVC position index, which has become the main sector that pulls down the overall position of Korea's manufacturing industry.

**Keywords**: Global Value Chain, Korea, Participation, Position
**JEL Classifications**: D9, F710, O14

## 1. Introduction

From the early 1960s to the early 1970s, Korea took advantage of the opportunity of industrial restructuring in Japan and Europe and the United States to undertake labor-intensive industries such as textiles, clothing, and daily necessities. This was the first time Korea had undertaken international industrial transfer. Beginning in the early 1970s, the

outbreak of the two oil crises caused Western developed countries to accelerate the development of technology-intensive industries such as new energy and microelectronics, and gradually abandon capital-intensive industries such as steel, shipbuilding, and chemicals. In response to this change, the Korean government issued the "Declaration of Heavy Chemical Industrialization" in January 1973, focusing on ten industries such as steel, machinery, shipbuilding, automobiles, and petrochemicals. This is the second time that Korea has undertaken industries transfer (Li and Hou,2019). Beginning in the late 1970s, Korea also transferred some labor-intensive industries that gradually lacked comparative advantages to ASEAN and China. In the 1980s, technology-intensive industries represented by information technology and life sciences developed rapidly in developed countries in Europe and the United States. Korea undertook capital and technology-intensive industries such as electrical and electronics, chemicals, and transportation machinery. In these three industrial transfers, parts of Korea's industries, such as shipbuilding and steel, have embarked on a development path of "imitation and innovation". Other industries, such as textiles and garments, automobiles, electronics, daily chemicals, animation, etc., firstly intervene at the low end of the industry chain, even starting from OEM, and gradually extending to ODM and OBM, realizing the leap to the high end of the value chain. However, since the 2008 international financial crisis, with the implementation of the "re-industrialization" strategy of developed countries and the increasing international competition in the manufacturing industry, Korea's manufacturing industry is facing new challenges and urgently needs to implement a new round of transformation and upgrading Korean manufacturing competitiveness.

With the in-depth development of the information technology revolution and economic globalization, the international division of labor has undergone tremendous changes, allowing resources to be integrated and effectively used on a global scale. Under the realistic background of the division of labor in the global value chain, countries obtain certain benefits in the production and creation of product value, but the distribution of benefits in the value chain is uneven. Countries located in the upper reaches of the value chain mainly provide cores to other countries. Raw materials or intermediate products control and control the two ends of the value chain with high added value; developing countries located in the downstream link of the value chain import a large amount of foreign intermediate inputs to produce final products, which are squeezed into low value-added processing Manufacturing process. While the global value chain brings opportunities and benefits to Korean industries, it is also accompanied by many risks and challenges. These uncertain factors will bring some new problems to Korean companies, such as high input and low output, and value chain position bottlenecks, foreign capital's absolute control over the industry, etc. Countries located in the upstream link of the value chain mainly provide core raw materials or intermediate products to other countries, and control and control both ends of the value chain with high added value; developing countries located in the downstream link of the value chain import a large amount of foreign intermediate inputs to The production of final products is squeezed in the low value-added processing and manufacturing links. How to seize the development opportunities of globalization, better integrate into the international division of labor system, and achieve the climb to the high-end links of the global value chain and the acquisition of a controlling position is an effective way for Korea to become a trade power. Since countries are in different positions in the division of labor in the value chain, and their different positions determine the benefits of division of labor a country obtains in trade, how to fully integrate into the global value chain division of labor system, taking into account the global value of Korean manufacturing The position in the chain not only affects the formulation of Korea's opening policy and industrial policy, but also relates to whether

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Korea can seek advantages and avoid disadvantages in this process. It is also an important issue that needs to be solved urgently to realize the transformation and upgrading of Korea's manufacturing industry (Yang, 2015). Therefore, measuring and judging Korea's position in the global value chain and the degree of participation in the international division of labor has always been the focus of domestic and foreign scholars. This article will take Korea's manufacturing industry as an example to estimate Korea's global value chain position from the perspective of overall and sub-industry, hoping to provide a theoretical reference for Korean manufacturing to climb the global value chain.

The main contributions of this article are as follows: First, re-examine the characteristics of Korea's participation in global value chains under a more systematic and accurate theoretical framework, and provide new empirical references for related research; second, from the dual perspectives of forward and backward linkages Analyzing the characteristics of global value chains has made up for the lack of existing literature that is limited to a single perspective; third, the research content covers most of the manufacturing sectors, so as to more completely characterize the characteristics of Korean manufacturing participating in global value chains; fourth, revealing that Korea has been involved in global value chains in recent years Some new features of participating in global value chains have revised some conclusions in the existing literature.

The structure of the rest of this article is the second part to explain the methods and data used in this article; the third part is the test results of the position and upgrades position of some of Korea's manufacturing industries in the global value chain, and is similar to the United States, China and other manufacturing powerhouses. Compare the situation; the fourth part is the conclusion.

## 2. Literature Review

### 2.1. The Meaning of Global Value Chain

The United Nations Industrial Development Organization (United Nations Industrial Development Organization, UNIDO) once authoritatively pointed out: "The global value chain refers to a global enterprise that conducts research and development, manufacturing, marketing, and recycling of goods or services on a global scale, and is connected to realize the value of these products. A networked organization chain, which involves the entire process of the procurement and transportation of raw materials, the production and distribution of intermediate inputs and final products, and the final consumption and recycling of goods or services." The global value chain includes the organizational models and value distribution methods of all participating entities and production and operation activities, and uses a professional process system to connect with suppliers, partners and customers in the chain division of labor to support the operating capabilities of the participating entities And efficiency, and multinational companies spreading all over the world and embedded in the global value chain are carrying out a series of continuous value-added activities from product development and design, manufacturing, marketing, after-sales service to final recycling, etc.; worldwide The value chain is mainly based on the vertical dimension of value to study the relationship between the global economic organization and the division of production, while the global production network maps the relationship between the global economic organization and the division of production from the horizontal and vertical dimensions, so the description of the global economic form is more three-dimensional and complex ; The traditional theory of global value chain division of labor particularly emphasizes the analysis

of the value level. Many existing studies decompose the product structure and functional structure of the value chain when analyzing the governance path of the global value chain, in order to find the realization ideas for climbing the high-end nodes of the value chain(Wang,2016). The multi-dimensional construction of global value chains is also conducive to the integrated analysis of multiple industrial chains. Porter (1985) was the first to notice the phenomenon of the division of labor in the value chain between enterprises within the industry, and put forward the value chain theory. His research perspective at that time only paid attention to the country's internal, and only considered the interaction between different enterprises in the production of the same product division of labor and cooperation(Porter,1985).

## 2.2. Measurement of the Position of the Division of Labor in the Global Value Chain

Scholars from various countries have used different indicators to quantitatively analyze the position of the division of labor in the global value chain to judge its governance model. Tu (2011) used RCA and other indexes to analyze the international competitiveness of China's manufacturing industry and its position in the global value chain when studying manufacturing upgrades; Wang and wei (2008) used exports in the research. The commodity structure similarity index is used to consider the different positions of a country's industry in the global value chain. By comparing the similarity of the export product structure of developing countries and developed countries, we can study and judge the relationship between a country's industry and the high-end nodes of the global value chain. Relative distance, and gives a reference; many scholars usually use indirect and alternative indicators to measure the position of a country's industry in the global value chain, although it can help analyze some countries to a certain extent. Or the development position of certain industries in the global economy in the global economy, but there are still certain limitations in the detailed discussion of a specific industry, which is largely due to the difficulty of obtaining and collating relevant data. In addition, the GVC position index is an important indicator and method for judging the position of a country's manufacturing industry embedded in the global value chain. Some studies also use the upgrade index of Kaplinsky and others to measure the dynamic position of manufacturing upgrades(Lin and He,2015). Koopman et al. (2010) created a mathematical decomposition model of total exports based on value-added trade theory and forward linkages, and used Hummels et al. (2001) to construct a global value chain participation index and a position index to quantitatively evaluate a country's global. Hummels et al. (2001) created the "Vertical Specialization Index" and used the HIY model to measure the degree of vertical division of OECD countries and emerging developing countries; Wen and Xian (2010) combined the HIY model with China's national conditions and obtained The latest data on the vertical sub-project degree of China's manufacturing industries; Yu and Deng (2014) reformed the HIY method on the basis of separating processing trade from general trade. Tang (2015) uses a net trade index that pays equal attention to imports and exports to investigate 22 sub-industries in China's manufacturing industry, and evaluates the different performance of these industries in each link of GVC.

## 2.3. Division of Labor in Global Value Chains and Manufacturing Upgrades

In the research on the division of labor in the global value chain and the upgrade path of the manufacturing industry, Wang et al. (2015) used industrial industry panel data to estimate that the overall effect of industrial transformation is on the rise. The deepening of GVC

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embeddedness is conducive to promoting China's industrial transformation and upgrading, but It has the most significant impact on labor-intensive and technology-intensive industries; Kam (2013) conducted a study on the international production segmentation of Malaysia's manufacturing industry, and the results showed that international production segmentation is conducive to the technological progress of the manufacturing industry, and also conducive to improvement The country's position in the global value chain. Wang and Li (2020) Research on the position and participation index of manufacturing global value chain in 42 countries from 2003 to 2014, found that OFDI can improve the position and high score of the home country's manufacturing global value chain in the higher quantile Participation in the global value chain of the home country's manufacturing industry hinders the improvement of the position and participation of the home country's manufacturing global value chain in the low quantile. At the same time, OFDI can increase the participation of the developed country's manufacturing global value chain in the high quantile. At the same time, it will hinder the promotion of the global value chain position of the developed countries' manufacturing in the 0.10 quantile and the middle quantile. Ren (2017) uses the world input-output table data to calculate the manufacturing trade value-added and structure of China, Japan and Korea, and comparative analysis of the position of the three countries' manufacturing in the global value chain and the degree of division of engineering. Research shows that the position of China's manufacturing industry in the global value chain is constantly improving, Korea is stabilizing, and Japan is declining. China's low- and medium- and high-tech manufacturing industries are in the upper reaches of the value chain, and high-tech manufacturing has a higher degree of participation in the value chain, but the position is lower than that of Korea and Japan. The manufacturing industries of all technological levels in Japan are in the middle and upper reaches of the value chain, but all have a downward trend. Korea has the highest degree of participation in value chain sub-projects in manufacturing industries of all technological levels. The increase in the proportion of foreign value of exported intermediate products is an important reason for the deepening of the degree of global participation in the value chain of China, Japan and Korea. From the perspective of value chain integration, Shao and Li (2007) explained that the transformation and upgrading process of manufacturing industry is a process of industrial innovation and industrial value appreciation, which promotes the leap of value modules along the value chain and the evolution of the value chain. The transition of value modules and value chains requires the promotion of "innovative energy". The level of "innovative energy" not only reflects the size of industrial innovation and how much industrial value is added, but also can be used as an important measure for judging the integrated performance of the value chain. Chen and Liu (2011) used I-O analysis and found that the lower intermediate input levels and obvious leakage effects in various sectors of the equipment manufacturing industry hindered the extension of the domestic value chain, and intensified GVC's impact on China's equipment manufacturing industry. Lock-in effect.

## 2.4. Global Value Chain Division of Labor System

As the concept of global value chain has received more and more heated discussions in the international academic community, more and more researches on the division of labor system of global value chain have also attracted the attention of many scholars, and this research is also the theory of global value chain One of the core issues. In order to distinguish it from the original form of international division of labor and highlight the differences in the specialization of different stakeholders in the global production network, the concept of the global value chain division of labor system has entered the field of relevant research (Alvstam

et al., 2020; Pratono, 2020; Beach and Virgo, 2019; Sun et al., 2019). Hummels et al. (2001) believe that a country can participate in the vertical specialization international division of labor in two ways, namely, importing intermediate inputs for the production of exports (backward linkage) and exporting intermediate inputs for the production of exports by other countries (Forward linkage), and use the indicators VS (the value of imported inputs contained in a country's exports), VS1 (the part of a country's exports that are used as intermediate inputs for exports by other countries) and the ratio of the two to total exports To measure the scale of vertical specialization and the degree of participation. Fally (2011), Antràs et al. (2012) and other documents try to construct indicators such as the length of the production chain, upstream degree, and downstream degree to measure which part of the global value chain a country conducts specialized production, and then judge a country as a whole and its industry Position and division of labor in the global value chain. The main difference between the global value chain division of labor system and the traditional form of international division of labor is: the division of labor in the global value chain places more emphasis on enterprises represented by multinational companies. Huang et al. (2019) Technological progress has a promoting effect on the improvement of manufacturing competitiveness, blindly Deepening the global division of labor system is not conducive to the upgrading of the manufacturing industry. It is necessary to rely on technological progress to promote the improvement of international competitiveness by improving the position of division of labor, and thus realize the overall upgrade of the manufacturing industry. In the process of shifting the manufacturing industry to the high-end nodes of the global value chain, it is necessary to transform the vertical The idea of division of labor to the level of division of labor, build a "whole industry chain" development model led by technological progress, create a manufacturing value ecosystem, and conduct horizontal cooperation with global partners in multiple value links, increase China's domestic indirect value-added rate, and enhance manufacturing International competitiveness of the industry (Huang, 2019).

It can be seen that due to different research fields, directions and national conditions, the focus of the same general research direction will be different. In addition, due to differences in research angles, database selection, research methods, and index structures, the research results may vary greatly. There are many studies on the position of the manufacturing industry, but the research based on the GVC perspective is relatively lacking. Exploration from this perspective is innovative and can reflect the position of a country's manufacturing industry in the global value chain. Therefore, this article refers to the research results of other scholars, combines the current position of the industry, selects the latest available data, measures the position of Korea's manufacturing industry from the GVC perspective, and proposes more targeted and operable countermeasures based on the calculation results.

## 3. Empirical Method and Data

### 3.1. Model Construction of the Value Chain Position Measurement Index System

This paper draws on the decomposition method of Koopman et al. (2011) on a country's total exports to measure the foreign added value contained in Korea's exports, as well as Korea's participation in GVC and its international division of labor position.

Suppose there are two countries (country r and country s), and each country has n departments. All products can be used as intermediate products or final products, which can be used in the country or exported to foreign countries for use. Therefore, the following

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equation can be used to express a domestic product:

$$E_r = A_{rr}X_r + A_{rs}X_s + Y_{rr} + Y_{rs} \quad r,s = 1,2 \tag{1}$$

Among them, X r and Y rs are both $N \times 1$ order vector, which respectively represent the total output of country r and the final demand of country s for domestic production of r; Ars is an $N \times N$ order square matrix, which represents the production used in country s The direct consumption coefficient of intermediate goods in country r is: (1) Equation can be written in matrix form:

$$\begin{bmatrix} X_r \\ X_s \end{bmatrix} = \begin{bmatrix} A_{rr} & A_{rs} \\ A_{sr} & A_{ss} \end{bmatrix} \begin{bmatrix} X_r \\ E_s \end{bmatrix} + \begin{bmatrix} Y_{rr} & Y_{rs} \\ Y_{sr} & Y_{ss} \end{bmatrix} \tag{2}$$

The above formula can be sorted out:

$$\begin{bmatrix} X_r \\ X_s \end{bmatrix} = \begin{bmatrix} 1 - A_{rr} & A_{rs} \\ A_{sr} & 1 - A_{ss} \end{bmatrix}^{-1} \begin{bmatrix} Y_{rr} & Y_{rs} \\ Y_{sr} & Y_{ss} \end{bmatrix} = \begin{bmatrix} B_{rr} & B_{rs} \\ B_{sr} & B_{ss} \end{bmatrix} \begin{bmatrix} Y_r \\ Y_s \end{bmatrix} \tag{3}$$

Bsr is an $N \times N$ Leontief inverse (complete consumption coefficient) matrix, which represents the increased intermediate input of country s needed to produce a unit of product in country r. Ysr is an $N \times 1$ final demand matrix, which represents the final demand of country r for country s. It can also be abbreviated as:

$$X = (1 - A)^{-1}Y = BY \tag{4}$$

X and Y are both $2N \times 1$ matrices, and both A and B are $2N \times 2N$ matrices.
Thus, the direct value-added coefficient can be defined:

$$V_1 = u[1 - A_{rr} - A_{sr}] \ , \ V_2 = u[1 - A_{rs} - A_{ss}] \tag{5}$$

Vr is a $1 \times N$ direct value-added coefficient matrix, which is the direct value-added coefficient vector of country r. The elements of this vector represent
The direct value-added coefficient of a certain industry in the country, that is, the element of the direct value-added output after excluding the intermediate product input Vri=1-"all intermediate input coefficients"; u is a $1 \times N$ matrix, and the element is 1.
Then define the direct value-added coefficient matrix:

$$V = \begin{bmatrix} V_r & 0 \\ 0 & V_s \end{bmatrix} \tag{6}$$

V is a $2 \times 2N$ matrix.
Multiply the value-added coefficient matrix Vri and the Leontief inverse matrix B_sr to obtain the final value-added matrix:

$$VB = \begin{bmatrix} V_1 B_{rr} & V_1 rs \\ V_2 B_{sr} & V_2 B_{ss} \end{bmatrix} \tag{7}$$

VB is a $2 \times 2N$ matrix.
Let Ers be an $N \times 1$ matrix, representing the intermediate inputs and final products exported from country r to country s, and then the total export of country r is:

$$X_r = \sum_{r \neq s} E_{rs} = \sum_s (A_{rs}X_s + Y_{rs}) \quad r,s = 1,2 \tag{8}$$

$$E = \begin{bmatrix} E_r & 0 \\ 0 & E_s \end{bmatrix} \tag{9}$$

$$\widehat{E} = \begin{bmatrix} diag(E)_r & 0 \\ 0 & diag(E_s) \end{bmatrix} \tag{10}$$

E is a 2N × 2 matrix. $\widehat{E}$ is a 2N × N2 diagonal matrix.
The export value-added matrix at the industry (sector) level is:

$$VB\widehat{E} = \begin{bmatrix} V_1 B_{rr} \widehat{E}_r & V_1 B_{rs} \widehat{E}_s \\ V_2 B_{sr} \widehat{E}_r & V_2 B_{ss} \widehat{E}_s \end{bmatrix} \tag{11}$$

The export value-added matrix at the country (overall) level is:

$$VBE = \begin{bmatrix} V_1 B_{rr} E_1 & V_1 B_{rs} E_s \\ V_2 B_{sr} E_r & V_2 B_{ss} E_s \end{bmatrix} \tag{12}$$

Among them, $VB\widehat{E}$ is a 2 × 2N matrix, and VBE is a 2 × 2 matrix.
Generalizing to the case of country g, the VBE is a 3 × 3 matrix:

$$VBE = \begin{bmatrix} V_1 rr E_r & V_1 B_{rs} E_s & V_1 B_{rg} E_g \\ V_2 B_{sr} E_r & V_2 B_{ss} E_s & V_1 B_{sg} E_g \\ V_3 B_{gr} E_r & V_3 B_{gs} E_g & V_1 B_{gg} E_g \end{bmatrix} \tag{13}$$

At this time, VBE is a 3 × 3 matrix.
The diagonal elements in the VBE matrix add value to the domestic value of each country's total exports:

$$DV_r = V_r B_{rr} E_r \tag{14}$$

The non-diagonal elements in each column of the VBE matrix add up to the foreign value added in the total exports of a country:

$$FV_r = \sum_{r \neq s} V_s B_{sr} E_r \tag{15}$$

The addition of the non-diagonal elements in each row of the VBE matrix is the domestic indirect value added included in the exports of other countries:

$$IV_r = \sum_{s \neq r} V_r B_{rs} E_{st} \tag{16}$$

Total exports are equal to the sum of domestic value added and foreign value added:

$$E_r = DV_r + FV_r \tag{17}$$

Daudin et al. (2009) finally decomposed a country's export into the following five parts:

$$E_r = DV_r + FV_r = V_r B_{rr} \sum_{g \neq r} Y_{rs} + V_r B_{rr} \sum_{s \neq r} A_{rs} X_{ss} + V_r B_{rr} \sum_{s \neq r} \sum_{t \neq r,s} A_{rs} X_{st} + V_r B_{rr} \sum_{s \neq r} A_{rs} X_{st} + FV_r \tag{18}$$

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## 3.2. Index Selection for the Measurement Index System of Manufacturing Value Chain Position

Based on the above decomposition of total exports, four indicators for a country's participation in the global value chain can be constructed:

(1) Index of vertical division of labor in the value chain (foreign value-added index)

Hummels et al. (2001) proposed to use the vertical specialization ratio to measure the degree of participation in the division of labor in the value chain. The vertical specialization ratio uses the input-output table to calculate the value of imported intermediate goods contained in exports, which is divided into absolute quantity (VS) and relative quantity (VSS). With reference to the calculation formula of Hummels et al. (2001), the $VSS_i$ measures the degree of division of a country's value chain in a certain industry is:

$$VSS_i = \frac{VS_i}{X_i} \tag{19}$$

$$VS_i = \left(\frac{M_i}{Y_i}\right)X_i \tag{20}$$

Where: i represents the industry, $X_i$ represents the total export value of a country's industry i industry, $VS_i$ represents the value of imported intermediate products contained in the export products of industry i, $M_i$ represents the value of intermediate products imported by industry i, and $Y_i$ represents industry i Gross domestic output. In the previous analysis, $FV_i$ represents foreign value-added, which means the foreign value added in the export of a country's industry i, so it is easy to know $FV_i = VS_i, X_i = E_i$, you can get:

$$VSS_i = \frac{VS_i}{X_i} = \frac{FV_i}{E_i} \tag{21}$$

Therefore, the vertical division of labor in a certain industry is equal to its foreign value-added rate.

Assuming that a country has n industries, the total export of a country is $EX = \sum_{i=1}^{n} X_i = \sum_{i=1}^{n} E_i$, then its total vertical division of labor (foreign value-added rate )for:

$$VSS = \sum_{i=1}^{n} VS_i \Big/ \sum_{i=1}^{n} X_i = \frac{1}{EX} \sum_{i=1}^{n} VS_i = \frac{1}{EX} \sum_{i=1}^{n} FV_i = \frac{1}{EX} \sum_{i=1}^{n} \left(\frac{M_i}{Y_i} X_i\right) \tag{22}$$

(2) Export value-added index

Export value-added refers to the proportion of indirect value-added exports of a certain industry in a country's total exports. Among them, indirect value-added exports measure how much value-added is included in the country's intermediate exports of that industry and is After being processed in one country, it is exported to a third country. The export value-added index formula can be expressed as:

$$VSS_i^{VA} = \frac{IV_i}{X_i} \tag{23}$$

$IV_r$ represents the indirect added value brought by the intermediate goods contained in the export of a certain industry in a certain country.

Extending to the overall situation of a country, the country has n industries, the total export value-added index is:

$$VSS^{VA} = \left.\sum_{i=1}^{n} IV_i \middle/ \sum_{i=1}^{n} X_i\right. = \frac{1}{EX}\sum_{i=1}^{n} IV_i \tag{24}$$

(3) GVC participation rate index

According to the GVC participation rate index proposed by Koopman (2011), the GVC participation rate index of a country's i industry can be expressed as:

$$GVC_{Participation_i} = \frac{FV_i}{E_i} + \frac{IV_i}{E_i} \tag{25}$$

In the formula, $\frac{IV_i}{E_i}$ is the export value-added index, which is also called the GVC forward participation rate index, and some scholars call it outward participation. The higher the index, the more global value the country is in the industry. Upstream of the chain; where $\frac{FV_i}{E_i}$ is the foreign value-added index and the vertical division of labor index. It is also called the GVC backward participation rate index, and some scholars call it inward participation. The higher the index, the higher it indicates The country is further down the global value chain in this industry.

Therefore, the total GVC participation rate index of a country can be expressed as:

$$GVC_{Participation} = VSS + VSS^{VA} = \frac{1}{EX\left(\sum_{i=1}^{n} FV_i + \sum_{i=1}^{n} IV_i\right)} \tag{26}$$

Considering that even if the two countries have the same level of GVC participation, their position in the global value chain will be different. Koopman et al. (2011) further constructed an indicator reflecting the position of a country's international division of labor GVC_Position$_i$.

(4) GVC position index

The GVC position index examines a country's international division of labor position in the GVC by comparing the export value added of a certain industry in a country with the foreign value added. The GVC position index of the i industry is expressed as follows:

$$GVC\_Position_i = \ln\left(1 + VSS_i^{VA}\right) - \ln\left(1 + VSS_i\right) = \ln\left(1 + \frac{IV_i}{X_i}\right) - \ln\left(1 + \frac{VS_i}{X_i}\right) \tag{27}$$

It can be obtained from this that the total GVC position index of a country is:

$$GVC_{Position} = \ln\left(1 + \frac{1}{EX}\sum_{i=1}^{n} IV_i\right) + \ln\left(1 + \frac{1}{EX}\sum_{i=1}^{n} VS_i\right) \tag{28}$$

### 3.3. Data Sources and Selection

The input-output table used in this paper is the World Input-Output Table (WIOT) in the World Input-Output Database (WIOD) jointly developed by OECD and other institutions, We use the world input-output tables (WIOTs). The World Input Output Database (WIOD) project has developed WIOTs for calculating the GVC. and World Input-Output Tables and

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underlying data, covering 43 countries, and a model for the rest of the world for the period 1995-2016. The trade data and output data used in the calculation can also be obtained from the world input-output table of the corresponding year. The WIOD tables connect the trade flows of intermediate and final goods across countries and industries.

Meanwhile, some international organizations and research centres provide the database similar to the WIOT during this period, also they are having its own advantages and disadvantages of the database.

For example, the NACE (the French Nomenclature statistique des Activités économiques dans la Communauté Européenne) database is provided by the European Community and it is used to classify 35 industries, belong in the 14 manufacturing sectors. the SITC Rev3 for products, manufactured goods by degree of manufacturing groupings in the SITC 5 to 8 less 667 and 68 of the classification from sample countries in the WIOT

This paper of reasons for using the WIOD` data are as follows:

(i) many Korean studies on GVCs are providing empirical evidence of the WIOT data sources, and there is means by which clearly to absolute confidence in the

statistical figures calculated from the WIOTs. (ii) the WIOTs database is available for the recent years from 1995 to 2016, deflated WIOTs in Previous Years' Prices (World IO Tables PYP) are available, as well as national aggregations (National IO Tables). Additionally the underlying International Supply and Use Tables (International SUTs).while other databases only provide simple tables.

According to the description of methods and original sources of information used for the construction of the WIOTs. We are restructuring for the WIOD data structure.The data in this paper is calculated by using MATLAB (2014a) coding. The following calculation results are analyzed based on the manufacturing industry.

Data for 6 sectors are classified according to the International Standard Industrial Classification revision 3 (ISIC Rev. 3): Manufacture of basic metals, Manufacture of fabricated metal products, Manufacture of electrical equipment,Manufacture of computer, electronic and optical products, Manufacture of machinery and equipment n.e.c.. Manufacture of transport equipment.

# 4. Results

## 4.1. Overall Measurement of Korean Manufacturing Value Chain Position

### 4.1.1. Measurement and Analysis of the Overall GVC Participation Rate Index

This paper selects representative 9-year data to measure the overall GVC participation rate of the manufacturing industry. The results are shown in Fig. 1. It can be seen that the overall GVC participation rate of the Korean manufacturing industry is relatively stable, floating within the range of 72% to 80%. From the perspective of global value chain participation, Korea's participation in the international division of labor is showing a steady upward trend. The 2008 financial crisis increased the participation index of all industries. This proves from the side that the stimulus of the financial crisis will temporarily prevent Korea from gaining global value. The rise in the upper reaches of the chain has increased the participation of Korean GVCs. Korea's participation in the international division of labor is higher than that of China, and its GVC participation index value is around 0.5, and GVC participation has shown a steady upward trend, indicating that Korea's role in the international division of labor has been deepening.

**Fig. 1.** The change of GVC participation rate in Korea's manufacturing industry from 1995 to 2016

(Unit: GVC participation rate)
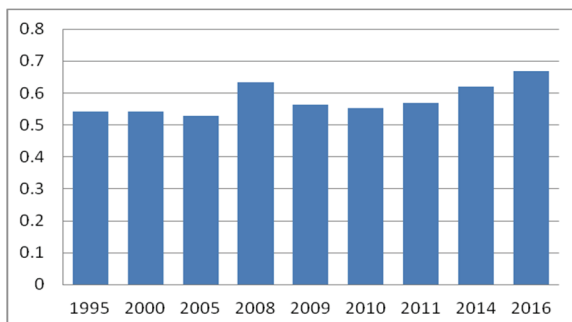


**Source**: Authors' calculation using the WIOD data.

Although gratifying progress can be seen in the above analysis, there is still a certain gap between Korea and industrialized countries such as the United States (Table 1). The United States has seized the opportunity of two industrial revolutions and an information technology revolution. Both are industrial powers. The overall backward participation rate of the manufacturing industry of the two countries is very low. The United States stabilized at about 20%, and Korea was only 5.15% in 1995. , Which has risen in recent years, but is always below 20%. Although the overall backward participation rate of China's manufacturing industry has dropped to 43.18% in 2016, it is still about twice that of the United States and three times that of Korea. It can be seen that China's manufacturing industry is highly dependent on imported intermediate products and foreign added value It accounts for a large proportion of China's total manufacturing exports. However, a high backward participation rate does not mean bad. Cheng (2015) found that China's participation was comprehensively evaluated from three perspectives: intermediate product correlation, value-added correlation, and input-output correlation through cross-border input-output analysis, and the degree and evolutionary trend of the division of labor in the global value chain. The study found that China's relationship with the world as measured by the proportion of foreign value added is increasing, and is higher than the degree measured by the proportion of imported intermediate products. China and the United States, Japan, Korea, China Taiwan and Germany are highly correlated; but from a trend point of view, the degree of correlation between China and the United States and Germany is rising, and the degree of correlation with Japan, Korea, and Taiwan is declining. Most industries in China tend to be from higher-income economies. Importing more value-added also tends to export more value-added to the latter. Most industries in China have a value chain correlation index based on output and input exceeding 1.5. There are far more industries with rising correlation indexes than falling industries. It shows that China has deeply integrated into the global value chain through two channels of output supply and input demand. Liu (2015) obtained a similar conclusion that the foreign value-added rate of high-tech manufacturing exports has risen most significantly after calculation and comparison. From this, we can also see the "lock-in effect" of global value chains on medium and high-tech industries. This is consistent with the research conclusions of other scholars (Wang, 2014; Wang,Du and Zhou, 2012).

In terms of forward participation rates, the United States and Korea are both ahead of developing countries and far higher than China. In 1995, the forward participation rate of

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China's manufacturing industry was only 11.13%, which was far lower than that of the United States and Korea. However, by 2008, the forward participation rate of China's manufacturing industry was already very close to that of the United States. By 2011, China had already completely surpassed the United States and gradually narrowed the gap with Korea, thanks to the increase in the added value of China's manufacturing exports of intermediate goods.

From the perspective of forward participation rate, Korea is lower than that of the United States and China. China's backward participation rate is too high, resulting in a high overall GVC participation rate, which is about 20% higher than that of the United States and Korea. This reflects the global value of manufacturing level of participation in the chain. However, because the higher the backward participation rate, the more it indicates that you are at the low end of the value chain, and the higher the forward participation rate is, the more you are at the high end of the value chain. Combining the performance of China, Korea, and the United States in the overall GVC and the front and back indicators It is not difficult to find that the manufacturing industries of the United States and Korea as a whole are steadily in the upper reaches of the global value chain; China's manufacturing industry as a whole is still in the lower reaches of the global value chain, but there is a tendency to gradually move closer to the upper and middle reaches.

**Table 1**. Changes in GVC Participation Rates in Manufacturing Industries in Korea China and the United States

| Year | | 1995 | 2000 | 2005 | 2008 | 2009 | 2010 | 2011 | 2014 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| Overall backward participation rate $\left(\frac{FV_i}{X_i}\right)$ | China | 0.7234 | 0.7112 | 0.6457 | 0.5983 | 0.5777 | 0.5413 | 0.4916 | 0.4772 | 0.4318 |
| | Korea | 0.0515 | 0.0675 | 0.0967 | 0.1153 | 0.1317 | 0.1503 | 0.1598 | 0.1766 | 0.1889 |
| | USA | 0.1733 | 0.1943 | 0.2092 | 0.2218 | 0.2009 | 0.2128 | 0.2334 | 0.2446 | 0.2517 |
| Overall forward participation rate $IV_{Ii}/x_{-i}$ | China | 0.1113 | 0.1716 | 0.2456 | 0.3009 | 0.3543 | 0.3677 | 0.3754 | 0.3977 | 0.4123 |
| | Korea | 0.4893 | 0.4741 | 0.4317 | 0.5176 | 0.4311 | 0.4035 | 0.4089 | 0.4426 | 0.4788 |
| | USA | 0.2711 | 0.2785 | 0.3092 | 0.3123 | 0.3589 | 0.3685 | 0.3714 | 0.3810 | 0.3923 |
| Overall GVC participation rate $\left(\frac{FV_i}{X_i} + \frac{IV_i}{X_i}\right)$ | China | 0.8347 | 0.8828 | 0.8913 | 0.8992 | 0.9320 | 0.9090 | 0.8670 | 0.8749 | 0.8441 |
| | Korea | 0.5408 | 0.5416 | 0.5284 | 0.6329 | 0.5628 | 0.5538 | 0.5687 | 0.6192 | 0.6677 |
| | USA | 0.4444 | 0.4728 | 0.5184 | 0.5341 | 0.5598 | 0.5813 | 0.6048 | 0.6256 | 0.6440 |
| Overall GVC Position Index | China | -0.2955 | -0.332 | -0.251 | -0.083 | -0.082 | -0.091 | -0.087 | -0.081 | -0.082 |
| | Korea | 0.1833 | 0.0833 | 0.0544 | -0.105 | 0.0314 | 0.0438 | 0.0103 | 0.0217 | 0.0344 |
| | USA | 0.1547 | 0.144 | 0.121 | 0.113 | 0.134 | 0.110 | 0.0998 | 0.0878 | 0.0769 |

### 4.1.2. Measurement and Analysis of the Overall GVC Position Index

Fig. 2 illustrates the result of the impact shows the change in the GVC position index of Korea's manufacturing industry. It can be seen that Korea's position in the GVC in 1995 was relatively high, and it was in the upper reaches of the value chain. After 1995, its position in the value chain continued to decrease, and the decline was large. Dropped from nearly 0.2 in 1995 to about 0 in 2011. This is because Korea is more deeply involved in the international division of labor. The growth rate of foreign value added (FV) in its export trade is greater than that of indirect domestic value added exports (IV). Therefore, the value of the GVC position index continues to decrease. The position of division of labor continues to decline.

As Korea's economy has experienced decades of rapid growth, it has entered a period of transition and adjustment since 1991. During this period, the Korean government not only worked hard to improve the country's technical level and international competitiveness to rejuvenate export trade, but also carried out large-scale operations. Foreign investment seeks new economic growth points, which has led to a high degree of external dependence on the Korean economy. It can also be seen from Figure 2 that the value of Korea's GVC position index has dropped significantly. The impact of the financial crisis in 2008 showed a negative value, which also shows that Korea has a strong dependence on the global value chain. The impact is greater.

**Fig. 2.** Changes in GVC position index of Korean manufacturing

(Unit: GVC position rate)
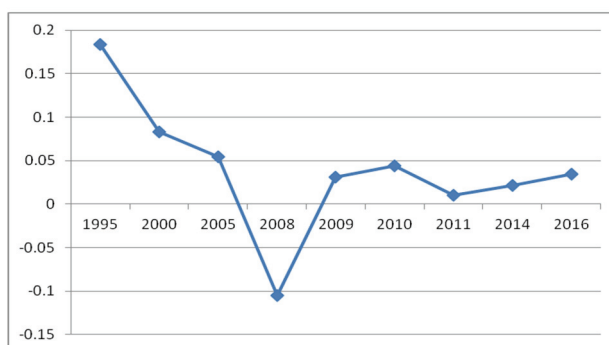


**Source**: Authors' calculation using the WIOD data.

From the perspective of changing trends, the GVC position index of the Korean manufacturing industry showed a downward trend from 1995 to 2008, but rose rapidly after 2008, and was relatively stable after 2008 and gradually approached the axis. In Table1, the overall GVC position index of Korea's manufacturing industry has a very large gap compared with that of the United States. Which sectors have lowered the overall GVC participation rate of Korea's manufacturing industry? Only by calculating the sub-industries below can we make further progress discuss.

## 4.2. Sectoral Measurement of Korea's Manufacturing Value Chain Position

### 4.2.1. Measurement and Analysis of Sector GVC Participation Rate Index

Table 2 shows the result of the impact that the forward participation rate of each sector has shown an increasing trend as the year progresses, which is consistent with the growth trend of the overall forward participation rate of the manufacturing industry. The number in brackets represents the forward participation of the sector in that year. The ranking of the rate in each sector, across the rankings, the same sector's ranking in different years is very stable, indicating that the export value added of each sector accounted for the proportion of its exports are relatively stable. The backward participation rate of each department has different trends over time. The basic metal industry is relatively stable, with small changes, and its backward participation rate has always maintained the smallest value among the six sectors in different years. In the same year, the smaller the number of backward participation rate rankings, the better. Therefore, the three sectors of metal products, machinery and

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equipment manufacturing, electrical machinery and instrument manufacturing are in a higher value chain position than the other three sectors.

Combining the participation rate of the preceding and following items, the three sectors of the metal products industry, machinery and equipment manufacturing, electrical machinery and instrument manufacturing industries have a higher value chain position in the Korean manufacturing industry; the metal products industry is in the middle; computer, electronics, optical equipment manufacturing and electrical The machinery and instrument manufacturing sectors have a low position in the value chain.

**Table 2.** GVC participation rate index of various sectors in Korea's manufacturing industry

| | | 1995 | 2000 | 2005 | 2008 | 2009 | 2010 | 2011 | 2014 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| Manufacture of basic metals | GVC forward participation rate | 0.3012 | 0.3122 | 0.3233 | 0.3089 | 0.3214 | 0.3109 | 0.3345 | 0.3215 | 0.3017 |
| | GVC backward participation rate | 0.2433 | 0.2344 | 0.2634 | 0.2712 | 0.2456 | 0.2546 | 0.2598 | 0.2457 | 0.2678 |
| | GVC participation rate | 0.5445 | 0.5466 | 0.5867 | 0.5801 | 0.567 | 0.5655 | 0.5943 | 0.5672 | 0.5695 |
| Manufacture of fabricated metal products | GVC forward participation rate | 0.3467 | 0.3566 | 0.3423 | 0.3876 | 0.3122 | 0.3023 | 0.3134 | 0.3234 | 0.3357 |
| | GVC backward participation rate | 0.1123 | 0.1234 | 0.1346 | 0.1016 | 0.1578 | 0.1349 | 0.1566 | 0.1766 | 0.1548 |
| | GVC participation rate | 0.459 | 0.48 | 0.4769 | 0.4892 | 0.47 | 0.4372 | 0.47 | 0.5 | 0.4905 |
| Manufacture of electrical equipment | GVC forward participation rate | 0.3033 | 0.3123 | 0.3233 | 0.3378 | 0.3417 | 0.3564 | 0.3561 | 0.3603 | 0.3566 |
| | GVC backward participation rate | 0.1997 | 0.2039 | 0.2138 | 0.2213 | 0.2167 | 0.2209 | 0.2146 | 0.2217 | 0.2155 |
| | GVC participation rate | 0.503 | 0.5162 | 0.5371 | 0.5591 | 0.5584 | 0.5773 | 0.5707 | 0.582 | 0.5721 |
| Manufacture of computer, electronic and optical products | GVC forward participation rate | 0.2633 | 0.2655 | 0.2789 | 0.2897 | 0.3011 | 0.2899 | 0.3018 | 0.3323 | 0.3412 |
| | GVC backward participation rate | 0.2442 | 0.2566 | 0.2678 | 0.2744 | 0.2803 | 0.3011 | 0.3013 | 0.2988 | 0.3012 |
| | GVC participation rate | 0.5075 | 0.5221 | 0.5467 | 0.5641 | 0.5814 | 0.591 | 0.6031 | 0.6311 | 0.6424 |
| Manufacture of machinery and equipment n.e.c. | GVC forward participation rate | 0.2997 | 0.3013 | 0.3323 | 0.3513 | 0.3452 | 0.3245 | 0.3313 | 0.3458 | 0.3516 |
| | GVC backward participation rate | 0.1954 | 0.2009 | 0.2122 | 0.2214 | 0.2342 | 0.2412 | 0.2123 | 0.2311 | 0.2452 |
| | GVC participation rate | 0.4951 | 0.5022 | 0.5445 | 0.5727 | 0.5794 | 0.5657 | 0.5436 | 0.5769 | 0.5968 |
| Manufacture of transport equipment | GVC forward participation rate | 0.2211 | 0.2345 | 0.2588 | 0.2755 | 0.2566 | 0.2435 | 0.2514 | 0.2513 | 0.2677 |
| | GVC backward participation rate | 0.2899 | 0.2845 | 0.2909 | 0.3015 | 0.3246 | 0.3442 | 0.3347 | 0.3415 | 0.3542 |
| | GVC participation rate | 0.511 | 0.519 | 0.5497 | 0.577 | 0.5812 | 0.5877 | 0.5861 | 0.5928 | 0.6219 |

### 4.2.2. Measurement and Analysis of Departmental GVC Position Index

In order to further analyze the phenomenon of the gap between the overall Korean manufacturing industry and the United States and China, the GVC position index of each sector of the manufacturing industry is calculated, and Table 3 shows the result of the impact From 1995 to 2016, the industry's GVC position index is equal, it is a positive value, while most of the years in China are negative, and the rest of the sectors are negative. From the perspective of the Korean manufacturing industry, the machinery and equipment manufacturing industry has the highest GVC position, with an average level greater than 0.05, which is much higher than other industries, and the basic metal industry has the lowest GVC position index. The GVC position index of the basic metal industry was ahead of China at the beginning of the research cycle, but it was lower than that of the United States and China in the later period. By 2011, the GVC index of this industry in China was completely ahead of the United States and China. During the study period, Korea's metal products industry, mechanical equipment manufacturing, computer, electronics, optical equipment manufacturing, and electrical machinery and instrument manufacturing industries have lower GVC indexes than the United States, but higher than China. The transportation equipment manufacturing industry was higher than the United States before 2000, but was surpassed by the United States after 2000, and was surpassed by China after 2008, indicating that the overall level of the industry in Korea is declining, and China has intensified reforms in recent years. Intensified, many related policies have been introduced to promote the development of the industry, and the rapid development surpassed the United States in 2011.

**Table 3.** GVC position index of each sector in Korea

| GVC Position Index | 1995 | 2000 | 2005 | 2008 | 2009 | 2010 | 2011 | 2014 | 2016 |
|---|---|---|---|---|---|---|---|---|---|
| Basic Metal Industry | 0.1433 | 0.0374 | 0.0321 | -0.1507 | 0.0123 | 0.0129 | -0.0321 | -0.0117 | 0.0122 |
| Manufacture of fabricated metal products | 0.1809 | 0.0904 | 0.0567 | -0.1017 | 0.0457 | 0.0435 | 0.0127 | 0.0245 | 0.0432 |
| Manufacture of electrical equipment | 0.1898 | 0.1023 | 0.0619 | -0.0903 | 0.0563 | 0.0519 | 0.0234 | 0.0267 | 0.0453 |
| Manufacture of computer, electronic and optical products | 0.1235 | 0.0453 | 0.0123 | -0.1346 | 0.0154 | 0.0213 | -0.0096 | -0.0077 | 0.0213 |
| Manufacture of machinery and equipment n.e.c. | 0.2034 | 0.0813 | 0.0634 | -0.0654 | 0.0432 | 0.0653 | 0.0218 | 0.0239 | 0,0244 |
| Manufacture of transport equipment | 0.1345 | 0.0654 | 0.0128 | -0.1238 | 0.0235 | 0.0217 | 0.0113 | 0.0104 | 0.0237 |

## 5. Conclusion

By examining the overall participation of the Korean manufacturing industry and the global value chain of various sectors and the division of labor position in the value chain, the following conclusions are drawn:

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(1) The overall GVC participation rate of the Korean manufacturing industry is relatively stable, fluctuating in the range of 50% to 70%. From the perspective of global value chain participation, Korea's participation in the international division of labor is showing a steady upward trend. The 2008 financial crisis increased the participation index of all industries. This proves from the side that the stimulus of the financial crisis will temporarily prevent Korea from gaining global value. The rise in the upper reaches of the chain has increased the participation of Korean GVCs. Korea's participation in the international division of labor is higher than that of China. The empirical results based on the WIOD date find the same results from previous. Korea was participated in GVCs most actively of Countries from 1995 to 2011. Meanwhile, Korean manufacturers also increased their contribution to foreign GVCs by supplying intermediate goods, and accounted for more than the half of the total manufacturing GDP (Chung, 2016).

According to the empirical results, this paper provides some proposed policies. Korean GVC participation has shown a steady upward trend, indicating that Korea's role in the international division of labor has been deepening. At the same time, Korean entry into the Asia-Pacific region enhances Korea-organized GVC by integrating in the Asia-Pacific region's production division networks (Choi, 2019).

(2) The Korean GVC of forward participation rate of each sector has shown an increasing trend as the year progresses, which is consistent with the growth trend of the overall forward participation rate of the manufacturing industry.

The ranking of the same sector in different years is very stable, indicating that the export of each sector proportion of added value in its exports is relatively stable.

The empirical results supported conclusions of the theoretical model. In the Korean GVC of electrical and optical sector, while stronger forward linkages than backward linkages to GVCs are advantageous for an average advanced country, the benefits of downstream tasks are pronounced for non-advanced countries (Kim and Lee, 2020).

The backward participation rate of each department has different trends over time. The Korean GVC of basic metal industry is relatively stable, with small changes, and its backward participation rate has always maintained the smallest value among the six sectors in different years.

In the same year, the smaller the number of backward participation rate rankings, the better. Therefore, the three sectors of metal products, machinery and equipment manufacturing, electrical machinery and instrument manufacturing are in a higher value chain position than the other three sectors. For example, Generally, Electrical and optical and Metals industries happen to be the top cross cutting industries in all East Asian countries (Robert and Jung, 2014).

(3) A comprehensive comparison of the six sectors shows that the "labor-intensive" and "capital-intensive" manufacturing sectors have a significantly higher division of labor in the GVC than the "technology-intensive" sectors.

The GVC position index of the metal products industry, mechanical equipment manufacturing industry, electrical machinery and instrument manufacturing industry is mostly positive in each year and is higher than that of China, far higher than the basic metal industry and transportation equipment manufacturing sector.

For example, In the GVC of metal industry sector, Korea has the highest participation rate followed closely by China and highest GVC position compared to the rest of East Asian countries (Robert and Jung, 2014).

The value of this paper is providing empirical evidence of the effect of Korea's the GVC of manufacturing sectors. The first three have a higher position in the value chain and are in the upper middle and upper reaches of the GVC. The latter two have a low GVC position index, which has become the main sector that pulls down the overall position of Korea's manufacturing industry.

It not only shows that these two sectors are downstream in the global value chain, but also reflects the research and development of these two sectors insufficient innovation capabilities in important links such as design and production of key components.

The empirical results of this article proved the correlation for an index to capture a country's upstream position or downstream position, it makes sense to compare that Korea's exports of intermediates in the same sector that are used by China and USA (Robert and Jung, 2014).

This paper lacks the identification of specific industries that may have positive effects on GVC. Sophisticating estimation strategies of industry specific estima-tion for domestic manufacturing GVC dependent exporting industries would provide more useful empirical evidence to verify the spillover effect of service industries's GVC reorganization. These short comings are postponed to the future research. Due to the limitations of WIOD's international input-output data, the empirical findings do not fully reflect current industrial structure.

For the future studies, WIOD's updated data of the international input-output table and domestic companies' data should be obtained by 2016 and empirical analysis should be further conducted. Furthermore, panel dynamic estimation analysis is required to control cross-sectional time series variations.

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# The Influence of Trade and Foreign Direct Investment on Green Total Factor Productivity: Evidence from China and Korea[*]

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## Abstract

***Purpose*** – This paper intends to conduct theoretical analysis and empirical test on the action mechanism of South Korea-China trade and South Korea's FDI to China on green total factor productivity, so as to provide a new perspective and ideas for the improvement of China's green total factor productivity and promote the high-quality development of China's economy

***Design/methodology*** – This paper uses the data of 30 provinces, autonomous regions and municipalities in China from 2004 to 2017 as the research sample, adopts the GML index method of SBM Directional Distance Function to measure GTFP, and analyzes the influence of South Korea-China trade and FDI from South Korea on China's GTFP.

***Findings*** – Trade is conducive to promoting technological progress, which has a significant promotion effect on China's green total factor productivity. While FDI has a significant inhibitory effect on China's green total factor productivity, which verifies the "pollution haven" hypothesis. In addition, such influence has certain regional overall heterogeneity. Trade has a more significant promoting effect on GTFP in eastern coastal areas, while FDI has a more significant inhibitory effect on GTFP in central and western inland areas. The interaction between trade and FDI is conducive to the improvement of green total factor productivity, indicating that the benign mechanism of trade and FDI has been formed. Urbanization, industrial structure, human resource level and investment in science and technology are all conducive to the improvement of GTFP.

***Originality/value*** – Through theoretical analysis and empirical test on the action mechanism of South Korea-China trade and South Korea's FDI on green total factor productivity, this paper provides a solid theoretical foundation for the further development of China-South Korea economic and trade cooperation in the future.

**Keywords**: Foreign Direct Investment (FDI), Green Total Factor Productivity (GTFP), Korea -China Economy and Trade, Trade
**JEL Classifications**: F18, F40

## 1. Introduction

The report of the 19th National Congress of the Communist Party of China pointed out that "China's economy has changed from the stage of high-speed growth to the stage of high-quality development, and is in the crucial period of transforming the mode of development, optimizing the economic structure and transforming the driving force of growth", and reiterated that "we must adhere to the principle of quality first and efficiency first, and take the structural reform of the supply side as the main line, so as to promote the quality change, efficiency change and dynamic change of economic development, and improve the total factor productivity yield", The word "green" has been highlighted four times, emphasizing that "building ecological civilization is the millennium plan for the sustainable development of the Chinese nation". It fully shows that "supply and demand dislocation" and "transformation of growth mode forced by resource and environment constraints" are two major problems under the new normal situation of China's economy. The 13th Five-Year Plan points out that green is a necessary condition for sustainable development, and the concept of green development is the direction that China must adhere to in the future development process. Total Factor Productivity (TFP), as the engine of sustainable economic development, is crucial to China's economic transformation and upgrading.

However, the traditional calculation method of total factor productivity does not consider the factors of resource waste and environmental pollution. With the highlight of environmental protection in China, many scholars add resource and environmental factors to the traditional total factor productivity, and adopt the Green Total Factor Productivity (GTFP) to measure the level of green high-quality economic development. Under the background of economic globalization, China has been deeply integrated into the global value chain division system, and the promotion of Green Total Factor Productivity has been unable to break away from the global division system with trade and foreign direct investment (FDI) as the main carriers. At present, China is in the critical period of economic transformation, and technological progress is the premise of achieving sustainable economic growth, which is conducive to the transformation of China's economic development into an economic growth model supported by total factor productivity. While a country's technological progress depends on R&D investment and talent cultivation of domestic high-tech industries, foreign innovation activities can also play a direct or indirect role through knowledge spillover. Trade and FDI are the main ways of technology transfer and knowledge spillover among countries, which are conducive to the spillover and diffusion of green technology with the expansion of the scale of opening up, thus promoting the green total factor productivity and realizing green economic development.

After the establishment of diplomatic relations between China and South Korea, bilateral economic and trade cooperation has developed steadily, healthily and rapidly. China is South Korea's largest trading partner, largest export market and largest import source country, and South Korea is China's third largest trading partner. On account of data from the Ministry of Commerce of the People's Republic of China in 2019, the import and export volume of bilateral goods between the South Korea and China was US $284.53 billion, among which the South Korea exported US $173.57 billion to China and imported US $110.96 billion from China. South Korea's trade surplus with China was $62.61 billion. By the end of 2019, South Korea was China's second largest source of foreign investment, with a total of US $82.58 billion in actual investment in China. In 2019, South Korea invested 2,108 projects in China, an increase of 12% over the previous year. And the actual adoption of South Korea's investment reached US $5.54 billion, an increase of 18.7% over the previous year.

So, with a comprehensive consideration of economical and environmental benefits, can

open development and green development be both achieved at the same time? Do South Korea's trade with China and FDI have a positive or negative net effect on China's GTFP? What is the path of action? Is the interaction between trade and FDI conducive to the improvement of green total factor productivity? These problems are worthy of our in-depth study. Therefore, this paper intends to conduct theoretical analysis and empirical test on the action mechanism of South Korea-China trade and South Korea's FDI to China on GTFP, so as to provide a new perspective and thinking for the improvement of China's Green Total Factor Productivity (GTFP) and provide a solid theoretical foundation for the development of China-South Korea economy and trade.

## 2. Literature Review

### 2.1. Research on the Influence of FDI on GTFP

Viewing a quantity of previous researches, it can be concluded that the foreign direct investment is often treated as a control variable to explore its impact on green total factor productivity in the regression model. Due to different samples and time spans as well as methodologies, no consensus has been reached about this proposition.

In terms of technology transfer, Wang and Blomstrom (1992) hold the view that the foreign direct investment can provide the abundant capital, advanced management experience and efficient chain to the host country. Of course, those three will promote enterprises to invest in R&D and technological innovation more. In other words, the foreign direct investment can improve the total factor productivity in the host country. Furthermore, in cooperating with China's regional environmental efficiency, Wang, Wu and Yan (2010) attempt to discuss the impact of foreign direct investment on environmental total factor productivity. Using the panel data across 30 provinces and employing the Tobit model to perform empirical analyses, they find that the foreign direct investment has a significant effect on promoting both environmental efficiency and environmental total factor productivity. With the same sample, Xu and Deng (2012) agree with findings of Wang, Wu and Yan (2010). they believe that the foreign direct investment has a positive effect on environmental total factor productivity.

On the contrary, some relating scholars propose different kinds opinions. Yang and Wang (2016) set China as an example to debate the impact of foreign direct investment on green total factor productivity. Because of regional difference, they find that the foreign direct investment has a negative effect on green total factor productivity in the west area of China. In the following researches, Zhu and Ren (2017) also find that the foreign direct investment has a negative effect on green total factor productivity growth in China. In addition, Rafindadi, Muye and Kaita (2018) conduct a comparative analysis. They figure out that developing countries often do not pay enough attention to the comprehensive ecological improvement so as to develop their economies. However, They also point out that developed countries transfer the production with high pollution to those developing countries. This has a significant environmental pollution effect on host country, which is not beneficial to the promotion of green total factor productivity. Besides, Ren and Lv (2019) find that due to the monopoly effect, absorbing the foreign direct investment poses a negative effect on green total factor productivity.

Furthermore, a number of scholars believe that the foreign direct investment has a time-varying or neutral effect on total factor productivity. Kukulski and Ryan (2011) conduct a discussion about this topic. Via controlling the institutional quality, financial development level, investment level and innovation heterogeneity, their findings indicate that the influence

of foreign direct investment on host country's green total factor productivity is uncertain and time-varying. With another point of view, Li, QI and Li (2016) find that the foreign direct investment can neither promote the green technology progress nor improve the green technology efficiency. That is to say, the foreign direct investment has no effect on green total factor productivity. Moreover, Wang and Wang (2017) conduct the regression analysis on green total factor productivity with a sample of China's service industry. Their results also show that the foreign direct investment has no significant effect on green total factor productivity.

## 2.2. Research on the Impact of Foreign Trade on GTFP.

Except for the impact of foreign direct investment on green total factor productivity, a large quantity of scholars point out that the foreign trade is also an important determinant of total factor productivity. To fully understand how the foreign trade affects the total factor productivity, they attempt to study this proposition from different kinds of aspects. Madsen (2007) treats Organization for Economic Cooperation and Development countries as a sample to discuss the relationship between knowledge import and total factor productivity. Taking use of 135 years of data to conduct empirical analyses, His findings suggest that there is a strong relationship between both of them. Generally speaking, in the past century, 93% of total factor productivity growth is entirely due to knowledge imports. Subsequently, Sun (2008) sets China's manufacturing industry as a research object to analyze the impact of trade openness on total factor productivity. He finds that the trade openness can significantly promote the total factor productivity growth. Moreover, he also finds that the only channel for trade openness to promote the total factor productivity growth is the technology spillover. In addition, Wei (2009) proves the reliability of Sun's results in 2008.

Seen from aspect of both competition and knowledge integration, Wan, Baylisk and Mulder (2015) indicate that the foreign trade is conducive to the total factor productivity through both competition and knowledge integration. As for the same proposition, Huang, Han and Ge (2017) regard the Belt and Road countries as an example to perform an empirical analyses. They believe that in these countries, the trade mode of primary products has forced enterprises to reduce product costs by employing cheap labor and ignoring technological innovation. Therefore, the trade openness has a negative effect on green total factor productivity. Conversely, adopting the same sample, Ji and Xu (2018) find that the trade openness has a positive effect on green total factor productivity incorporating with four other controlling variables such as economic development, infrastructure, financial development and institutional quality. But, With a sample of European countries, Wu, Ge and Xu (2018) also find that a better trade openness can significantly improve the green total factor productivity. Using the spatial panel model, Ho, Wang and Yu (2018) certificate that there is a significant innovation spillover effect on foreign trade, which is conducive to the total factor productivity.

In summary, those previous researches mentioned above have analyzed the impact of foreign direct investment and foreign trade on total factor productivity in different aspects. Compare with those achievements they obtained, we propose some innovations in this paper. First, each data of trade and foreign direct investment from South Korea to China is firstly selected to perform a research due to the great contribution of South Korea's trade to China. Second, the Malmquist Luenberger index of SBM directional distance function is employed to access the green total factor productivity. This index have a better reflection on coordinated development relationship environment and economic growth. Third, this paper not only analyzes the influence mechanism of trade and foreign direct investment on green total factor

productivity, but also tests the influence of trade, foreign direct investment and their interaction term on green total factor productivity. Finally, because of the difference in the level of economic development among different regions in China, this paper will further analyze the impact of trade, foreign direct investment and their interaction term on green total factor productivity among different regions, respectively.

## 3. Methodology

### 3.1. The Action Path of Trade on GTFP

Trade openness has brought about the expansion of market scale and the deepening of professional division of labor, which has injected strong impetus into China's economic growth (Zhang Tong-Bin & Liu Feng-Qi, 2018). Foreign trade enlarges the market scope of Chinese enterprises, which not only enables China to form economies of scale through large-scale commodity export, but also helps to reduce the cost of intermediate products needed by Chinese enterprises, improve the quality of their products, and enhance their production capacity and competitive advantage. At the same time, China's enterprises are faced with the "reverse force" mechanism formed by external pressure, which is conducive to the optimization, innovation, transformation and upgrading of enterprises. Under the background of deepening specialization and division of labor, Chinese enterprises can fully grasp the opportunity of low cost of resources and labor force, improve the efficiency of factor utilization, continue the comparative advantage, and realize the rapid growth of output. Trade opening accelerates the spread of knowledge and technology, which is conducive for Chinese enterprises to learn green and clean technologies from developed countries, reduce environmental pollution in the production process, reduce environmental governance costs, and promote productivity (Li Xiao-Ping & Zhu Zhong-Di, 2004). In addition, with the continuous expansion of the scale of trade opening, the accumulation level of human resource and the technological innovation and imitation ability of enterprises can be improved, which is conducive to the promotion of China's green total factor productivity. Based on the above facts, hypothesis 1 is proposed in this paper.

*H1: Trade is conducive to promoting GTFP.*

Since 2012, China's trade structure has undergone a profound transformation; with a huge trade surplus, a substantial increase in the export of industrial manufacturing, and a high proportion of high pollution, high consumption and resource-based products in the export trade. It has brought great pressure to the environment (Ni Sha, 2018). The environmental effect of trade opening is the result of import and export mutually promoting and offsetting each other. Trade opening makes the geographical distribution of industries significantly different, which further affects the direct effect of trade opening on green development (Lu Fei, Liu Ming-hui, Sun Yuan-yuan, 2018). In terms of regional differences, the eastern coastal region of China has a superior geographical location, convenient transportation facilities, and the government has given a lot of policy support. Therefore, the eastern coastal region enjoys frequent trade activities, which have given birth to a large number of manufacturing enterprises and accelerated its economic development, but at the same time, it has also brought about environmental pollution problems that cannot be ignored. With the enhancement of ecological and environmental protection in China, the eastern coastal areas have accelerated the upgrading of trade structure by virtue of their own economic advantages, thus promoting green development. By contrast, the inland areas in the central and western

regions are not well connected, their foreign trade is underdeveloped, and their industries are mostly resource-intensive. As a result, their industrial structure is upgraded slowly, their trade structure is unreasonable, and their resource consumption and environmental pollution are aggravated, which seriously affect the environmental quality. Therefore, although the expansion of trade opening promotes the upgrading of China's industrial structure, it is not conducive to the improvement of the ecological environment. Especially, the export trade of industrial manufacturing with high pollution and consumption increases the consumption of resources and the emission of pollutants in China, thus exacerbating the environmental pollution. Unreasonable foreign trade structure and huge trade surplus make China's environment face great pressure, which is not conducive to the improvement of GTFP. Considering that the impact of trade on the environment may vary among regions, this paper proposes hypothesis 2.

*H2: The effect of trade on promoting GTFP has regional heterogeneity.*

## 3.2. The Action Path of FDI on GTFP

With the expansion of opening to the outside world and the deepening of international economic integration, China's FDI has achieved sustained and rapid growth. FDI provides rich capital, advanced management experience and efficient production chain for the development of China's national economy (Ma Lijun, 2013), alleviates the shortage of capital in the early stage of China's reform and opening up, and promotes technological R&D and innovation. At the same time, FDI is beneficial to reduce the cost of introducing advanced technologies in China, promotes the flow and application of advanced technologies in China, and brings about technology spillover effect. Moreover, the transnational flow of productive factors optimizes the efficiency of resource allocation and plays a significant role in promoting the rapid development of China's economy. First of all, the introduction of foreign capital can accelerate the flow of domestic and foreign workers, which is conducive to the domestic enterprises to learn, imitate and apply the advanced technology and management experience of foreign enterprises; secondly, FDI enterprises can establish a forward and backward integration with local enterprises in value chain and industrial chain, which is conducive to the knowledge and technology spillover from developed countries or regions to developing countries and/or less developed regions, thus generating vertical technology spillover effect (Wang Hui & Wang Shu-Qiao, 2016).

The "pollution haven" hypothesis has been prevalent in FDI academia. In view of the high cost of environmental pollution, developed countries will transfer some pollution-intensive enterprises to developing countries with lax environmental regulations to reduce the cost of pollution control. While, in order to enhance their competitiveness in attracting foreign investment, developing countries will reduce the level of environmental regulation and introduce some pollution-intensive industries and low-technology industries, which will aggravate environmental pollution and hinder the improvement of green total factor productivity (Cole M A, Elliot R J R, 2006; Nie Fei & Liu Hai-Yun, 2015). The introduction of FDI will also occupy the market share of enterprises in the importing country, and even form monopolies on some industries, hinder the production of local enterprises, hinder the improvement of independent R&D ability of enterprises in the importing country, form technology dependence, and thus have a negative impact on GTFP. The demonstration effect, technology spillover effect and competition effect of foreign direct investment have a certain lag; the environmental pollution problem brought by foreign direct investment has an inertia, which will gradually accumulate over time; in order to develop the regional economy, some

local governments tend to relax environmental regulations, lower environmental standards and blindly attract foreign investment -- these factors may cause damages to the ecological environment (Sang Bai-Chuan & Zhang Cai-Yun, 2018). Therefore, foreign direct investment may play a long-term role in promoting GTFP, but it cannot significantly promote GTFP in the short term. In view of this, hypothesis 3 is proposed in this paper.

*H3: FDI plays a long-term role in promoting green total factor productivity.*

## 4. The Empirical Analysis

### 4.1. Model Setting

In order to verify the research hypothesis, this paper constructs the following basic model:

$$
\ln GTFP_{i,t} = a_{i,t} + \ln FDI_{i,t} + \ln TRADE_{i,t} + \ln FDI_{i,t}*\ln TRADE_{i,t} + \ln URB_{i,t}
$$
$$
+ \ln SEC_{i,t} + \ln HUM_{i,t} + \ln RD_{i,t} + \varepsilon_{i,t}
\tag{1}
$$

Where, subscript i represents region, subscript t represents time; The explained variable is GTFP, while the explanatory variable FDI is South Korea's investment in Chinese provinces and cities, and TRADE is the trade volume between South Korea and China. lnFDI *lnTRADE is the interaction term between trade and investment; URB is the urbanization level; SEC is the level of industrial structure; HUM is manpower development level; RD is the R&D level of science and technology; ε are random disturbance terms.

### 4.2. Variable Selection

#### 4.2.1. Explained Variable: Green Total Factor Productivity (GTFP).

As for the measurement of GTFP, Chung et al. proposed the directional distance function and expanded the Malmquist index into the Malmquist-Luenberger index. In this method, both desirable output increase and undesirable output decrease can be considered. Moreover, SBM directional distance function can solve the problem of input-output insufficiency or non-slack. Therefore, the Malmquist-Luenberger index method based on SBM directional distance function is adopted in this paper to calculate GTFP. Based on the index of GML directional distance function SBM, this index can also be decomposed into technical efficiency change index GEC and technical progress change index GTC, which are as follows:

$$
GML_t^{t+1} = \frac{1 + S_V^G(x^t, y^t, b^t; g)}{1 + S_V^G(x^{t+1}, y^{t+1}, b^{t+1}; g)} = GEC_t^{t+1} \cdot GTC_t^{t+1}
\tag{2}
$$

$$
GEC_t^{t+1} = \frac{1 + S_V^t(x^t, y^t, b^t; g)}{1 + S_V^{t+1}(x^{t+1}, y^{t+1}, b^{t+1}; g)}
\tag{3}
$$

$$
GTC_t^{t+1} = \frac{[1 + S_V^G(x^t, y^t, b^t; g)] / [1 + S_V^t(x^t, y^t, b^t; g)]}{[1 + S_V^G(x^{t+1}, y^{t+1}, b^{t+1}; g)] / [1 + S_V^{t+1}(x^{t+1}, y^{t+1}, b^{t+1}; g)]}
\tag{4}
$$

The index of GML represents the change of t+1phase relative to t phase. If the index is greater than 1, it represents the growth of GTFP. If less than 1, it represents a decrease in

GTFP. If it is equal to 1, it represents that GTFP is in a stable state, and the same rule applies to technological progress and technological efficiency.

Existing literature usually adopts SFA or DEA to measure GTFP. Relatively speaking, DEA has the following advantages: There is no need to set specific production functions and the inclusion of non-expected variables in multiple input variables is allowed. Therefore, under the DEA framework, this paper uses directional distance function (DDF) considering the undesirable output and combines with Global Malmquist-Luenberger productivity index to calculate the GTFP of 30 provinces and cities in China from 2004 to 2017. Here, environmental pollution and energy consumption are incorporated into the total factor productivity accounting framework system, and the Malmquist productivity index method of data envelopment analysis is adopted to measure China's GTFP index.

The selection of input and output indicators is defined as follows: ①Input index, this paper chooses labor, capital and energy as the input index. For labor input, the number of people employed at the end of the year (unit: ten thousand people) in each province is selected as the proxy index to measure labor factors. For capital input, capital stock index is selected to represent it. For the calculation of capital stock, the perpetual inventory method of Shan Haojie (2008) is used for reference to estimate the capital stock (unit: one hundred million yuan) of each province. We take 1978 as the base period, and use the fixed assets price index for the reduction. For energy input, since the energy consumption in the process of economic production includes oil, coal and natural gas, the energy consumption converted by standard coal method (unit: ten thousand tons of standard coal) is used to measure, and energy consumption is regarded as the main source of undesirable output; ②output index mainly includes desirable output and undesirable output. As for the desirable output, the GDP of each province and city (unit: one hundred million yuan) is used to represent the expected output. Taking 1978 as the base period, the GDP reduction index is used to offset the impact of inflation. For the unexpected output, considering that SO2 is a major environmental pollutant and the main object of environmental pollution control in China, the carbon dioxide (unit: ten thousand tons))in each province and urban area is selected as the proxy index of environmental pollution. In addition, the GTFP index is the GTFP change rate relative to the previous year, which cannot be directly used in econometric regression, so it should be transformed accordingly. This paper assumes that the green total factor productivity (GTFP) level in 2004 is 1, and then the GTFP level in 2005 is multiplied by the GTFP index in 2005. By the same process, the GTFP level index of 30 provinces and cities in China from 2004 to 2017 can be obtained.

### 4.2.2. Core Explanatory Variables

South Korean investment in China (FDI). FDI can influence GTFP in various regions through industrial transfer, technology connection and knowledge spillover. In this paper, the foreign direct investment data expressed in US dollars is converted into the annual average exchange rate, and the foreign direct investment (unit: one hundred million RMB) is obtained. On this basis, the logarithm processing is carried out to measure the level of foreign direct investment.

South Korea-China Trade (TRADE). In this paper, the South Korea-China Trade data expressed in US dollars is converted into the average exchange rate of each year to obtain the trade data expressed in RMB, and logarithmic processing is carried out to measure the level of South Korea-China trade.

### 4.2.3. Control Variables

Urbanization level (URB). Urbanization level promotes total factor productivity growth but has threshold effect. The ratio of urban to population is usually used as a measure of urbanization and the logarithm is calculated.

Industrial structure (SEC). Industrial structure upgrading can promote green total factor productivity growth more than energy efficiency improvement. Considering that the secondary industry is the main source of energy consumption and pollution emissions, this paper uses the added value of the secondary industry/gross domestic product of each region to measure the industrial structure, and the logarithm is calculated.

Human resource (HUM). Technical reform and innovation require human resource to realize. The professional skills, experience and knowledge quality of human resource have a significant role in promoting green technology innovation. The average years of education in each region are selected as the proxy variable, and the logarithm is calculated.

R&D investment intensity (RD). The intensity of R&D investment is usually expressed by the proportion of R&D expenditure in regional GDP, which is an important indicator to measure the scale of scientific and technological activities, investment level and innovation capacity of a region. The logarithm is calculated.

### 4.2.4. Data Description

Due to the lack of data, the research sample does not include data from Xizang, Hong Kong, Macao and Taiwan. The sample covers a total of 30 provinces (autonomous regions and municipalities directly under the Central Government), covering a period from 2004 to 2017. The original data are mainly from China Statistical Yearbook, China Business Yearbook, China Labor Statistics Yearbook, the statistical yearbooks of various regions, the website of Ministry of Commerce of China, Korea Trade Association, and The Export- Import Bank of Korea.

**Table 1.** Variables and Data Sources

| Abbreviation | Variable | Data source |
|---|---|---|
| GTFP | the Green Total Factor Productivity assumes that the green total factor productivity (GTFP) level in 2004 =1 | China Statistical Yearbook, the statistical yearbooks of various regions2004 to 2017 |
| FDI | South Korean investment in China | The Export- Import Bank of Korea https://www.koreaexim.go.kr |
| TRADE | South Korea's trade with China's provinces and cities | Korea Trade Association www.kita.net |
| URB | The ratio of urban to population is usually used as a measure of urbanization | China Statistical Yearbook |
| SEC | added value of the secondary industry/gross domestic product of each region to measure the industrial structure | China Statistical Yearbook, the statistical yearbooks of various regions |
| HUM | he average years of education in each region are selected as the proxy variable | the statistical yearbooks of various regions |
| RD | The intensity of R&D investment is usually expressed by the proportion of R&D expenditure in regional GDP | the statistical yearbooks of various regions |

### 4.2.5. Full Sample Regression Results

**Table 2.** Full Sample Regression Results

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| C | -2.805*** | -3.045*** | -3.041*** | -2.799*** |
|  | (-6.972) | (-7.781) | (-7.736) | (-7.161) |
| lnFDI | -0.001* |  | -0.001* |  |
|  | (-1.854) |  | (-1.938) |  |
| lnTRADE |  | 0.035** | 0.036** |  |
|  |  | (2.376) | (2.402) |  |
| lnFDI*lnTRADE |  |  |  | 0.004* |
|  |  |  |  | (1.886) |
| lnURB | 0.658*** | 0.637*** | 0.638*** | 0.668*** |
|  | (7.587) | (7.566) | (7.549) | (7.892) |
| lnSEC | 0.009 | 0.048 | 0.053 | 0.014 |
|  | (0.147) | (0.745) | (0.808) | (0.228) |
| lnHUM | 1.912*** | 2.009*** | 2.007*** | 1.910*** |
|  | (11.981) | (12.955) | (12.889) | (12.295) |
| lnRD | 0.078*** | 0.079*** | 0.078*** | 0.076*** |
|  | (5.750) | (5.942) | (5.792) | (5.762) |
| R2 | 0.880 | 0.883 | 0.882 | 0.885 |
| aj-R2 | 0.869 | 0.872 | 0.871 | 0.875 |

**Note:** The t value in brackets, *, ** and *** indicate that the statistical value is significant at 10%, 5%and 1%, respectively.

Taking 30 provinces, autonomous regions and municipalities as samples, this paper adopts fixed effects regression model to analyze the impact of South Korea's trade with China and FDI on GTFP. The regression results are shown in Table1. Model (1) is the benchmark regression of FDI to GTFP, Model (2) is the benchmark regression of trade to GTFP, Model (3) introduces trade on the basis of model (1) to test the influence of both trade and FDI on GTFP. Model (4) is the benchmark regression of the interaction terms of trade and FDI to GTFP. As can be seen from the regression results of model (2) and model (3), trade has a positive promotion effect on the improvement of GTFP. The regression coefficient is positive and both of them are significant at 5%. Hypothesis 1 is supported, indicating that the net utility of trade between South Korea and China on China's GTFP is positive, and the technology spillover effect, scale effect, human resource effect and competition effect generated by it are effectively released in China. The opening up of trade between South Korea and China is conducive to the introduction of green technologies and the improvement of pollution control. It is conducive to learning advanced management experience and effective production technology from South Korea, promoting technological progress and innovation in China, and thus promoting the improvement of GTFP. Moreover, with the deepening of China's opening to the outside world, the market scale has been further expanded, the efficiency of resource allocation has been improved, and scale economy has been formed,

which is conducive to the realization of green production and improvement of environmental quality.

From the regression results of model (1) and model (3), FDI has a reverse inhibitory effect on GTFP, and the regression coefficient is negative and both are significant at 10%, indicating that FDI has a negative net effect on GTFP, which verifies the "pollution haven" hypothesis. The reasons may lie in the following aspects: First, South Korea has a high level of environmental regulations. Considering the cost of environmental pollution control, these regulations will promote the transfer of polluting industries to developing countries. However, China is still a large developing country with low level of environmental regulation. In the international division of labor, China mainly introduces some FDI with high pollution intensity. This shows that foreign-funded enterprises have occupied a large number of market shares in China, which leads to the reduction of production and the decline of profits of domestic enterprises, and is not conducive to the technological innovation of enterprises in various regions of China; Second, China's digestion and absorption capacity and introduction and re-innovation capacity of advanced technologies from South Korea are insufficient at present, and the technological spillover effect brought by FDI is not effective, thus hindering the improvement of GTFP. It can be seen that FDI plays a long-term role in promoting green total factors, so hypothesis 3 is supported. From the regression results of model (4), the interaction terms of trade openness and FDI have a positive promotion effect on GTFP, and the regression coefficient is positive and significant at 10%, indicating that the expansion of trade weakens the reverse inhibitory effect of FDI on GTFP. The opening of trade has widened the channels of attracting foreign investment in various regions; the diversified demand for foreign capital has enhanced the competitive strength of each region, and has improved the current situation that each region relies on relaxing the level of environmental regulation to attract foreign investment; the improvement of environmental regulation level can effectively release the technology spillover effect and demonstration effect of FDI, which is conducive to promoting technological innovation and progress of enterprises, realizing green production and improving GTFP.

From the regression results of control variables, the impact of urbanization level on GTFP is positive, the regression coefficient is positive, and both of them are significant at the level of 5%. Thus it can be seen that since the reform and opening up, with the gradual release of the three dividends of reform, population and resources, the marginal effect of urbanization characterized by "labor-intensive" and "institutional reform" on improving the efficiency of resource allocation and TFP gradually increases.

The impact of industrial structure on national TFP is positive, but not significant. However, in the regional analysis, the proportion of the secondary industry in GDP in the East has a positive and significant impact on the GTFP at the level of 1%, while the proportion of the secondary industry in the central and western regions has a negative impact on the GTFP at the level of 1%. This is because the eastern coastal cities are relatively developed areas in China, and the secondary industry has gradually changed from high energy consumption and high pollution to low energy consumption and clean new industry, which has the characteristics of low-carbon and environmental-friendly, and can drive economic growth. However, most enterprises in the central and western regions are still in the middle stage of industrialization led by manufacturing industry. The acceleration of industrialization is often accompanied by resource consumption and environmental pollution, which is not conducive to efficiency improvement and technological progress.

The effect of human resource on GTFP is positive. This is similar to the research results of most scholars. In summary, human resource acts on GTFP mainly through three channels:

First, the increase of human resource intensity can squeeze out energy use, reduce energy intensity and improve energy efficiency by changing technology; Second, the improvement of human resource promotes green technology to act on pollution reduction; The effect of human resource on GTFP is significantly positive. Third, the cultivation of human resource improves the production efficiency and learning ability of workers, which is conducive to the learning of foreign advanced technology and management experience, and helps to enhance people's awareness of energy conservation and emission reduction, thus affecting the conditions of energy and environment.

The impact of science and technology input on GTFP is positive, which indicates that the increase of science and technology expenditure of the government can increase the R&D of enterprises, promote production technology innovation, be conducive to scientific and technological progress, and then promote the efficiency of resource allocation.

### 4.2.6. Regional Sample Regression Results

Considering that trade and economic development levels are different in different regions, there may be regional differences in the impact of trade and FDI on GTFP, this paper divides the whole sample into eastern coastal areas and central and western inland areas for empirical analysis, and the results are shown in Table 3 and Table 4. From the regression results of model (2) and model (3), trade has a significant role in promoting the GTFP of the eastern coastal area. From the regression results of model (1) and model (3), the influence coefficient of FDI on GTFP in the eastern coastal area is negative, and has not passed the significance

**Table 3.** The Eastern Coastal Areas Regression Results

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| C | -6.621*** | -6.871*** | -6.579*** | -6.302*** |
| | (-8.149) | (-9.186) | (-8.294) | (-7.296) |
| lnFDI | -0.005 | | -0.014 | |
| | (-0.394) | | (-1.099) | |
| lnTRADE | | 0.115** | 0.137** | |
| | | (2.075) | (2.347) | |
| lnFDI*lnTRADE | | | | 0.007* |
| | | | | (1.912) |
| lnURB | 0.555*** | 0.541*** | 0.517*** | 0.545*** |
| | (3.223) | (3.184) | (3.010) | (3.176) |
| lnSEC | 0.572*** | 0.667*** | 0.714*** | 0.607*** |
| | (3.411) | (3.921) | (4.068) | (3.587) |
| lnHUM | 3.453*** | 3.496*** | 3.381*** | 3.334*** |
| | (11.002) | (12.033) | (10.945) | (10.010) |
| lnRD | 0.111*** | 0.106*** | 0.087*** | 0.103*** |
| | (6.189) | (5.790) | (4.925) | (5.929) |
| R2 | 0.849 | 0.855 | 0.856 | 0.850 |
| aj-R2 | 0.833 | 0.839 | 0.839 | 0.834 |

**Note:** The t value in brackets, *, ** and *** indicate that the statistical value is significant at 10%, 5% and 1%, respectively.

test; FDI has an inhibitory effect on GTFP in the central and western inland regions, while the impact coefficient of trade on GTFP in the central and western inland regions is positive, but it fails the significance test. The reasons may lie in the following aspects: at present, the eastern coastal areas have a relatively high level of economic development and have gathered a large amount of high-quality human resource. Moreover, the trade opening areas are mostly located in the eastern coastal areas, which is conducive to technology spillover effect and thereby promoting the GTFP in the eastern coastal areas. In addition, with the improvement of the level of environmental regulation and the increase of labor costs in the eastern coastal areas, environmental pollution intensive industries begin to transfer to the central and western inland areas, which will increase the environmental pollution pressure in the central and western regions.

Moreover, the level of foreign trade, economic development and science and technology investment in the central and western inland regions are relatively low, which cannot absorb the effects of trade opening and FDI technology spillover. Therefore, FDI is not conducive to the improvement of green total factor productivity in the central and western regions, and hypothesis 2 is verified. It can be seen from the regression results of model (6) and model (8) that the interaction terms of trade opening and FDI have a promoting effect on GTFP in the two regions, indicating that the benign mechanism of trade opening and FDI has been formed.

**Table 4.** The Central and Western Inland Areas Regression Results

| Variables | (5) | (6) | (7) | (8) |
|---|---|---|---|---|
| C | -0.044 | -0.170 | -0.089 | -0.031 |
| | (-0.094) | (-0.362) | (-0.188) | (-0.066) |
| lnFDI | -0.007* | | -0.007* | |
| | (-1.677) | | (-1.694) | |
| lnTRADE | | 0.001 | 0.001 | |
| | | (0.070) | (0.117) | |
| lnFDI*lnTRADE | | | | 0.002* |
| | | | | (1.885) |
| lnURB | 0.969*** | 0.970*** | 0.963*** | 0.970*** |
| | (9.480) | (9.456) | (9.408) | (9.413) |
| lnSEC | -0.909*** | -0.924*** | -0.827*** | -0.896*** |
| | (-7.244) | (-7.297) | (-6.001) | (-6.949) |
| lnHUM | 0.822*** | 0.866*** | 0.839*** | 0.810*** |
| | (4.390) | (4.601) | (4.430) | (4.281) |
| lnRD | 0.055*** | 0.058*** | 0.56*** | 0.049*** |
| | (7.103) | (7.054) | (6.978) | (7.019) |
| R2 | 0.907 | 0.911 | 0.907 | 0.908 |
| AD-R2 | 0.898 | 0.902 | 0.898 | 0.900 |

**Note:** The t value in brackets, *, ** and *** indicate that the statistical value is significant at 10%, 5%and 1%, respectively.

## 5. Conclusion

This paper theoretically analyzes the mechanism of the trade between South Korea and China and South Korea's FDI to China on GTFP. Based on the data of 30 provinces, autonomous regions and municipalities in China from 2004 to 2017, this paper uses the Malmquist -Luenberger index method of SBM directional distance function to measure GTFP, and selects the fixed effect model to empirically analyze the influence of South Korea-China trade and FDI from South Korea on China's GTFP. The result shows that: At the national level, trade between Korea and China has a significant promoting effect on GTFP, while FDI has a significant inhibitory effect on GTFP, and this effect has certain regional heterogeneity. Trade opening has a more significant promoting effect on GTFP in eastern coastal areas, while FDI has a more significant inhibiting effect on GTFP in central and western inland areas. The interaction between trade opening and FDI is conducive to the improvement of GTFP, indicating that a benign mechanism of trade opening and FDI has been formed. Urbanization, industrial structure, human resource and science and technology investment are all conducive to the improvement of GTFP.

Based on the conclusions, this paper proposes the following policy recommendations. In terms of government, First, different regions should formulate different policies of trade opening and foreign investment introduction according to the actual situation. The eastern coastal areas should further expand the trade opening on the original basis. With the increase of labor costs in the eastern coastal areas, the introduction of foreign direct investment should gradually transfer from labor intensive industries to technology intensive industries, so as to give full play to the advantages of FDI. The central and western inland areas should improve the level of environmental regulation, make use of their own advantages to introduce more labor-intensive foreign enterprises, and increase the absorption capacity of green technology.

Second, we should further promote the speed of urbanization process, optimize the industrial structure, material capital and human resource accumulation, improve the ability of independent innovation, promote the digestion and absorption of foreign advanced technology, speed up the research and development of environmental protection technology, and improve the ability to control environmental pollution, so as to realize green development, and accelerate the formation of regional transportation network to promote the flow of production factors among regions.

Taking the firms into account, First, further expanding bilateral trade between South Korea and China and optimizing the import and export structure. We will accelerate the transformation of export trade from a quantitative to a qualitative one, reduce reliance on industries with low added value, high consumption and high pollution, and adopt strict environmental protection and energy consumption standards to force the upgrading of the industrial structure of export trade. In addition, we should expand the import trade of high and new technology, especially increase the import of green and clean technology, actively guide the effective cooperation between China's scientific and technological research and development and green and clean technology, and improve the ability of enterprises to digest, absorb and utilize green and clean technologies, so as to give full play to the positive net effect of trade liberalization on promoting green total factor productivity.

Second, improving the level of environmental regulation and optimizing the FDI introduction mechanism. At present, the introduction of foreign-funded enterprises should pay more attention to quality control. At the same time, we should strengthen the supervision of foreign-funded enterprises. We can also attract high-quality foreign-funded enterprises through preferential tax policies, industrial support funds, government subsidies and other preferential policies, optimize the structure of foreign direct investment, enhance the

absorptive capacity of various regions, and effectively release the technology spillover effect, demonstration effect and competition effect of FDI, so as to realize the positive promotion of FDI to GTFP.

To this end, there some limitations in this paper. For instance, these influences of foreign direct investment and trade in different industries on GTFP are much more different. Due to the data unavailability, no concrete contents about those differences are mentioned in the main body of this paper. Of course, these shortages can provide a good direction for future scholars to re-study this proposition.

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# A Study on the Prediction Model for International Trade Payment Using Logistic Regression[*]

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## Abstract

*Purpose* – Although remittance payment in international trade settlements has played a bigger role in recent years, scant research is being done. This study is to zero in on analyzing determinants of international trade payments focused on remittance by constructing a payment prediction model.
*Design/methodology* – This study categorizes the types of trade payments into advance remittance, post remittance, linked remittance, letter of credit, and mixed payment, and analyzes these after constructing a logit model. For empirical analysis, 147 survey data were collected for export manufacturers in Korea, and binominal logistic regression analysis was used to analyze the type of payment method the exporter chooses for trade transactions.
*Findings* – The likelihood of choosing advance remittance increased as the exporters had non-recovery experiences with payments, and decreased as the market power of importers increased. The possibility of post remittance increased when the export amount was large and the character of the buyer was reliable. In the case of linked remittance, it was highly likely to be selected when payment efficiency was important in trade settlement. In addition, when competition among companies in the global market is intense and market uncertainty is high, the possibility of using a letter of credit decreases. It was also found that the greater the export amount, the greater the possibility of choosing advance remittance, and even if the transaction period was longer, exporters using a letter of credit continued to use it.
*Originality/value* – Despite the high proportion of remittances in international trade settlements, it has been hard to find studies that reflect the practical characteristics of remittances. This study classified the types of remittance into advance remittance, post remittance, and linked remittance, and built a trade payment prediction model by adding a letter of credit and mixed payment. In addition, the originality of this study is recognized in that a logistic model was constructed and meaningful results were derived.

## 1. Introduction

As the points of selection of trade settlement methods between traders shift from traditional risk aversion to a focus on efficiency, the use of remittance settlement is increasing. Trade payment is a field with a conflict between an exporter that prefers pre-payment and an

importer that prefers post-payment to avoid the burden of capital.

It can be said that striking a balance between these two is the letter of credit (hereinafter referred to as L/C) method, but the usage rate is falling considerably due to a variety of reasons.

Accordingly, a new perspective is needed to embrace the changes in trade settlement mechanisms. However, discussions about what payment factors exporters and importers choose for international trade transactions have been conducted based on empirical studies confined to a few researchers (Kim Sung-Soo, 2016; Lee Oun-Yeong and Steve Ha, 2012; Choi Kwang-Ho, 2018; Han Woo-Jung and Cho Hyuk-Soo, 2019). In the case of Korea, remittance and L/C portions were reversed in terms of export payments in 1999, and this trend continued until the end of 2018.

**Fig. 1.** Changes in Export Payment Methods (1997-2018)                    (Unit: %)
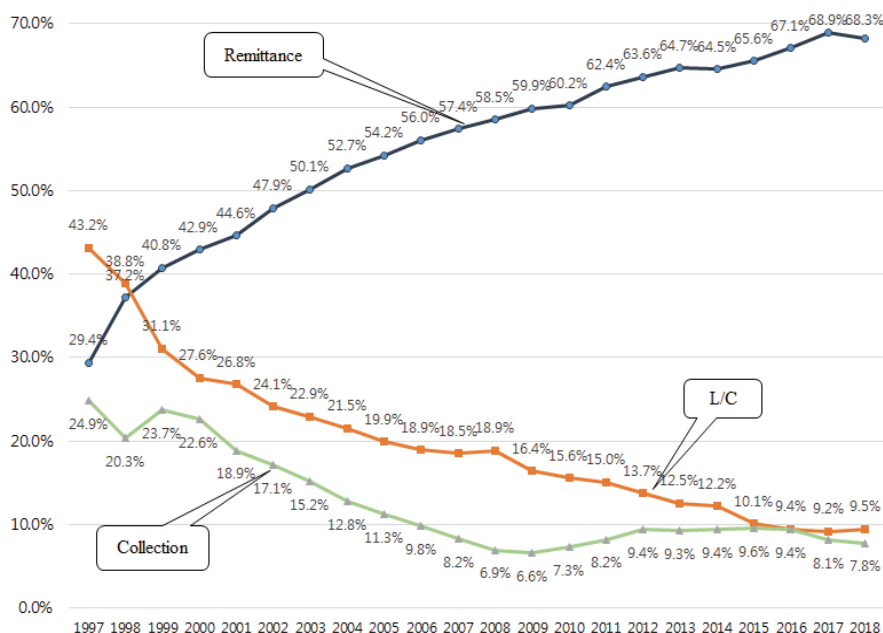


**Source:** Korea International Trade Association, Trade Statistics (http://stat.kita.net/stat).

Looking at remittances, which account for a large part of export payments in Korea, pre- and post-remittance have opposite interests between the exporter and importer, so the mechanism for selecting a payment method is very different. However, it is difficult to find studies that have analyzed these characteristics separately. From this point of view, so as to simplify the discussion and clarify the points of the study, this study attempted to analyze the determinants by dividing the types of remittances in which exporters receive payment from buyers into pre- and post-remittance.

In addition, we tried to analyze the difference in determinants between the single remittance method consisting of 100% advance remittance, 100% post remittance, and the linked remittance, consisting of some pre-remittance and the remainder post remittance.

Furthermore, the L/C payment method was added to the model, and a mixed settlement with remittance and L/C was also analyzed.

Therefore, this study aims to contribute to the creation of new knowledge and academic development in the international trade payment field by demonstrating the difference between the pre-remittance method and post-remittance method, or the difference between the linked remittance method and mixed payment, which has not been demonstrated in the field of trade settlement.

More specifically, the academic contributions of this study are as follows. First, although the linked remittance method and mixed payment are widely used in practice, they have not been considered in trade payment research.

Therefore, by constructing a research model that includes all, the perspective of international trade payment research is expanding.

Second, by constructing a logistic regression model that realistically reflects the selective situation of exporters and deriving meaningful research results, the study provides an empirical foundation that is helpful for subsequent research.

In general, it is said that export companies frequently use an L/C when conducting trade transactions for the first time, and then switch to a remittance method in consideration of efficiency. However, it seems that these facts, which have been solidified, have not been proved through empirical study. With respect to this, the study empirically verifies whether an exporter prefers an L/C payment to avoid risk when the export amount is large, and whether it is naturally converted to a method that emphasizes efficiency such as remittance when the trade transaction period is prolonged. Some research topics related to international trade payment will be scientifically examined through this empirical research.

## 2. Literature Review

When studies related to international trade settlements are divided into literature studies and empirical studies, literature studies centering on the legal principle of the L/C occupy a majority in trade settlements (Kim Sang-Man, 2018; Kim Sun-Ok, 2018; Song Kyung-Sook and Chae Hun, 2016; Chung Yong-Kyun and Jeong Jae-Yeon, 2015; Lee Dae-Woo, 2008).

However, in recent years, as payment methods have changed and the proportion of remittances increases, studies to manage the risk of remittances are emerging (Han Woo-Jung and Cho Hyuk-Soo, 2019). In addition, it was found that a number of studies on TSU/BPO are being conducted as an alternative to overcome the limitations of the L/C (Park Suk-Jae and Chun Hong-Chul, 2017; Yu Kwang-Hyun and Sim Sang-Mok, 2017; Joo Hye-Young and Yoo Byoung-Boo, 2018; Chae Jin-Ik, 2011).

In addition, in the case of empirical analysis, most of the three representative payment methods, such as L/C, collection, and remittance, are mainly used to analyze determinants. Kim Sung-Soo (2016) investigated eight determinants that influenced the choice of international trade settlement after dividing international trade payments into remittances and L/Cs in a study of small and medium-sized importers in Korea. Here, eight determinants include commodities, organizational factors, trade amounts, trade contracts, internal company factor, trade term factor, transaction type factor, and partner company factors.

Lee Oun-Yeong and Steve Ha (2012) analyzed the settlement risk management practices of export companies with post-remittance conditions. In other words, by assuming variables such as export orientation and settlement risk management level, the relationship with risk management performance was found through structural equation modeling. Han Woo-Jung and Cho Hyuk-Soo (2019) also found that company payment risks were also increasing as

the proportion of remittance payment methods has recently increased. Their research analyzed how settlement risk was affected by corporate factors, contract factors, and external factors.

When reviewing prior studies, they can be largely divided into the following characteristics: exporters, transaction characteristics, market characteristics, and the characteristics of importers as the preceding factors that affect the settlement of trade payments. Here, the characteristics of exporters refer to size, type of business, export experience, and so on that affect the settlement of trade payments (Shin Seung-Kwan, 2001; Lee Yong-Keun and Park Chong-Suk, 2003; Choi Kwang-Ho, 2018). Transaction characteristics mean the specificity of the transaction between the exporter and the importer, and can be classified into the export amount , settlement efficiency, reliability of buyers, and experience with non-recovery (Choi Seok-Beom, et al., 2007; Choi Kwang-Ho, 2018).

Market characteristics are the competitive characteristics and uncertainties of the market, which can influence exporter choices of trade settlement (Cho Young-Chul, 2010; Choi Kwang-Ho 2018). Also, trade payment is greatly affected by the characteristics of the importer (Lee Yong-Keun and Park Chong-Suk, 2003).

Therefore, these were assumed as determinants influencing the selection of trade settlement. In addition, when looking at the type of trade settlement, a dependent variable, in the remittance sector, if the importer makes a trade settlement, the payment can be made either by 100% pre-remittance or 100% post-remittance. In practice, there are many cases in which pre- and post-remittance are linked in a way that the remainder is post-remittance.

As such, research that reflects this practice is needed. Furthermore, except for a study by Kim Sung-Soo (2016), there is a need to escape from the perspective of research conducted somewhat uniformly based on a linear model in regression analysis. In the meantime, studies approaching from this perspective through empirical studies in the field of trade settlement are very hard to find.

This study subdivides international trade payment type, dependent variable, focused on remittance type, and categorizes it into advance remittance, post remittance, linked remittance, L/C, and mixed payment, and applies a binominal logit model as a realistic analysis method for analysis.

The goal of the study is differentiated from the prior studies in that it not only deepens the viewpoint of existing studies, it also expands the methodological viewpoint of related research fields.

Moreover, given that the common mixed payment is a combination of a L/C and remittance (T/T) (Lee Jung-Sun and Kim Cheol-Ho, 2016), this study intends to refer to the case where pre- and post-remittance occur together as a linked remittance method.

From an academic point of view, this study also tried to provide implications by empirically investigating whether the terms of credit are generally used when the export amount is large, and whether such terms of credit decrease as the transaction period with the importer increases. As discussed above, so as to overcome the limitations of previous research and propose a new research perspective, the following research topics are set.

*Research Topic 1: What variables affect the exporter's selection of trade payment method of pre-remittance, post-remittance, linked remittance, L/C, and mixed payment method?*

*Research Topic 2: In selecting a payment method, will an exporter prefer a safer transaction, such as an L/C when the export amount is large, and avoid an L/C as the transaction period increases?*
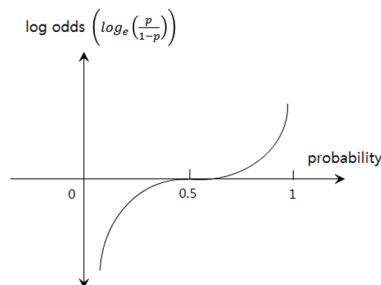
## 3. Methodology

### 3.1. Logistic Regression

The relationship between variables occurring in social phenomena is preferably expressed as a linear relationship: that is, a linear equation. This is because it is desirable in terms of ensuring the simplicity of the model (parsimony) and allows intuitive understanding. Here, when the independent variable and the dependent variable are continuous variables, there is no particular problem in setting up the model with this linear equation, but when the dependent variable is a binominal variable, the problem becomes somewhat complicated. Namely, when considering the dependent variable of home ownership, it is difficult to estimate the interval here because it exists only as a binary variable of having a house or not. Accordingly, it becomes impossible to solve with a linear equation whether or not such a house is owned by any preceding variables. Therefore, it is possible to convert the dependent variable into a probability for use, but this also has a problem as it may result in the possibility that the estimated probability in the linear equation exceeds 100%. That is to say, when calculated using a linear equation, the probability of owning a house can be 120%. Therefore, in order to solve this problem, a data conversion process called odd is needed. While probability is the chance of occurrence of an event compared to the total (p/1), odds represent the number of occurrences versus the number of non-occurrences (p/1-p).

The ratio of the probability of occurrence between different groups is also calculated through the odds ratio (Peng et al., 2002). As such, in logistic regression analysis, the odds ratio is calculated rather than the commonly calculated probability. This is because probability exists only between 0 and 1, whereas when the odds ratio is calculated, the range of the dependent variable becomes a value from 0 to infinity, and the range of the dependent variable expands to the entire real interval, and this enables us to estimate the regression model. The odds ratio, which is a value compared to other groups, has a more realistic meaning. In other words, in order to understand which variables have an important influence on the remittance payment method, it becomes clear by comparing the influence of these variables on payment methods other than remittance. In statistics, log transformation is performed to apply the dependent variable obtained by odds to regression analysis (Hair et al., 2006) because the interval converted to odds appears as 0 and infinity ($0 \leq odds \leq \infty$). Therefore, regression analysis becomes possible only when there is no negative number in the interval converted to odds, and the problems that appear in a nonlinear form are solved. For instance,

$$Logit_i = \ln\left(\frac{prob_{event}}{1 - prob_{event}}\right) = b_0 + b_1 x_1 + \cdots + b_n x_n.$$

This logit transformation enables data to stabilize linearly, and the range of the dependent variable exists from negative infinity to positive infinity. Thus, when the probability is 0, the log odds value becomes -∞, and when the probability becomes 1, the log odds value is+∞ (see Fig. 2).

Meanwhile, the fit of the logistic regression model is analyzed through a log likelihood ratio test. That is, the difference in the likelihood ratio of the model when there is no independent variable, the likelihood ratio when the independent variable is input is used as the test statistic, and a hypothesis test is performed based on the $\chi^2$ distribution (Hair et al., 1998). Also, the -2LL value of the test statistic always has a positive (+) value and follows a $\chi^2$ distribution with the number of independent variables as degrees of freedom. -2LL becomes a better model as it approaches '0'.

**Fig. 2.** Relationship between Probability and Log Odds



**Source:** Lee, Hun-Young (2019), Research Methodology, p. 701.

The fitness of logistic regression analysis can also be tested through the Hosmer & Lemeshow test (Peng et al., 2002), and it tests whether there is a difference between the actual value and the predicted value. Therefore, the goodness of fit can be judged only when the model shows no difference between the predicted result of the dependent variable and the actual category of the dependent variable.

However, since the value of the H-L index is very unstable depending on the number of samples, it is problematic to judge the model fit with only the H-L index. The method of interpreting the effect of logistic regression coefficient and odds ratio is shown in Table 1.

**Table 1.** Interpretation of Effects

| Logistic Regression Coefficient | Exp(b) | Effect on Odds |
|---|---|---|
| b > 0 | Exp(b) > 1 | Positive effect |
| b = 0 | Exp(b) = 1 | No effect |
| b < 0 | 0 < Exp(b) < 1 | Negative effect |

## 3.2. Study Model

This study extracted antecedents that influenced the exporter's choice of payment through a literature review. In addition, we tried to find how these antecedents affected the exporters' choice of payment method of remittance, linked remittance, L/C, and mixed payment through logistic regression analysis. For this, a binominal logistic model was constructed, and its contents are shown in Fig. 3.

**Fig. 3.** Prediction Model

$$log_e \left( \frac{p_i(y_i=1)}{1-p_i(y_i=1)} \right) = \beta_0 + \beta_1 (Size_i) + \beta_2(Category_i) + \beta_3(Experience_i) +$$
$$\beta_4(Standard\ of\ Payment_i) + \beta_5(Payment\ Efficienty_i) +$$
$$\beta_6(Buyer\ Trust_i) + \beta_7(Unrecovered\ Experience_i) +$$
$$\beta_8(Technlogical\ Capabilities_i) + \beta_9(Competitive\ Environment_i) +$$
$$\beta_{10}(Buyer\ Character_i) + \beta_{11}(Market\ Power_i)\ .$$

In addition, through this logit model, the probability of occurrence of an event can be estimated as follows. In other words, when

$z_i = \sum_{m=0}^{M} \beta_m x_{im} = \beta_0 + \beta_1 x_{i1} + \cdots + \beta_M x_{iM}$, $\frac{p_i(y_i=1)}{1-p_i(y_i=1)} = e^{z_i}$, $p_i(y_i = 1) = e^{z_i} - e^{z_i} \cdot p_i(y_i = 1)$, it becomes $p_i(y_i = 1) = \frac{e^{z_i}}{1+e^{z_i}} = \frac{1}{1+e^{-z_i}}$.

As such, through equation, $p_i(y_i = 1) = \frac{1}{1+e^{-(\beta_0+\beta_1+\beta_2+\beta_3+\beta_4+\beta_5+\beta_6+\beta_7+\beta_8+\beta_9+\beta_{10}+\beta_{11})}}$, we can estimate the probability of the occurrence of an event.

### 3.3. Measurement of Variables

In this study, on the basis of prior studies, factors that can influence export company selection of trade payments are classified into exporter characteristics, transaction characteristics, market characteristics, and importer characteristics.

Measurement items that constitute these antecedents and sources are presented as follows.

#### 3.3.1. Export Characteristics

In this study, characteristics of exporters were measured in terms of company size, industry type, and export experience. According to Lee Yong-Keun and Park Chong-Suk (2003), in international trade settlements, a company's industry type or export experience is an important factor affecting settlement method. Here, industry was divided into ① raw materials and processed goods and ② semi-finished products and finished products, and export experience was classified into ① 5 years or less, ② 6-15 years, and ③ 16 years or more. In addition, size of a company is highly likely to affect payment method as it affects the funding capacity of the exporting company and bargaining power (Huh Eun-Soog, 1996; Shin Seung-Kwan, 2001; Choi Kwang-Ho, 2018).

Company size was divided into ① small enterprise and ② medium enterprise and above. In general, employees know the size of their company, so they asked whether their company was small or large. The characteristics of exporters consist of a nominal scale, and dummy variables were processed for later analysis.

#### 3.3.2. Transaction Characteristics

The characteristics of trade transactions are known as a major determinant influencing international trade payment (Eom Kwang-Yeol and Shin Seung-Man, 2003; Choi Seok-Beom et al., 2007; Choi Kwang-Ho, 2013). In this study, ① export amount and settlement criteria, ② payment efficiency, ③ reliability for buyers, and ④ unrecoverable experience were assumed as items of transaction characteristics.

The scale for measuring the above is a Likert-type 5-point scale (1 point = Not at all, 3 points = Moderately, 5 points = Extremely).

#### 3.3.3. Market Characteristics

The characteristics of the global market are also a major variable affecting trade settlement (Chang Dong-Han and Kim Byung-Sun, 2001; Cho Young-Chul, 2010; Choi Kwang-Ho, 2018). In this study, ① the technological capabilities of export companies and ② the competitive environment of the global market were selected as sub-factors of market characteristics. For example, the better the technological competency of the exporter, the more favorable the payment terms for the exporter. Also, the scale for measuring is a Likert-type 5-point scale (1 point = Not at all, 3 points = Moderately, 5 points = Extremely).

### 3.3.4. Import Characteristics

The characteristics of the importer also have a major influence on an international trade payment (Lee Yong-Keun and Park Chong-Suk, 2003). In this study, ① the characteristics of the importer and ② market power of the importer were organized into the sub-dimensions of the characteristics of the importer. For example, the stronger the market power of the importer, the more likely it is that post-payment conditions that are favorable to the importer will be presented.

The scale for measuring the above is a Likert-type 5-point scale (1 point = Not at all, 3 points = Moderately, 5 points = Extremely).

### 3.3.5. Payment Type

In this study, we categorized payment type, a dependent variable, into 5 payment terms: ① 100% pre-remittance before shipment, ② 100% post-remittance after shipment, ③ linked remittance between pre- and post-remittance, ④ L/C, and ⑤ mixed payment of pre-remittance and L/C. Recently, remittance payments account for 60-70% of export payments, but there are few prior studies that have studied payment methods by specifically categorizing remittance payment methods in international trade payments. Therefore, from the results of this study, it is believed that the results will provide specific implications for trade settlement, focusing on the remittance settlement method.

For this measurement, when exporting companies received export payments for the past two years, the most used payment methods were answered in first and second order, and both single response or multiple responses were made possible.

## 4. Research Method

### 4.1. Pilot Study

Before conducting this survey, a pilot test was conducted by selecting 10 exporters located in Seoul. We visited the relevant companies in person or called to explain the purpose of the study, and asked for comments on questionnaires that were not understood or uncertain.

Through this process, it was checked whether a problem occurred in the content validity of the questionnaire, and the final questionnaire was prepared by supplementing the problem. In addition, companies that had undergone pilot tests were excluded in the final survey .

### 4.2. Data Collection

In this study, to collect the payment data of export companies, we used the 2013 Korean Business Directory CD Ver 1.0 published by the Korea Chamber of Commerce and Industry. This data not only can extract various occupational groups but also includes addresses, phone numbers, homepages, and major industries of export companies. In addition, this study used stratified sampling to extract samples.

Stratified sampling is a method of dividing a population into two or more homogeneous layers according to a certain criterion, and extracting samples using simple randomization or accounting extraction for each layer (Kim Gu, 2011). This method of extraction, for example, can select a sample by the random selection proportional to the size of Industry A in extracting the type of business of an exporter, and the sample can also be randomly extracted in proportion to the size of Industry B. It was considered that the subjectivity of a researcher

can be excluded, and that important groups can be included in the sample without omission. From this point of view, the study extracted samples mainly from export companies located in Seoul.

The data collection period lasted about 3 months from April 1 to June 30, 2020.

During the period, a total of 300 surveys were distributed through e-mail, and direct visits were also made. Thereafter, 159 copies were recovered (a recovery rate of 53.0%), of which 12 copies with poor responses or errors were excluded, resulting in a total of 147 valid samples.

## 4.3. Analysis Tools

In this study, frequency analysis, reliability analysis, and exploratory factor analysis were performed using the SPSS 26.0 statistical program. In addition, the type of trade settlement, a dependent variable, was classified into advance remittance, post-remittance, linked remittance, L/C, and mixed payment, which have been recently highly utilized. Here, since the dependent variable becomes a dichotomous variable, logistic regression analysis was used. As an example of advance remittance, the probability of occurrence of pre-remittance and the probability of it not occurring were calculated according to the characteristics of transaction, market, exporter, and importer.

# 5. Results

## 5.1. Sample Characteristics

As for the size of the companies, small businesses were the largest at 113 (76.9%), and annual sales of less than 100 million to KRW 100 million were found for 59 companies (40.1%). In addition, as for industry, 66 companies in electronics and machinery account for 44.8%. As for export type, direct export was the largest with 79 companies (53.7%), and overseas export experience was found to be largest at 6-10 years (52 companies, 35.4%). See Table 2 for more specific details.

**Table 2.** Sample Characteristics

| Criteria | Frequency (n=147) | Percentage (%) |
|---|---|---|
| **Size of Firm** | | |
| Small businesses | 113 | 76.9 |
| Medium-sized enterprises | 25 | 17.0 |
| Large companies | 9 | 6.1 |
| **Annual Sales (₩)** | | |
| Less than 100 million won | 46 | 31.3 |
| 100 million won to 1 billion won | 59 | 40.1 |
| 1 billion won to less than 5 billion won | 28 | 19.0 |
| 5 billion won to less than 10 billion won | 5 | 3.5 |
| More than 10 billion won | 9 | 6.1 |
| **Industry Classification** | | |
| Consumer goods industry | 43 | 29.3 |
| Basic industrial goods industry | 38 | 25.9 |
| Electronic and machinery industry | 66 | 44.8 |

**Table 2.** (Continued)

| Criteria | Frequency (n=147) | Percentage (%) |
|---|---|---|
| ***Form of Export Contract*** | | |
| Direct export | 79 | 53.7 |
| Inter-branch transaction | 18 | 12.2 |
| Processing deal (OEM) | 5 | 3.4 |
| Consignment export trade | 6 | 4.1 |
| Agency | 8 | 5.4 |
| Rental export | 3 | 2.0 |
| Intermediate trade | 5 | 3.4 |
| Etc. | 23 | 15.6 |
| ***Overseas Experience*** | | |
| Less than 5 years | 28 | 19.0 |
| 6 to 10 years | 52 | 35.4 |
| 11 to 15 years | 35 | 23.8 |
| More than 15 years | 32 | 21.8 |
| ***Form of Export Goods*** | | |
| Raw materials | 35 | 23.8 |
| Components and processed goods | 23 | 15.6 |
| Semi-finished products | 22 | 15.0 |
| Finished products | 51 | 34.7 |
| Etc. | 16 | 10.9 |

## 5.2. Exploratory Factor Analysis Results

An exploratory factor analysis was conducted to find whether the sub-elements of transaction characteristics, market characteristics, and importer characteristics, which are the main research constructs of this study, are grouped as expected. Principal Component Analysis was used for the factor extraction method, and according to the theoretical basis, the number of factors was designated as payment criteria, settlement efficiency, buyer reliability, and unrecovered experience. Varimax Rotation, which is a right angle rotation method, was used for clear analysis between factors. First, as a result of factor analysis of transaction characteristics, four sub-elements that were the same as expected were found (see Table 3). Factor loading values all exceeded 0.7, showing a high level of convergence validity.

**Table 3.** Transaction Characteristics

| Construct | Item | Varimax-Rotated Loadings | | | |
|---|---|---|---|---|---|
| | | Factor1 | Factor2 | Factor3 | Factor4 |
| Standard of Payment | One-time Export Volume | **.824** | -.015 | .091 | .072 |
| | Criteria for Payment Choice | **.704** | .149 | .014 | .024 |
| Payment Efficiency | Efficient Export Settlement | -.097 | **.871** | .094 | .127 |
| | Easy Trading | .248 | **.821** | .117 | -.025 |

**Table 3.** (Continued)

| Construct | Item | Varimax-Rotated Loadings | | | |
|-----------|------|----------|----------|----------|----------|
| | | Factor1 | Factor2 | Factor3 | Factor4 |
| Buyer Trust | Long Trading Period | -.116 | .032 | **.706** | .341 |
| | High Credit Rating of Buyers | .261 | .130 | **.720** | .249 |
| | Buyer's Payment Practices | .250 | .014 | **.815** | .144 |
| Unrecovered Experience | Uncollected Export Amount | -.029 | .092 | .039 | **.863** |
| | Other Firms' Case of Uncollected Export Amount | -.078 | .113 | .127 | **.860** |

In the same way, factor analysis was conducted on market characteristics, and as expected, sub-factors were found in the two dimensions of technical competence and competitive environment. In addition, it has a high level of convergence validity as it exceeds all of 0.7 or more (see Table 4).

**Table 4.** Market Characteristic

| Construct | Item | Varimax-Rotated Loadings | |
|-----------|------|----------|----------|
| | | Factor1 | Factor2 |
| Technological Capabilities | Recognized Technology | **.880** | -.001 |
| | High-Quality Products | **.872** | .021 |
| | High Brand Value | **.764** | .245 |
| Competitive Environment | Heavy Competition | .037 | **.843** |
| | Market Uncertainty | .167 | **.819** |

Finally, the results of factor analysis of importer characteristics are shown in Table 5. As expected, it was divided into two sub-dimensions, buyer character and buyer market power, and convergence validity is supported at a high level.

**Table 5.** Importer Characteristics

| Construct | Item | Varimax-Rotated Loadings | |
|-----------|------|----------|----------|
| | | Factor1 | Factor2 |
| Buyer Character | Buyer's Size | **.791** | .271 |
| | Unpaid Risk | **.751** | .086 |
| | Buyer's Integrity | **.712** | .006 |
| Market Power | Buyer's Request for Change of Payment Method | .186 | **.847** |
| | Change of Existing Trading Conditions | .130 | **.843** |
| | Buyer's High Bargaining Power | .166 | **.745** |

As described above, it can be seen that the concepts of this study, such as transaction characteristics, market characteristics, and importer characteristics, all constitute the sub-dimensions as expected. The characteristics of exporters consisted of nominal scales such as company size and industry, and were excluded from factor analysis.

## 5.3. Logistic Regression Results

First, looking at the results of the fitness of the model with pre-remittance as a dependent variable, the -2LL difference between the model without the independent variable and the model with the independent variable was 31.741.

When the degree of freedom was 12 in the $\chi^2$ distribution, the probability of significance was 0.002, and this difference is statistically significant. In other words, it can be confirmed that the explanatory power of the dependent variable was significantly increased by the input of the independent variable. The -2LL value was 705.216, Cox & Snell's $R^2 = 0.053$, and Nagelkerke's $R^2 = 0.074$. The variable affecting the advance remittance was interpreted as Exp(B) as follows. First, in terms of the size of the company, the probability of a medium-sized or larger company receiving payment by advance remittance was 1.449 times higher than that of a small company.

Manufacturers with more than 21 years of export experience were also less likely to receive advance remittance payments by 0.614 times than those with less than 10 years of export experience. However, these effects were not found to be significant at the 5% significance level, so they did not receive statistical support. In addition, the higher the experience of non-recovery of the exporter, the more likely it was that the possibility of payment by advance remittance was 1.244 times higher than that of other payment options. Moreover, the better the buyer's character, a 1.655 times increase in the likelihood that the exporter will receive payment by pre-remittance occurred.

When market power is on the side of the importer, the possibility of advance remittance decreased by 0.704 times. Namely, if the importer had strong market power, the possibility of advance remittance was reduced to some extent. Next, as for the model fit of post remittance, the -2LL difference between the model without the independent variable and the model with the independent variable was 104.119. This difference is statistically significant with a significance probability of 0.000 when the degrees of freedom were 12 in the $\chi^2$ distribution. Also, it can be seen that the explanatory power of the dependent variable significantly increased as the independent variable was introduced. The -2LL value was 659.965, Cox & Snell's $R^2 = 0.162$, and Nagelkerke's $R^2 = 0.223$.

Here, it was found that the probability of receiving payment by post remittance was 1.642 times higher than that of small companies when the size of export company was larger than medium. In addition, the likelihood of payment through post remittance from companies that produce semi-finished and finished products increased by 1.918 times over raw materials or processed products. It was also shown that the likelihood that a company with 11-20 years of export experience will receive payment by post remittance was 3.449 times higher than that of a company with less than 10 years.

In the case of export companies with established payment criteria, the likelihood of post remittance increased by 1.384 times compared to other payment terms, and the possibility of post remittance increased by 1.655 times as the buyer's characteristics were better. On top of this, it was confirmed that the higher the market power of the importer, the higher the possibility of post remittance by 1.348 times, but it was not significant at a significance level of 5%.

**Table 6.** Logistic Regression Analysis on Remittance

| Payment Type | Predictor | B | S.E. | Wald | d.f | p | Exp(B) |
|---|---|---|---|---|---|---|---|
| Advance Remittance | Size_Dum | .371 | .221 | 2.811 | 1 | .094 | 1.449 |
| | Category_Dum | -.116 | .195 | .356 | 1 | .551 | .890 |
| | Experience_Dum1 | -.342 | .256 | 1.777 | 1 | .182 | .711 |
| | Experience_Dum2 | -.488 | .275 | 3.148 | 1 | .076 | .614 |
| | Standard of Payment | -.159 | .141 | 1.261 | 1 | .261 | .853 |
| | Payment Efficiency | .215 | .125 | 2.981 | 1 | .084 | 1.240 |
| | Buyer Trust | .015 | .169 | .008 | 1 | .928 | 1.015 |
| | Unrecovered Experience | .219 | .111 | 3.859 | 1 | .049 | 1.244 |
| | Technological Capabilities | -.095 | .146 | .418 | 1 | .518 | .910 |
| | Competitive Environment | -.130 | .128 | 1.018 | 1 | .313 | .878 |
| | Buyer Character | .504 | .149 | 11.471 | 1 | .001 | 1.655 |
| | Market Power | -.351 | .144 | 5.972 | 1 | .015 | .704 |
| | Constant | 1.098 | .963 | 1.300 | 1 | .254 | .333 |
| Later Remittance | Size_Dum | .496 | .222 | 4.975 | 1 | .026 | 1.642 |
| | Category_Dum | .651 | .202 | 10.419 | 1 | .001 | 1.918 |
| | Experience_Dum1 | 1.238 | .301 | 16.895 | 1 | .000 | 3.449 |
| | Experience_Dum2 | .318 | .317 | 1.003 | 1 | .317 | 1.374 |
| | Standard of Payment | .325 | .155 | 4.378 | 1 | .036 | 1.384 |
| | Payment Efficiency | .151 | .135 | 1.261 | 1 | .262 | 1.163 |
| | Buyer Trust | .307 | .178 | 2.963 | 1 | .085 | 1.359 |
| | Unrecovered Experience | .138 | .112 | 1.510 | 1 | .219 | 1.148 |
| | Technological Capabilities | .278 | .155 | 3.208 | 1 | .073 | 1.321 |
| | Competitive Environment | .034 | .132 | .068 | 1 | .795 | 1.035 |
| | Buyer Character | .504 | .154 | 10.759 | 1 | .001 | 1.655 |
| | Market Power | .298 | .158 | 3.549 | 1 | .060 | 1.348 |
| | Constant | 8.941 | 1.190 | 56.440 | 1 | .000 | .000 |

**Notes:** Dum means Dummy Variable.

Next, in the model fitness of the linked remittance linking pre-remittance and post-remittance, the -2LL difference between the model without the independent variable and the model with the independent variable was 77.922; when the degree of freedom was 12 in the $\chi^2$ distribution, the significance probability was 0.000. The difference is also statistically significant. In other words, it can be seen that the explanatory power of the dependent variable was significantly increased by the input of the independent variable. The -2LL value

is 737.192, Cox & Snell's $R^2$ = 0.124, and Nagelkerke's $R^2$= 0.165. Here, the possibility that companies exporting semi-finished products and finished products will receive linked remittance payments is 1.490 times higher than that of other payments (see Table 7).

In addition, when the export company's payment standard was established, the possibility of linked remittance was reduced by 0.463 times, but when the efficiency of payment increased by one unit, the likelihood of linking remittance increased by 1.388. This proves the fact that when paying for trade payments, linked remittance is made when the efficiency of payment is important.

**Table 7.** Logistic Regression Analysis on Connected Remittance and L/C

| Payment Type | Predictor | B | S.E. | Wald | d.f | p | Exp(B) |
|---|---|---|---|---|---|---|---|
| Connected Remittance | Size_Dum | -.281 | .214 | 1.715 | 1 | .190 | .755 |
| | Category_Dum | .399 | .189 | 4.437 | 1 | .035 | 1.490 |
| | Experience_Dum1 | -.290 | .261 | 1.240 | 1 | .266 | .748 |
| | Experience_Dum2 | -.490 | .272 | 3.239 | 1 | .072 | .613 |
| | Standard of Payment | -.769 | .143 | 28.849 | 1 | .000 | .463 |
| | Payment Efficiency | .328 | .121 | 7.292 | 1 | .007 | 1.388 |
| | Buyer Trust | -.127 | .165 | .591 | 1 | .442 | .881 |
| | Unrecovered Experience | -.141 | .109 | 1.699 | 1 | .192 | .868 |
| | Technological Capabilities | .522 | .145 | 12.918 | 1 | .000 | 1.686 |
| | Competitive Environment | .230 | .124 | 3.417 | 1 | .065 | 1.259 |
| | Buyer Character | .102 | .141 | .522 | 1 | .470 | 1.107 |
| | Market Power | .604 | .148 | 16.742 | 1 | .000 | 1.829 |
| | Constant | 2.563 | .969 | 6.999 | 1 | .008 | .077 |
| Letter of Credit | Size_Dum | -.474 | .218 | 4.727 | 1 | .030 | .622 |
| | Category_Dum | .496 | .196 | 6.408 | 1 | .011 | 1.642 |
| | Experience_Dum1 | 1.837 | .287 | 41.031 | 1 | .000 | 6.277 |
| | Experience_Dum2 | 1.832 | .307 | 35.606 | 1 | .000 | 6.248 |
| | Standard of Payment | -.282 | .149 | 3.600 | 1 | .058 | .754 |
| | Payment Efficiency | -.051 | .128 | .161 | 1 | .688 | .950 |
| | Buyer Trust | .330 | .168 | 3.869 | 1 | .049 | 1.391 |
| | Unrecovered Experience | .157 | .109 | 2.089 | 1 | .148 | 1.170 |
| | Technological Capabilities | -.041 | .148 | .077 | 1 | .781 | .960 |
| | Competitive Environment | -.519 | .133 | 15.303 | 1 | .000 | .595 |
| | Buyer Character | .077 | .146 | .273 | 1 | .601 | 1.080 |
| | Market Power | -.374 | .144 | 6.705 | 1 | .010 | .688 |
| | Constant | 1.162 | .975 | 1.421 | 1 | .233 | 3.196 |

**Note:** Dum means Dummy Variable.

Additionally, the higher the technology competency of the exporter, the more likely the linked remittance was made increased 1.686 times, and the more competitive the environment, the higher the probability of linked remittance increased 1.259 times. However, it was not significant at the 5% significance level. It was found that the stronger the market power of the importer, the more likely the payment will be made by linked remittance increased 1.828 times higher than that of other payment possibilities.

For credit payment, the -2LL difference between the model without the independent variable and the model with the independent variable was 105.464; when the degree of freedom was 12 in the $\chi^2$ distribution, the significance probability was 0.000, which is statistically significant.

In other words, it can be seen that the explanatory power of the dependent variable was significantly increased by the input of the independent variables. The -2LL value is 707.471, Cox & Snell's R2 = 0.164, and Nagelkerke's $R^2$ = 0.219.

Here, it was found that the likelihood of paying with a L/C for medium-sized enterprises decreased by 0.622 times more than that of small-sized firms. On the other hand, it was analyzed that the likelihood that companies that export semi-finished and finished products were more likely to make payments using a L/C was 1.642 times higher than that of companies that export raw materials and primary products.

**Table 8.** Logistic Regression Analysis on Mixed Payment

| Payment Type | Predictor | B | S.E. | Wald | d.f | p | Exp(B) |
|---|---|---|---|---|---|---|---|
| Mixed Payment | Size_Dum | .476 | .225 | 4.491 | 1 | .034 | 1.610 |
| | Category_Dum | -.305 | .196 | 2.428 | 1 | .119 | .737 |
| | Experience_Dum1 | .187 | .269 | .483 | 1 | .487 | 1.206 |
| | Experience_Dum2 | .354 | .285 | 1.547 | 1 | .214 | 1.425 |
| | Standard of Payment | -.096 | .146 | .428 | 1 | .513 | .909 |
| | Payment Efficiency | -.173 | .131 | 1.749 | 1 | .186 | .841 |
| | Buyer Trust | .349 | .173 | 4.059 | 1 | .044 | 1.418 |
| | Unrecovered Experience | .012 | .112 | .012 | 1 | .912 | 1.012 |
| | Technological Capabilities | -.577 | .150 | 14.706 | 1 | .000 | .562 |
| | Competitive Environment | -.016 | .131 | .015 | 1 | .902 | .984 |
| | Buyer Character | -.966 | .154 | 39.345 | 1 | .000 | .380 |
| | Market Power | -.245 | .148 | 2.752 | 1 | .097 | .782 |
| | Constant | 4.815 | 1.025 | 22.057 | 1 | .000 | 123.324 |

**Note:** Dum means Dummy Variable.

Companies with 11-20 years of export experience were also more likely to pay with an L/C by 6.277 times than companies with less than 10 years of export experience, and companies with more than 21 years of export experience were more likely to use an L/C than companies with less than 10 years of export experience by 6.248 times. This result can be attributed to the fact that companies with long experience in the export market prefer an L/C to avoid the risk of settlement.

When an exporter has clearly established a payment standard, the possibility of using an L/C also decreased by 0.754 times. Moreover, even if an export company had a long business relationship with a buyer, and the buyer has creditworthiness, the possibility of transacting with an L/C is 1.391 times higher than that of other payments.

Meanwhile, in a competitive market environment, the possibility that an exporter will receive payment with an L/C decreased by 0.595 times, and when an importer is in control, the probability of receiving payment by L/C was also analyzed to decrease by 0.688 times. Since the beneficiary of the credit is an exporter, and the importer has various burdens due to the opening of credit, it can be interpreted that if the importer has market power, the utilization of the credit is also reduced.

Content related to mixed payment can be found in Table 8. First, the -2LL difference between the model without the independent variable and the model with the independent variable was 75.939, when the degree of freedom was 12 in the $\chi^2$ distribution and the significance probability was 0.000, which is statistically significant. Namely, the explanatory power of the dependent variable increased significantly by the input of the independent variable. The -2LL value is 688.164, Cox & Snell's $R^2 = 0.121$, and Nagelkerke's $R^2 = 0.167$. Here, when the export company's size is relatively large, the possibility of mixed payment increased by 1.610 times, and when the credit to buyers was also high, the chance of mixed payment increased by 1.418 times.

However, when the export company's technical competence is high, the probability of mixed payment decreased by 0.562 times, and the buyer's characteristics reduced mixed payment by 0.380.

Table 9 is a result of the analysis of how the export amount and transaction period, which are considered important variables in selecting a trade payment, have an effect on export company adoption of trade payment. First, companies whose export amount is more than 100 million to 1 billion won have are 2.484 times more likely to pay by pre-remittance compared to companies with less than 100 million won. Exporters with more than 1 billion won have an increased possibility of advance remittance by 1.976 times compared to those with less than 100 million won. In other words, the greater the export amount, the greater the possibility of advance remittance.

Meanwhile, export companies whose transaction period with importers is 6-10 years were reduced by 0.632 times more than that of exporters with 5 years or less. Companies older than 11 years were also less likely to pay by advance remittance by 0.352 times compared to companies with less than 5 years.

Regarding post remittance, it was found that the likelihood that exporters with export amounts of more than 100 million to 1 billion won receive payment by post remittance was 2.817 times higher than that of companies under 5 years. As the transaction period increases, post remittance also increases. In other words, the possibility of an exporter with a transaction period of 6-10 years receiving post remittance was 1.856 times higher than that of a company with less than 5 years. It was also analyzed that the likelihood that exporters older than 11 years receiving post remittance was 1.927 times higher than that of exporters older than 5 years.

The only variable that had a significant effect on linked remittance was export amount, but the possibility that an exporter with an export amount of more than 100 million to 1 billion will receive linked remittance was reduced by 0.483 times compared to an exporter of less than 100 million won.

In the case of an L/C, export amount did not have much effect on the choice of payment with an L/C, and in particular, export companies with a transaction period of 6-10 years were 2.094 times more likely to receive payments by L/C than exporters with less than 5 years.

**Table 9.** Logistic Regression Analysis of Export Amount and Transaction Period on Payment Type

| Payment Type | Predictor | Estimate | 95 %Confidence Interval | | S.E. | z | p | Odds ratio |
|---|---|---|---|---|---|---|---|---|
| | | | Lower | Upper | | | | |
| Advance Remittance | Export Amount_Dum1 | .910 | .452 | 1.367 | .234 | 3.90 | .001 | 2.484 |
| | Export Amount_Dum2 | .681 | .188 | 1.173 | .251 | 2.71 | .007 | 1.976 |
| | Transaction Period_Dum1 | -.459 | -.893 | -.024 | .222 | -2.07 | .039 | .632 |
| | Transaction Period_Dum2 | -1.045 | -1.530 | -.559 | .248 | -4.22 | .001 | .352 |
| Later Remittance | Export Amount_Dum1 | 1.036 | .589 | 1.482 | .228 | 4.55 | .001 | 2.817 |
| | Export Amount_Dum2 | .422 | -.066 | .911 | .249 | 1.69 | .090 | 1.526 |
| | Transaction Period_Dum1 | .618 | .158 | 1.079 | .235 | 2.63 | .008 | 1.856 |
| | Transaction Period_Dum2 | .656 | .178 | 1.133 | .243 | 2.69 | .007 | 1.927 |
| | Export Amount_Dum1 | -.728 | -1.135 | -.320 | .208 | -3.50 | .001 | .483 |
| Connected Remittance | Export Amount_Dum2 | -.139 | -.577 | .298 | .223 | -.624 | .533 | .870 |
| | Transaction Period_Dum1 | .111 | -.302 | .525 | .211 | .528 | .598 | 1.118 |
| | Transaction Period_Dum2 | -.359 | -.797 | .079 | .224 | -1.60 | .108 | .698 |
| Letter of Credit | Export Amount_Dum1 | -.111 | -.518 | .296 | .208 | -.534 | .593 | .895 |
| | Export Amount_Dum2 | .067 | -.372 | .508 | .225 | .302 | .763 | 1.070 |
| | Transaction Period_Dum1 | .739 | .324 | 1.154 | .212 | 3.49 | .001 | 2.094 |
| | Transaction Period_Dum2 | .833 | .393 | 1.272 | .224 | 3.71 | .001 | 2.300 |
| Mixed Payment | Export Amount_Dum1 | -.622 | -1.038 | -.206 | .212 | -2.93 | .003 | .537 |
| | Export Amount_Dum2 | -.984 | -1.452 | -.515 | .239 | -4.12 | .001 | .374 |
| | Transaction Period_Dum1 | .342 | -.098 | .783 | .225 | 1.52 | .128 | 1.408 |
| | Transaction Period_Dum2 | .501 | .038 | .964 | .236 | 2.12 | .034 | 1.651 |

**Note:** Dum1 and Dum2 mean Dummy Variables.

In addition, it was analyzed that the likelihood of an export company with a transaction period of 11 years or more receiving payment through an L/C increased by 2.300 times compared to a company with less than 5 years. This result contradicts the common sense of general payment that the utility of an L/C generally decreases as the transaction period of an import/export company increases. In the combined payment of remittance and L/C, the likelihood that exporters with an export amount of more than 100 million to 1 billion will receive payment through mixed payments was reduced by 0.537 times compared to those with less than 100 million. In addition, the likelihood of companies with more than 1 billion won to receive payments with mixed payments decreased by 0.374 times compared to those with less than 100 million. In addition, the chance of an export company with a transaction period of 11 years or more receiving payment by mixed payment was 1.651 times higher than that of an exporter less than 100 million.

Fig. 4 shows the relationship between advance remittance and export amount more intuitively. The possibility of advance remittance significantly increased when the dummy variable was 1 compared to when the dummy variable was 0. Fig. 5 indicates the relationship between advance remittance and the transaction period. When the dummy variable was 1, it can be seen that the possibility of pre-remittance was significantly reduced.

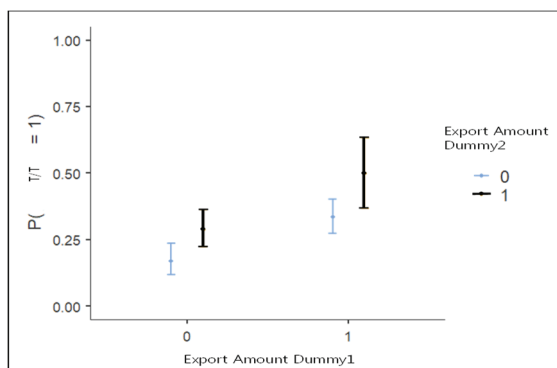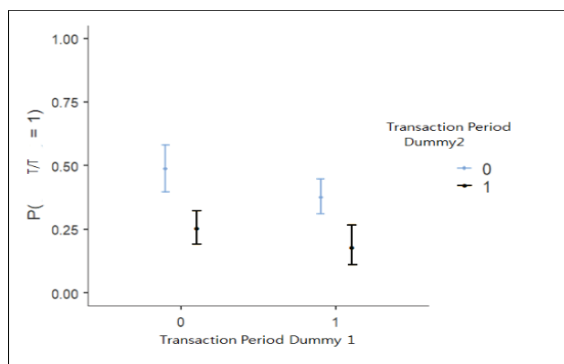**Fig. 4**. Relationship between Advance Remittance & Export Amount



**Fig. 5.** Relationship between Advance Remittance & Transaction Period

# 6. Discussion & Implication

In international trade, exporters prefer to receive payments as quickly as possible, and importers want to make payments as late as possible. In this respect, the payment field, a basic condition for trade transactions, is also representative in which the positions of exporters and importers conflict. In addition, there are many cases in which various variables must be considered rather than only one specific variable representatively affecting payment.

For instance, from the importer's point of view, if the quality of the exported goods is excellent or scarce, the importer is likely to make payment before shipment to preempt it in the global market. However, if market power is with the importer, the possibility of pre-payment will be lowered.

Also, in organization theory, some organizations do not easily accept a change due to the inertia of the organization, even when the external environment changes or any innovation is selected (Gilbert, 2005). In other words, even if embracing changes in the external environment is beneficial to most organizations in the long term, there are cases in which they cannot be implemented (Besson and Rowe, 2012). Therefore, it is generally predictable to maintain any practice for a certain period of time to the extent that it does not significantly affect the corporate profit structure.

In the meantime, the utilization of the L/C, which has held a key role in trade payment, has gradually decreased, and the utilization rate of the export L/C has remained at more than 10% of the total amount of an export payment. In addition, the situation related to trade payments has changed recently as remittances occupy vacant places where there was an L/C. Furthermore, although not much has been revealed academically, remittance payments are more subdivided and utilized in practice. As the trade payment environment changes, an academic approach to these changes has been required, but it has been difficult to find studies that satisfy these demands. This study was conducted to fill the academic gap required in this respect. The main results analyzing the L/C and mixed payment are presented and discussed as follows.

First, as a result of analyzing the relationship between export experience and L/C, it was found that companies with high export experience were more likely to choose L/C transactions than those with low export experience. Specifically, even if buyers have high credit ratings, they are more likely to choose an L/C. This result suggests that companies with greater export experience are more likely to choose payment methods such as an L/C that can more effectively manage risks arising from the market. To interpret the reason why the L/C has a high utilization even when a buyer's credit is favorable, the buyer will stand a chance to accept the request of the exporter in good faith when there is a demand for an L/C from an exporter. These results remind us that there is a favorable relationship that satisfies each parties' needs in similar businesses rather than a one-dimensional view that buyer post-payments increase if a buyer's credibility is high.

Meanwhile, in a competitive market environment, the selection of the L/C is decreasing, and as the market power of importers increases, the choice of the L/C also decreases. In other words, if competition among companies in the global market is intense and/or market uncertainty is large, the possibility of using an L/C will decrease. Thus, in a case where fierce competition between companies or of high market uncertainty, faster logistics and provision of services may be highly required, but in the case of an L/C, there are relatively many restrictions in this respect. A practice such as the surrendered B/L, which is widely used to provide fast logistics services to local importers, is also hampered in the L/C system where requesting original documents is in principal.

If market power belongs to the importer, the use of a cumbersome L/C payment for the importer decreases. When it comes to mixed payments, the larger the company, the greater the possibility of using mixed payments. On the other hand, it was found that the higher the technical competence of an exporter and the more reliable the buyer's character, the less likely a mixed payment.

When we juxtaposed these results with linked remittance and post remittance, it can be considered that the higher the technical competence of the exporter, the higher the possibility of linked remittance over mixed payment. A buyer's character also can be judged to be more meaningful in the selection of post remittance over a mixed payment.

Finally, the results of analyzing how the export amount and transaction period affect the choice of payment type are as follows.

First, the greater the export amount, the greater the possibility of advance remittance, and post remittance only increased when the export amount was more than 100 million to 10 billion won. On the other hand, linked remittance decreased when the export amount was more than 100 million to 10 billion. In the L/C, there was no significant relationship with export amount, and mixed payment decreased as the export amount increased.

These results are believed to reflect the fact that remittance payments occupied the largest part of trade settlement in recent years, and that the use of T/T-based remittance payments have increased even for relatively large trade payments. In addition, as the export amount increases, it can be thought that the utilization of a mixed settlement combined with advance remittance and an L/C will increase, but this study clearly exemplifies that it is decreasing. The reason for this is that the difference in export amount is relatively small due to the majority of this study sample being concentrated in small enterprises.

Next, when examining the effect of the transaction period on the selection of payment type, it was confirmed that when the transaction period with the importer is prolonged, pre-remittance significantly decreases, and post remittance increases significantly. Therefore, it is understood that Korean exporters tend to receive payments by post remittance when the transaction period with the importer is long.

In general, it is known that the longer the transaction period between the exporter and the importer, the more credit is accumulated with the importer, such that a simpler payment tool is preferred instead of an L/C. On the other hand, according to the results of this study, the possibility of selecting an L/C persists even when the transaction period is long.

These research results can be considered in connection with this research sample. In other words, as most of the subjects of this study are small exporters, these small-scale exporters are often have insignificant financing capabilities. In this case, even if the transaction period is extended, there is relatively little room to change to other payment terms.

For example, small-scale exporters have to procure raw materials to export overseas. In this case, an exporter uses a local L/C to relieve the burden of investing equity capital. As such, the original L/C is required to benefit from trade finance, which means that the demand for an export L/C does not diminish for small exporters. Also, as is well known, there are many cases in practice that importers consider the situation of small exporters in good faith. The main implications of this study are as follows.

First, this study subdivided trade payment types into pre- and post-remittance, as well as linked remittances linked with pre- and post-remittance, and mixed payments linked with pre-remittances and letters of credit, focusing on remittances that have been widely used in recent trade payments. Until now, little research has been done on which the types related to remittances have been subdivided and applied, and this research can be expected to expand related research perspectives on international trade payments. Second, this study also

provides implications in terms of trade payment methodology.

In other words, the significance of this study is recognized in that payment type was subdivided into advance remittance, post remittance, linked remittance, L/C, and mixed payment, and a binominal logit analysis model was established for, resulting in meaningful results. Generally, it is hard for researchers to collect payment data, not least because exporters often use more than one payment method, such as advance remittance or L/C.

In this respect, as many previous studies did, the assumption that one enterprise only uses one payment is not suitable for a real situation. In order to overcome these limitations, this study categorizes the data using a ranked scale for the most used payment. Then, through logit analysis, the probability of selecting a corresponding payment method and other payment methods was calculated.

Therefore, this attempts of this study are considered to have a large spin-off in subsequent studies in that it not only reflects the latest payment environment but also attempts a more realistic methodological approach.

The main results of this study are presented and discussed as follows. First, from the analysis results of the remittance sector, including pre-remittance, post remittance and linked remittance, it was confirmed that the more experience the exporter has with unrecovered trade payments, the more likely it is to choose advance remittance. The possibility of advance remittance was also significantly reduced when the market power of the importer was large.

On the other hand, the possibility of post remittance increased when the amount of an export was large, or when the exporter had certain payment standards for trade payments. In terms of export amount, the greater the amount to be paid, the greater the burden on the importer, such that there was a high possibility of post payment.

In addition, the more reliable a buyer's character, the higher the possibility of post-remittance, which can be thought of as an agreement on post-remittance in order for the exporter to believe in the integrity of the importer and strengthen the business relationship. What is a more remarkable result of linked remittance is that the possibility of linked remittance increases when the efficiency of payment is emphasized. The higher the technical competence of the exporter, the greater the possibility of a linked remittance. This result tells the possibility that if the export amount is large and the quality of the exported goods is superior, advance payment for raw material procurement costs is paid first by a buyer, and the balance is settled afterwards. Furthermore, even when the market power of the importer is high, the possibility of linked remittance is significantly increased.

Despite this study making such an academic contribution to the field of trade payment, there are also limitations. First, 147 copies of data were collected mainly from export manufacturers located in Seoul, but the collected data were not sufficient to attempt various analyses. In addition, since most of the research samples were concentrated in small-scale enterprises, caution is advised in generalizing the results of this study.

Second, despite the growing number of transactions between head offices and branch offices in international payments, the lack of control over these areas is also a limitation. For instance, it is presumed that special circumstances, such as transactions between a head office and branch offices, are somewhat different from the payment mechanism chosen by exporters and importers, who are far apart and lacking mutual trust. Thus, it is judged that more detailed research is needed to supplement these limitations in future research.

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# The Determinants of Foreign Subsidiary CEO Selection: Effects of Internal and External Network Embeddedness of Foreign Subsidiaries and Market Characteristics of Host Country[*]

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## Abstract

*Purpose* – This study empirically analyzes the impact of the internal and external network embeddedness of foreign subsidiaries and local market characteristics of the host country on the CEO selection whether or not to appoint an expatriate as the CEO of a foreign subsidiary.

*Design/methodology* – To conduct an empirical analysis, we obtained a list of the headquarters of Korean MNCs from the Korea Chamber of Commerce and Industry. Based on the list of HQs, we identified a final list of overseas subsidiaries of Korean MNCs that have entered the world from KOTRA (Trade-Investment Promotion Agency for Korea). Then we conducted an empirical analysis based on the results of 391 questionnaires by employing logistic regression analysis.

*Findings* – The results of empirical analysis are as follows. First, the higher the subsidiary's internal network embeddedness, the higher the tendency appoint an expatriate as the CEO. Second, the higher the volatility of the local market, the higher the tendency to appoint an expatriate as the CEO. Third, the stronger the competition in the local market, the lower the tendency to appoint a PCN.

*Originality/value* – This study has significant theoretical implications in that it examines the link between the internal and external embeddedness of overseas subsidiaries and the appointment of parent country nationals (PCNs) as the CEO that prior research has not examined.

## 1. Introduction

In the field of international business, the study of multinational corporations (hereafter MNCs) and subsidiaries has been an important research topic that has attracted many scholars for a long time (Bartlett and Ghoshal, 1986; Nohria and Ghoshal, 1994; Werner, 2002). Because MNCs by definition have multiple overseas subsidiaries in various countries, whether these foreign subsidiaries can be managed efficiently and effectively is a matter of competitive advantage that affects the global competitiveness of MNCs, and is ultimately linked to the growth and survival of the MNCs as well (Birkinshaw and Hood, 1998; Frost,

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2001; Frost et. Al., 2002; Roth and Nigh, 1992). In particular, a group of scholars has paid major attention to research related to the staffing decisions of foreign subsidiaries (Delios and Björkman, 2000; Tung, 1982; Harzing, 2001; Gong, 2003). These studies have primarily focused on identifying the factors that influence decisions regarding the use of human resources such as the appointment of parent country nationals (PCNs) dispatched from the headquarters, or host country nationals (HCNs) or third-country nationals (TCNs) (Boyacigiller, 1990; Harzing, 2001; Gong, 2003; Belderbos and Heijltjes, 2005).

Previous research has emphasized the advantages of an assigning expatriate CEOs to executive positions in foreign subsidiaries so that they can operate subsidiaries according to the headquarters' strategic direction by performing control activities appropriate to the MNC's policies and goals. However, they also emphasize disadvantages such as cultural myopia caused by an insufficient understanding of local culture (Egelhoff, 1984; O'Donnell, 2000; Geringer and Hebert, 1989; Wang et al., 1998). On the other hand, when a CEO is appointed from a host country, it is possible to overcome the liabilities of foreignness based on a sufficient understanding of the local market and to capture local business opportunities and perform appropriate management activities, although it may have disadvantages such as smooth communication with the headquarters being impeded, and this may lead to problems of goal mismatch between the subsidiaries and the headquarters (Jensen and Meckling, 1976; Roth and O'Donnell, 1996).

MNCs are embedded in external networks at multiple levels in various ways (Nell, Ambos, and Schlegelmilch, 2011), and the foreign subsidiaries of MNCs are simultaneously embedded in the local business's external business network and the MNE's internal network (Garcia-Pont, Canales, and Noboa, 2009; Yamin and Andersson, 2011). Network embeddedness serves as a means for knowledge gathering (Najafi-Tavani, Giround and Andersson, 2014) and plays a crucial role in the MNC's capacity development and competitive advantage creation (Yamin and Andersson, 2011; Achcaoucaou, Miravitlles and Leon-Darder, 2014). Also, the degree of local embeddedness of subsidiaries influences the strategic decision making of MNCs (Andersson and Forsgren, 2000). Given the significant impact of internal and external network embeddedness on the innovation and performance of MNCs and subsidiaries (Almeida and Phene, 2004; Andersson, Forsgren, and Holm, 2002; Figueiredo, 2011; Garcia-Pont et al, 2009), analyzing the impact of network embeddedness on the CEO staffing decisions of a foreign subsidiary is an important research agenda. It can be expected that network embeddedness and local market characteristics will act as determinants that have a significant influence on the choice of the expatriate CEO of an overseas subsidiary. In addition, it is meaningful to investigate expatriate CEO staffing, not the portion of expatriates in general because staff members in key management positions have a potentially stronger impact on the effectiveness of subsidiaries than just functional or technical positions (Colakoglu, Tarique, and Caligiuri, 2009). Despite this importance, none of the prior studies on the nationality of the CEO of an overseas subsidiary have analyzed the impact of the simultaneous internal and external network embeddedness of the foreign subsidiary. In fact, Prior studies on the CEO nationality of foreign subsidiaries have been mainly focused on country-level characteristics, industry-level characteristics, subsidiary characteristics, MNC headquarters, and the relationship between subsidiaries and headquarters (Harzing, 2001; Gong, 2003; Rickley. and Karim, 2018, Thompson and Keating, 2004; Delios and Bjorkman, 2000; Belderbos and Hejitjes, 2005).

External environmental factors are one of the important determinants influencing an MNC's decisions on HRM practices, control and coordination, subsidiary management, centralization and formalization of multinational headquarters and subsidiaries (Holm, Holmström, and Sharma, 2005; Guar, Delios and Singh, 2007; Thomson and Keating, 2004).

Therefore, we argue that external environmental factors, such as local market characteristics, will affect MNC subsidiary CEO staffing decisions. The nature of the host country itself is one of the factors influencing subsidiary CEO staffing decisions (Ando, Rhee and Park, 2008). The overall features of the environment influence the extent to which external linkages are built (Nell et al., 2011). The level of knowledge about the host country market of foreign subsidiaries required to respond to the characteristics of the local environment can influence subsidiary CEO staffing decisions. With rare exceptions (Tan and Mahoney, 2006; Bebenroth, Li and Sekiguchi, 2008), previous research has not focused on the direct relationship between local market characteristics and foreign subsidiary CEO staffing decisions. Tan and Manhoney (2006) and Bebenroth et al., (2008) examined types of industry that are characterized by great uncertainty; however, they tested their hypotheses based on the ratio of the number of expatriates, not the CEO manager's nationality.

Therefore, this study attempted to investigate the impact of network embeddedness (e.g., internal network embeddedness and external network embeddedness) on the appointment of an expatriate as the CEO of a foreign subsidiary in 391 foreign subsidiaries of Korean MNCs. Also, we aimed to empirically analyze the impact of local market characteristics on the appointment of an expatriate as the CEO of a foreign subsidiary by dividing two aspects of local market volatility and local market competition intensity.

The present study contributes to foreign subsidiary executive staffing literature in two ways. First, this study expands our understanding of foreign subsidiary executive staffing by analyzing the effects of internal and external network embeddedness of a foreign subsidiary on the appointment of an expatriate as the CEO of a foreign subsidiary, which has not been examined in previous studies. Second, this research provides new insights into MNCs' strategic executive staffing decisions in response to market conditions in host markets. By examining the local market characteristics of the host country, such as the volatility of the local market and the local market competition, the empirical results provide further insight into the strategic executive staffing decisions of MNCs.

The structure of this study is as follows. Chapter II reviews related literature and Chapter III presents research hypotheses. Chapter IV presents the research methods. Chapter V presents the results of empirical analysis for hypothesis testing. Finally, in Chapter VI, the conclusion, implications, and limitations of this study are presented.

## 2. Literature Review

The subsidiary CEO staffing strategy is a key strategic tool for MNCs for knowledge management, control and coordination (Guar et al., 2007) and is an important topic that affects the overall performance of MNCs (Ciabuschi, Holm, and Martín Martín, 2014). The main focus of subsidiary CEO staffing decisions is whether to choose a local CEO or an expatriate CEO (Guar et al., 2007). In addition, whether the CEOs of foreign subsidiaries are host country nationals (HCNs) or parent country nationals (PNCs) has a significant impact on the degree of integration of headquarters-subsidiary activities, the degree of localization, and knowledge management (Harzing, 2001; Guar et al., 2007).

Prior literature on the staffing decisions of foreign subsidiaries have focused on the characteristics of the country, industry, subsidiary, and MNC headquarters and the relationship between subsidiary and headquarters (Harzing, 2001; Gong, 2003; Rickley and Karim, 2018; Thompson and Keating, 2004; Delios and Björkman, 2000; Belderbos and Heijltjes, 2005).

The characteristics of the host country are one of the factors influencing subsidiary CEO

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staffing decisions (Ando et al., 2008). Previous studies analyzed the effects of cultural distance (Gong, 2003) and institutional distance (Rickley and Karim, 2018) on foreign subsidiary staffing decisions. For instance, Rickley and Karim (2018) examined the direct impact of the institutional distance between home and host country on subsidiary CEO staffing decisions from host country nationals (HCNs) to parent country nationals (PCNs). In addition to the country factors, the characteristics of the industry also have an impact on the subsidiary staffing decisions. Industry factors, such as those with high R&D intensity, globally integrated industries, and industries with great uncertainty, are reported to influence foreign subsidiary staffing decisions (Thompson and Keating, 2004; Harzing, 2001; Delios and Bjorkman, 2000; Tan and Mohoney, 2006). Parent firm factors such as international experience (Delios and Björkman, 2000; Rickley and Karim, 2018), host market experience (Ando et al., 2008; Delios and Björkman, 2000), and international strategy of MNCs (Ando et al., 2008), were found to influence foreign subsidiary staffing decisions. The relationship between the MNC headquarters and the subsidiary were found to influence foreign subsidiary staffing decisions as well. For instance, the degree of dependence of the headquarters on the foreign subsidiary (Belderbos and Heijltjes, 2005), inter-organizational ties within the business groups (Belderbos and Heijltjes, 2005), ownership share (Bebenroth et al, 2008; Delios and Björkman, 2000), and the level of global integration a foreign subsidiary in the MNC (Ando et al., 2008) were found to be the factors that have an impact on foreign subsidiary CEO staffing decisions.

Even though the results of these previous studies have increased the collective understanding of the determinants of subsidiary CEO staffing decisions, the possible influence of internal and external network embeddedness and host country market characteristics on foreign subsidiaries' CEO staffing decisions has not been well investigated. In addition to that, the importance of the local market conditions of the host country in subsidiary CEO staffing decisions has been under-represented in most prior research.

Basically, firms are embedded social networks with other actors (Granovetter, 1985). The concept of embeddedness represents the relationships and dependencies of various types of networks and firms (Halinen and Törnroos, 1998) and emphasizes the importance of relationships with other business and institutional actors that can be important drivers of organizational success (Yamin and Andersson, 2011). Existing studies on embeddedness emphasize that firms can acquire strategic assets through social relationships or networks to develop competitive advantages (Uzzi and Gillespie, 2002). Embeddedness is built upon strong social attachments with trust and reciprocity (Figueiredo, 2011). In this context, the concept of network embeddedness has been used to deal with issues related to MNCs (Andersson, Forsgren and Holm, 2002) in that foreign subsidiaries are externally embedded in each local context of the host country and internally embedded in the MNE's network (Garcia-Pont et al., 2009).

External network embeddedness implies that each foreign subsidiary is embedded in a specific business network with customers, suppliers and competitors in the local market of the host country (Bresciani and Ferraris, 2016). Internal network embeddedness means how embedded the foreign subsidiary is with the headquarters or other subsidiaries of the MNC's intra network (Bresciani and Ferraris, 2016). Both internal and external network embeddedness are considered to be a source of knowledge (Figueiredo, 2011) and competitive advantage (Garcia-Pont et al., 2009; Nell et al., 2010). The extant research literature has primarily focused on the impact of internal embeddedness or external embeddedness on knowledge creation in MNCs (Andersson, Björkman, and Forsgren, 2005), product development (Yamin and Andersson, 2011), innovation (Bresciani and Ferraris, 2016; Figueiredo, 2011; Almeida and Phene, 2004; Ciabuschi et al., 2014), and performance

(Andersson et al., 2001; Andersson et al, 2002).

Prior researches on subsidiary CEO staffing decisions have been discussed based on agency theory, resource-based view, knowledge-based view, and organizational learning theory. Agency theory focuses on the relationship between a headquarters and a subsidiary as a principal-agent relationship and analyzes how an agent subsidiary can be aligned with the principal headquarters' objectives. Based on the agency theory, an expatriate CEO as an overseas staffing decision is a means to align the interests of foreign subsidiaries with those of the MNC headquarters (Belderbos and Heijltjes, 2005).

From a resource-based view, local CEOs and expatriate CEOs are considered valuable resources for MNEs with different managerial capabilities (Tan and Mahoney, 2006). Based on the resource-based views, where local adaptation is an important management task for foreign subsidiary staffing decisions, it is very likely that an MNC will appoint a local CEO to a foreign subsidiary (Tan and Mahoney, 2006). In particular, in the case of great market uncertainty or intense competition, the success or failure of the operation in the host country will depend on how the MNC uses human resources.

Meanwhile, from a knowledge-based view and learning perspective, even if a foreign subsidiary has knowledge that can contribute to a competitive advantage for the MNC as a whole, it is likely to remain unrealized due to the nature of the knowledge itself (Najafi-Tavani et al., 2014). How to efficiently transfer and use this type of knowledge in the MNC network is an important task for MNCs to create competitive advantages and even to survive.

In this context, both internal and external embeddedness play an important role in the MNC network in understanding and utilizing this valuable knowledge. In essence, internal network embeddedness and external network embeddedness are both sources of knowledge (Figueiredo, 2011) and sources of learning (Andersson et al., 2002). Here, internal network embeddedness can help to recognize the value of knowledge acquired from each subsidiary of an MNC to a high level (Yamin and Andersson, 2011), and can enable the optimal use of this knowledge for an MNC's internal context. On the other hand, overseas subsidiaries are socially, politically and technologically embedded in external networks with local actors in their own local-specific context in each host country (Andersson et al., 2002). This external network embeddedness provides learning opportunities through exposure to new local knowledge, ideas and opportunities (Andersson et al., 2002), while at the same time gaining in-depth knowledge from trust and mutually beneficial relationships, which in turn enhance subsidiaries' ability to absorb and leverage the new knowledge from the environment (Andersson et al., 2005). As a result, the degree of external network embeddedness helps to create and develop a competitive advantage, while also having a significant impact on performance and innovation (Andersson et al., 2005; Andersson et al., 2002; Yamin and Andersson, 2011). After all, in order for MNCs to make full use of all the knowledge of foreign subsidiaries in their respective countries, there must be sufficient internal and external network embeddedness (Meyer, Mudambi and Narula, 2011). However, the foreign subsidiaries' experience in the host market, which is expected to be valuable to MNCs, is largely embedded in the routines of individuals and organizations (Argote and Ingram, 2000). Therefore, both internal and external network embeddedness should be considered as important factors influencing foreign subsidiary CEO staffing decisions.

Meanwhile, the characteristics of the host country itself are among the factors influencing subsidiary CEO staffing decisions (Ando et al., 2008). The overall nature of the environment influences the extent to which external linkages are built (Nell et al., 2011). The level of knowledge about the host country market of foreign subsidiaries required to respond to the characteristics of the local environment is expected to influence subsidiary CEO staffing decisions. In fact, prior studies have shown that HCNs tend to be deployed more in industries

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or functional areas where local responsiveness (or localization) is important (Guar et al., 2007; Tan and Mahoney, 2006). In addition, because there is a high risk of under-performing in environments with large uncertainties and unknowns (Tan and Mahoney, 2006; Delios and Björkman, 2000), decisions to assign PCNs or HCNs to executive positions in foreign subsidiaries are very important.

## 3. Hypotheses Development

### 3.1. Internal Network Embeddedness and the Appointment of an Expatriate as the CEO of a Foreign Subsidiary

Previous research has found that efficient communication between the headquarters and foreign subsidiaries is a crucial factor that affects the overall performance of foreign subsidiaries (Ando et al., 2008). In order to be able to interpret messages from overseas accurately and timely, it is necessary to understand the meaning of the headquarters' decisions on overseas subsidiaries (Ando et al., 2008). In this situation, the degree of internal network embeddedness of foreign subsidiaries can have an impact on the extent of such interpreting ability of foreign subsidiaries.

CEOs often have socializing experiences within MNC headquarters' networks during their international assignments, and are often rotated to other subsidiaries within the multinational network (Tan and Mahoney, 2006). Thus, the presence of social ties with other managers in the same MNC can enhance the abundance of previous knowledge transfer channels within the MNC (Guar et al., 2007). In addition, an expatriate CEO's social capital with an MNC's top management team can be used to make decisions that will help them operate (Colakoglu et al, 2009).

Often, expatriate CEOs have a better understanding of corporate policy and the role of individual subsidiaries within a multinational network in MNCs (Tan and Mahoney, 2006; Guar et al., 2007). Therefore, expatriate CEOs may have a greater ability to operate subsidiaries in line with the strategic direction of the headquarters than local CEOs.

Expatriate CEOs are well placed to understand how valuable the knowledge generated by foreign subsidiaries is within the MNC network (Guar et al., 2007). Therefore, as the embeddedness of overseas subsidiaries increases in the MNC internal network, it is possible to accurately grasp the value of the knowledge required for subsidiary operations or the knowledge acquired. As a result, expatriate CEOs are likely to pursue strategies that align with the MNC's overall strategy.

The higher the internal network embeddedness, the more likely it is to be embedded in the MNC's informal communication network (Rickley and Karim, 2018). By carrying out appropriate control activities, it is possible to operate subsidiaries in the strategic direction of the headquarters (Guar et al., 2007).

> *H1: Subsidiaries with a high degree (high level) of internal network embeddedness (subsidiary-headquarters embeddedness) are positively related to the appointment of an expatriate as the CEO of a foreign subsidiary.*

### 3.2. External Network Embeddedness and the Appointment of an Expatriate as the CEO of a Foreign Subsidiary

One of the most important reasons for appointing a CEO from a foreign country to an overseas subsidiary is their knowledge of their local market, business practices and cultural

preferences (Harzing, 2001). In addition, knowledge of specific customer and supplier relationships in the host country tends to exist for local subsidiary employees (Andersson et al., 2005).

Local embeddedness, such as the subsidiary's individual relationships with customers, suppliers, and competitors in the local market, can be a source of knowledge and can have a positive impact on performance by providing an opportunity to increase the stock of knowledge (Andersson et al., 2005; Bresciani and Ferraris, 2016). However, it takes time for foreign subsidiaries to develop the ability to create close relationships with local business partners (Andersson et al., 2005). Embeddedness is built on strong social attachments (Figueiredo, 2011), and the extraordinary knowledge and skills gained through these connections are important factors in building the skills required for product or service innovation (Figueiredo, 2011; Bresciani and Ferraris, 2016).

In this respect, local CEOs have a local knowledge and local business network that can help MNCs gain valuable local resources or adapt to their local environment (Tan and Mahoney, 2006). The high degree of external network embeddedness may imply that foreign subsidiaries have long known each other and local customers or suppliers, traded for a long time, exchanged information on market conditions and adapted each other's business practices (Andersson et al., 2002). Thus, the higher the external network embeddedness of an overseas subsidiary, the closer it is to local customers and suppliers. This closeness enhances the subsidiary's ability to absorb new knowledge from the local environment (Andersson et al., 2005). In this perspective, local CEOs have greater ability to develop close relationships with local customers or business partners than expatriate CEOs (Tan and and Mohoney, 2006). A better understanding of the needs and capabilities of local firms enables efficient local operations in areas such as marketing and purchasing (Andersson et al., 2002).

Taken together, it is very likely that a local CEO will be appointed to leverage the advantages of the MNC headquarters due to the external network embeddedness of overseas subsidiaries.

*H2: A subsidiary with a high degree (high level) of external network embeddedness (local embeddedness) is negatively related to the appointment of an expatriate as the CEO of a foreign subsidiary.*

### 3.3. Volatility of the Local Market and the Appointment of an Expatriate as the CEO of a Foreign Subsidiary

High volatility in the local market implies market uncertainty. In a highly uncertain and turbulent environment, the likelihood of appointing a local CEO is expected to be higher than that of a Korean CEO from the home country.

It is important for an MNC to have local market knowledge and local relationships to respond to contingencies and mitigate risks in high uncertainty environments (Tan and Mahoney, 2006). Because local CEOs are embedded in the local network and are familiar with local demand preferences (Rickley and Karim, 2018), they are more likely to adapt well to situations in a more volatile local market than expatriate CEOs.

CEOs from host countries have local knowledge and business connections to deal with uncertainty in their markets (Tan and Mahoney, 2006). In addition, local CEOs are well aware of local market-specific issues, such as cultural, economic and political issues for the host country, and can negotiate better with local suppliers or buyers (Ando et al., 2008).

In highly uncertain markets, CEOs are more likely to respond to the environment better if they have closer business relationships than arm's-length market relationships (Figueiredo,

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2011; Andersson et al., 2002), therefore a local CEO with the ability to establish close business relationships with customers is expected to be more advantageous.

In addition, local CEOs can respond to market changes faster than their competitors and can defend against adverse effects from unfavorable external environments (Holm et al., 2005). It has been suggested that in a situation where the need for local responsiveness is high, local CEOs are preferred as foreign subsidiary managers because the MNC can use their knowledge and information regarding the local environment (Thomson and Kneating, 2004).

*H3: The degree of the volatility of the local market is negatively related to the appointment of an expatriate as the CEO of a foreign subsidiary.*

## 3.4. Competition in the Local Market and the Appointment of an Expatriate as the CEO of a Foreign Subsidiary

Basically, given that local CEOs share the same culture and language as their local customers (Tan and Mahoney, 2006), it is expected to be more advantageous to appoint a CEO from a host country than from a parent country in terms of competition in the host country market.

As the intensity of market competition in a host country increases, the need for information gathering in order for foreign subsidiaries to respond also increases (Nell et al., 2009). In this situation, the ability of local CEOs to gather the information needed to compete is likely to be higher than that of an expatriate CEO (Tan and Mohoney, 2006).

The higher the market competition, the more likely it is that a complex type of knowledge of the local market will be required, which tends to be better understood and recognized through close relationships (Andersson et al., 2005). Indeed, close contact with the exchange of goods and services enhances the likelihood of new needs or new product development (Andersson et al., 2005).

In addition, the ability to identify and absorb new knowledge in the local market depends on close relationships with business partners (Lane and Lubatkin, 1998). In this respect, since CEOs from local countries share the same culture and language as locals (Tan and Mohoney, 2006), the likelihood of local CEOs to have a closer relationship with businesses or customers in the local network is higher than with expatriate CEOs.

As market competition becomes severe, there is more needs for MNCs to maintain clear and frequent communication with local customers and to be able to better understand their own preferences (Tan and Mohoney, 2006). In this case, a CEO from a local country with a good understanding of the local market can play this role well. It is very difficult and time-consuming for PCNs to be as familiar with the local situation as a CEO from a host country (Harzing, 2001). Previous research has found that local CEOs have a better ability to effectively transform global product ideas to better suit local tastes, thereby increasing the competitiveness of overseas subsidiaries over local competitors (Rickley and Karim, 2018).

Taken together, the more competitive the local market is, the more likely it is to appoint a CEO from a host country rather than a parent country. According to the above discussion, the following hypothesis was derived.

*H4: The degree of local market competition is negatively related to the appointment of an expatriate as the CEO of a foreign subsidiary.*

## 4. Methodology

### 4.1. Data Collection

This study empirically analyzed the impact of the internal and external network embeddedness of foreign subsidiaries and local market characteristics of the host country on the *appointment of an expatriate as the CEO of a foreign subsidiary.*

To conduct an empirical analysis, we obtained a list of the headquarters of Korean MNCs from the Korea Chamber of Commerce and Industry. Based on the list of HQs that we obtained, we were able to obtain the final list of overseas subsidiaries of Korean MNCs that have entered the world from the Korea Trade-Investment Promotion Agency (KOTRA). We conducted a survey of 2302 foreign subsidiaries on the final list. The survey was conducted in parallel with various methods such as telephone, e-mail, fax, and online surveys for 2 months. In order to increase the response rate of the survey, we called the overseas subsidiaries directly and politely asked them to actively participate in the survey. As a result of the survey, we collected 409 copies of the questionnaire. However, we excluded 18 questionnaires from the analysis due to incomplete responses. Finally, we conducted an empirical analysis based on 391 questionnaires.

### 4.2. Measurement

#### 4.2.1. Dependent Variable

The dependent variable of this study is the nationality of the CEOs of Korean MNCs' foreign subsidiaries. Many prior studies have used methods to infer a CEO's nationality from the CEO's name obtained through secondary data (Harzing, 2001; Gong, 2003; Choe Soonkyoo, Lee Jae-Eun and Park Young-Ryeol, 2009). This method is simple but somewhat inaccurate. We obtained the data by directly asking the nationality of the CEO in the survey. We created a variable called CEO nationality for analysis. We gave the variable a value of "1" if the CEO's nationality was Korean and "0" if he (or she) was any other nationality.

#### 4.2.2. Independent Variables

In this study, a foreign subsidiary's network embeddedness (internal and external) and market characteristics of the host country (variability and competition) were considered major independent variables. First, based on the research by Frost et al. (2002), the internal network embeddedness of foreign subsidiaries was measured by the extent of their influence on internal corporate customers, internal corporate suppliers, affiliates, and R&D units within the MNC network.

External network embeddedness was measured based on a study by Andersson et al. (2002; 2005). In other words, to effectively respond to the most important local business relationships, external network embeddedness was measured by how much the foreign subsidiary adapted their (1) product technology, (2) production technology, (3) standard operating procedures, and (4) business practices.

Next, based on studies by Miller and Dröge (1986) and Jaworski and Kohli (1993), the volatility of the local market was measured to the extent that the rate of obsolescence of products and services in the local market, the difficulty in predicting consumer demand and preferences, and the difficulty in predicting competitor behavior were measured.

Finally, based on a study by Miller and Dröge (1986), competition in the local market was measured by the degree of fierce competition between firms in the local market and frequency of entry of new competitors into the local market.

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### 4.2.3. Control Variables

In addition to the aforementioned independent variables, this study considered cultural distance, industry dummy (capital-intensive industry and global industry), ownership of HQs, size and age of subsidiaries, and control level of HQs as control variables. First, cultural distance was calculated using a formula proposed by Kogut and Singh (1988), and the detailed formula is as follows.

$$CD_j = \sum_{i=1}^{4} \left\{ \left( I_{ij} - I_{ik} \right)^2 / V_i \right\} / 4 \tag{1}$$

$CD_j$: the cultural distance between Korea and country ($j$)
$I_{ij}$: country ($j$)'s score on the ($i$)th cultural dimension
$I_{ik}$: the score of Korea on the ($i$)th cultural dimension
$V_i$: the variance of the index of the ($i$)th cultural dimension

Next, two industry dummy variables (capital-intensive industry and global industry) were created to control the influence of industry. Capital-intensive industries include such industries as food and beverage products, textiles and clothing, paper and wood, chemical industries, petrochemicals and pharmaceuticals, basic metal industries, etc. In such an industry, the resources required by overseas subsidiaries are often owned by local governments and local firms, so it is more likely to use CEOs of host country nationals to increase their accessibility to such resources (Gomes-Casseres, 1989; Park Young-Ryeol et al., 2009). Thus, the industry dummy(capital-intensive) variable was measured as a dummy variable with a value of '1' for capital-intensive industries and '0' for other industries.

On the other hand, the global industry includes electricity and electronics, machinery and equipment, transportation equipment and pharmaceutical industries. In general, in the global industry, overseas subsidiaries must have close communication and interaction with their HQs, and sometimes tend to have a high degree of dependence on their HQs. In the case of global industries, it is very likely to use a CEO of home country nationals as the head of a subsidiary (Bartlett and Ghoshal, 1998; Makhija et al., 1997, Park Young-Ryeol et al., 2009). The industry dummy (global) variable was measured as a dummy variable with a value of "1" for global industry and "0" for other industries.

Ownership was measured by the percentage of shares of overseas subsidiaries owned by headquarters (Belderbos and Heijltjes, 2005). The size of the foreign subsidiary was measured by the logarithm of the total number of employees (Björkman, Barner-Rasmussen and Li, 2004; Gupta and Govindarajan, 2000), and the age of the overseas subsidiary was measured by the number of years elapsed from the date of its establishment to the present (Yang, Mudambi and Meyer, 2008). Finally, based on the research by Johnston and Menguc (2007), we measured the level of control by HQs over their subsidiaries to the extent to which the HQ holds some authority in decision making related to the operation of its subsidiary, such as decisions on organizational structure, production/sales/marketing, development of new products and services, human resources management, financial affairs, and establishment of business goals.

## 5. Results

Table 1 presents the regional distribution of research sample in this study. The largest number of overseas subsidiaries were located in Asia (246 firms, 62.9%), followed by North

America (62 firms, 15.9%), Europe (57 firms, 14.6%), South America (13 firms, 3.3), Oceania (8 firms, 2.0%), and Africa (5 firms, 1.3%). Next, <Table 2> shows the distribution of research sample by country. The largest number of overseas subsidiaries were located in China (138 firms, 35.3%), followed by U.S.A (57 firms, 14.6%), Vietnam (26 firms, 6.6%), Germany (12 firms, 3.1), and Etc. (158 firms, 40.4%).

Table 3 shows the results of the validity and reliability analysis of the variables used in this study. As shown in Table 1, exploratory factor analysis shows that each factor has a factor load value of 0.5 or more. Therefore, we judged that there was no significant problem with the validity of the measurement variables. We looked at the Cronbach's alpha value to check the reliability of the variables. As a result, we confirmed that the Cronbach's alpha value was 0.7 or higher for all of them, so we judged that there was no serious problem with the reliability of the variables.

Table 4 presents the results of the descriptive statistics and correlation analysis of the variables used in this study. As you can see in the table, the correlation coefficients between the variables were found to be generally satisfactory, without major problems. However, we conducted an additional analysis to check for potential multicollinearity problems. The preceding studies generally suggest that if the VIF value is less than 10 and the CI value is 30 or less, there is no need to worry too much about the possibility of multicollinearity (Chatterjee, Hadi and Price, 2006; Hair et al., 1998). The analysis showed that both the VIF and CI values were within acceptable values, so the problem of multicollinearity was not considered to be of great concern.

Next, Table 5 presents the results of logistic regression analysis. Model 1 includes only control variables in the regression model, and Model 2 includes control variables and independent variables together in the regression model. First of all, model 1 shows that the industry dummy (capital-intensive) ($p<0.05$), the industry dummy (global) ($p<0.05$), the ownership of HQs ($p<0.05$), and control level of HQs ($p<0.05$) have significantly positive effects on the appointment of an expatriate as the CEO of a foreign subsidiary. Next, Model 2 shows that, as with Model 1, control variables such as the industry dummy (capital-intensive) ($p<0.1$), the industry dummy (global) ($p<0.1$), the ownership of HQs ($p<0.001$), and control level of HQs ($p<0.05$) have significantly positive effects on the appointment of an expatriate as the CEO of a foreign subsidiary, and there are growing tendencies to appoint an expatriate as the CEO.

**Table 1.** Regional Distribution of Overseas Subsidiaries

|   | Africa | Asia | Europe | N.America | Oceania | S.America | Total |
|---|--------|------|--------|-----------|---------|-----------|-------|
| N | 5 | 246. | 57. | 62 | 8 | 13 | 391 |
| % | 1.3 | 62.9 | 14.6 | 15.9 | 2.0 | 3.3 | 100 |

**Table 2.** Country Distribution of Overseas Subsidiaries

|   | China | U.S.A | Vietnam | Germany | Etc. | Total |
|---|-------|-------|---------|---------|------|-------|
| N | 138 | 57 | 26 | 12 | 158 | 391 |
| % | 35.3 | 14.6 | 6.6 | 3.1 | 40.4 | 100 |

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**Table 3.** Validity and Reliability Analysis

|  |  | (1) | (2) | (3) | (4) |
|---|---|---|---|---|---|
| (1) | External Network Embeddedness 1 | .696 | .014 | .165 | .025 |
|  | External Network Embeddedness 2 | .794 | .123 | .069 | -.011 |
|  | External Network Embeddedness 3 | .802 | .056 | -.020 | .057 |
|  | External Network Embeddedness 4 | .791 | .104 | -.009 | .122 |
| (2) | Internal Network Embeddedness 1 | .085 | .753 | -.005 | .012 |
|  | Internal Network Embeddedness 2 | .077 | .848 | -.016 | -.039 |
|  | Internal Network Embeddedness 3 | .050 | .736 | .065 | .019 |
|  | Internal Network Embeddedness 4 | .063 | .666 | -.037 | .110 |
| (3) | Volatility of the Local Market 1 | .124 | .051 | .563 | .348 |
|  | Volatility of the Local Market 2 | .079 | -.051 | .886 | .064 |
|  | Volatility of the Local Market 3 | .005 | .015 | .872 | .114 |
| (4) | Competition of the Local Market 1 | .126 | -.009 | .249 | .734 |
|  | Competition of the Local Market 2 | .007 | .090 | .088 | .844 |
|  | Eigen Value | 2.442 | 2.313 | 1.969 | 1.423 |
|  | % of Variance | 18.788 | 17.792 | 15.145 | 10.944 |
|  | Cumulative % of Variance | 18.788 | 36.580 | 51.725 | 62.669 |
|  | Cronbach's Alpha | .781 | .747 | .725 | .737 |

**Table 4.** Results of Descriptive Statistics and Correlation Analysis

|  | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | ⑩ | ⑪ | ⑫ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ① CEO Nationality | 1 |  |  |  |  |  |  |  |  |  |  |  |
| ② Cultural Distance | .006 | 1 |  |  |  |  |  |  |  |  |  |  |
| ③ Industry Dummy (Capital-intensive) | .058 | -.031 | 1 |  |  |  |  |  |  |  |  |  |
| ④ Industry Dummy (Global) | .084 | .033 | -.29** | 1 |  |  |  |  |  |  |  |  |
| ⑤ Ownership of HQs | .221** | .123* | -.001 | -.004 | 1 |  |  |  |  |  |  |  |
| ⑥ Size of Subsidiary | -.025 | -.221** | -.009 | .229** | -.092 | 1 |  |  |  |  |  |  |
| ⑦ Age of Subsidiary | -.037 | .109* | .003 | -.038 | .013 | .024 | 1 |  |  |  |  |  |
| ⑧ Control Level of HQs | .139** | .011 | -.081 | .026 | .073 | -.036 | .018 | 1 |  |  |  |  |
| ⑨ Volatility of the Local Market | .135** | .097 | -.046 | .106* | .130** | .070 | -.012 | .143** | 1 |  |  |  |
| ⑩ Competition of the Local Market | -.018 | .021 | -.066 | -.006 | .095 | -.063 | .056 | .112* | .377** | 1 |  |  |
| ⑪ Internal Network Embeddedness | .115* | -.035 | -.024 | -.024 | .012 | .066 | .013 | .071 | .023 | .092 | 1 |  |
| ⑫ External Network Embeddedness | .022 | .022 | -.075 | -.072 | .059 | .024 | .034 | .060 | .165** | .157** | .187** | 1 |
| Mean | 0.96 | 2.11 | 0.32 | 0.32 | 87.5 | 4.42 | 2.26 | 3.90 | 4.30 | 4.89 | 4.29 | 4.74 |
| S.D. | 0.19 | 1.06 | 0.47 | 0.46 | 23.6 | 1.84 | 0.76 | 1.31 | 1.20 | 1.25 | 1.06 | 1.09 |

**Note:** * $p<0.05$, ** $p<0.01$(2-tailed).

**Table 5.** Results of Logistic Regression Analysis

| | | CEO Nationality (Korean CEO) | |
|---|---|---|---|
| | | Model 1 | Model 2 |
| control variables | constant | -1.609 (1.813) | -3.568 (2.514) |
| | cultural distance | -0.059 (0.231) | -0.258 (0.256) |
| | industry dummy(capital-intensive) | 1.538* (0.729) | 1.319† (0.736) |
| | industry dummy(global) | 1.840* (0.903) | 1.768† (0.937) |
| | ownership of HQs | 0.034*** (0.009) | 0.037*** (0.010) |
| | size of subsidiary | -0.020 (0.172) | -0.074 (0.190) |
| | age of subsidiary | -0.092 (0.380) | 0.171 (0.439) |
| | control level of HQs | 0.521* (0.231) | 0.511* (0.250) |
| independent variables | internal network embeddedness | | 0.625* (0.267) |
| | external network embeddedness | | 0.032 (0.254) |
| | volatility of the local market | | 0.492† (0.266) |
| | competition of the local market | | -0.540* (0.275) |
| | Model Chi-square | 28.703 | 39.200 |
| | Correct class-identification ratio | 96.2 | 96.4 |
| | Cox & Snell $R^2$ | 0.071 | 0.096 |
| | Nagelkerke $R^2$ | 0.245 | 0.330 |
| | P-value | 0.000 | 0.000 |

**Note:** † $p<0.1$ * $p<0.05$, ** $p<0.01$, *** $p<0.001$ (2-tailed).

We checked the influence of independent variables. First, internal network embeddedness ($p<0.05$) was found to have a significantly positive effect on CEO nationality. In other words, the higher the internal network embeddedness, the greater the tendency to appoint Korean CEOs to overseas subsidiaries. Hypothesis 1 was therefore supported. Second, external network embeddedness was found to have no significant impact on the appointment of an expatriate as the CEO of a foreign subsidiary. Hypothesis 2 was therefore not supported. Third, volatility of the local market ($p<0.1$) was found to have a significantly positive effect on the appointment of an expatriate as the CEO of a foreign subsidiary. In other words, the higher the volatility of the local market, the greater the tendency to appoint CEOs from their home country to overseas subsidiaries. Surprisingly, however, Hypothesis 3 was not supported because these results were the opposite of the hypotheses direction expected in this study. There will be further discussion on this in the next chapter. Finally, competition in the local market has a significantly negative impact on the appointment of an expatriate as the

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CEO of a foreign subsidiary. In other words, the stronger the competition in the local market ($p<0.05$), the less the tendency to appoint CEOs from their home country to overseas subsidiaries. Hypothesis 4 was therefore supported.

## 6. Conclusion and Discussion

The purpose of this study was to analyze the effects of the internal/external network embeddedness of foreign subsidiaries and local market characteristics on the appointment of an expatriate as the CEO of a foreign subsidiary. The results of the analysis of 391 overseas subsidiaries of Korean MNCs located around the world are as follows. First, the higher the internal network embeddedness of overseas subsidiaries, the higher the tendency to appoint an expatriate as the CEO of a foreign subsidiary. That is, in order to facilitate smooth communication and knowledge transfer between the HQs and their subsidiaries, and to enhance understanding of the strategic direction pursued by the HQs, it suggests that the deeper the subsidiary is embedded in the MNC's network, the more likely it tends to appoint a CEO from its parent country nationals.

Second, Hypothesis 2, which predicted that the higher the external network embeddedness, the lower the tendency to appoint an expatriate as the CEO of a foreign subsidiary, was not supported. Many prior studies have emphasized that MNCs tend to use host-country nationals to acquire host-country-specific knowledge in the local market and enhance local cultural familiarity. However, unlike previous studies, the results of this study showed that foreign subsidiaries' external network embeddedness does not affect an expatriate as the CEO of a foreign subsidiary.

Third, the results of this study suggested that the higher the volatility of the local market, the higher the tendency to appoint an expatriate as the CEO of a foreign subsidiary. These results are the opposite of our prediction that the higher the volatility of the local market, the lower the tendency to appoint an expatriate as the CEO of a foreign subsidiary. Many prior studies argue that MNCs tend to appoint host country nationals with a better understanding of the local market as CEOs of overseas subsidiaries as one way to solve problems under great uncertainties in the local market. However, the results of this study suggest that the MNCs tend to appoint a CEO from their home country who understands the strategic direction set by the HQs and can easily communicate with and transfer knowledge to the HQs.

Fourth, the stronger the competition in the local market, the lower the MNC's tendency to appoint an expatriate as the head of a foreign subsidiary. This trend is consistent with the results emphasized by many prior studies. In other words, the strong competition of the local market requires foreign subsidiaries to have a good understanding of local consumers and local markets. In such a situation, the results of this study suggest that the HQs' tendency to appoint a CEO from their home country as a representative of an overseas subsidiary decreases because local subsidiaries need to quickly acquire knowledge unique to the host country.

In conclusion, this study has the following implications. First, this study has significant theoretical implications in that it examines the link between the internal and external embeddedness of overseas subsidiaries and the appointment of an expatriate as the CEO of a foreign subsidiary, which prior research has not examined. Until now, research on the internal and external embeddedness of overseas subsidiaries has mainly dealt with subsidiary capability development and performance, and the appointment of an expatriate as the CEO of a foreign subsidiary has mainly been seen from the perspective of localization strategy. Based on a knowledge management and network perspective, this study presents a theoretical

link between the two topics that have been studied individually, so this study has significant theoretical implications. Second, many prior studies stress that MNCs are less inclined to appoint parent country nationals as their subsidiary CEO when the volatility of the local market is high, but the results of this study rather stress that they are more inclined to appoint parent country nationals as their subsidiary CEO. In other words, this study has theoretical implications because the results of suggest a new perspective that high volatility in the local market increases the tendency to appoint PCNs as the CEOs of subsidiaries, that enables close communication and knowledge transfer between HQs and subsidiaries. Finally, the results of this study can provide meaningful practical implications for MNCs seeking to enter overseas markets in that they provide useful practical guidelines for the appointment of appropriate subsidiary CEOs based on their internal and external embeddedness and the characteristics of the local market.

Despite these implications, this study has the following limitations. First, since this study measured the nationality of a subsidiary CEO in the dummy variable of whether he is Korean or not, it is difficult to identify the nationality of a CEO if he or she is not Korean. In future studies, the nationality of the subsidiary's CEO needs to be identified more specifically and used for analysis. Second, despite the presence of a variety of strategic considerations in the appointment of subsidiary CEOs, such as the role of subsidiaries or global initiatives of MNCs, this study only considers the network embeddedness of subsidiaries and the characteristics of the local market as major factors. For instance, HQ could increase strategic intervention to a subsidiary if the subsidiary does not have enough capabilities to manage and overcome the volatility or competition in a local market. Therefore, the impact of the interaction between the external environment and subsidiary capability can affect the CEO choice rather than that of only external environmental factors. In order to broaden our understanding of CEO choice for overseas subsidiaries, future research needs to include more diverse strategic considerations by MNCs in the research model.

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# A Comparative Study on Marine Transport Contract and Marine Insurance Contract with Reference to Unseaworthiness

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## Abstract

*Purpose* – This study analyses the excepted requirement and burden of proof of the carrier due to unseaworthiness through comparison between the marine transport contract and marine insurance contract.

*Design/methodology* – This study uses the legal analytical normative approach. The juridical approach involves reviewing and examining theories, concepts, legal doctrines and legislation that are related to the problems. In this study a literature analysis using academic literature and internet data is conducted.

*Findings* – The burden of proof in case of seaworthiness should be based on presumed fault, not proved fault. The burden of proving unseaworthiness/seaworthiness should shift to the carrier, and should be exercised before seeking the protections of the law or carriage contract. In other words, the insurer cannot escape coverage for unfitness of a vessel which arises while the vessel is at sea, which the assured could not have prevented in the exercise of due diligence. The insurer bears the burden of proving unseaworthiness. The warranty of seaworthiness is implied in hull, but not protection and indemnity policies. The 2015 Act repeals ss. 33(3) and 34 of MIA 1906. Otherwise the provisions of the MIA 1906 remain in force, including the definition of a promissory warranty and the recognition of implied warranties. There is less clarity about the position when the source of the loss occurs before the breach of warranty but the actual loss is suffered after the breach. Nonetheless, by s.10(2) of the 2015 Act the insurer appears not to be liable for any loss occurring after the breach of warranty and before there has been a remedy.

*Originality/value* – When unseaworthiness is identified after the sailing of the vessel, mere acceptance of the ship does not mean the party waives any claims for damages or the right to terminate the contract, provided that failure to comply with the contractual obligations is of critical importance. The burden of proof with regards to loss of damage to a cargo caused by unseaworthiness is regulated by the applicable law. For instance, under the common law, if the cargo claimant alleges that the loss or damage has been caused by unseaworthiness, then he has the burden of proof to establish the followings: (i) that the vessel was unseaworthy at the beginning of the voyage; and that, (ii) that the loss or damage has been caused by such unseaworthiness. In other words, if the warranty of seaworthiness at the inception of the voyage is breached, the breach voids the policy if the ship owner had prior knowledge of the unseaworthy condition. By contrast, knowingly permitting the vessel to break ground in an unseaworthy condition denies liability only for loss or damage proximately caused by the unseaworthiness. Such a breach does not, therefore, void the entire policy, but only serves to exonerate the insurer for loss or damage proximately caused by the unseaworthy condition.

**Keywords**: Burden of Proof, Marine Insurance Contract, Marine Transport Contract, MIA 1906, Unseaworthiness, 2015 Act,
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# 1. Introduction

The importance of seaworthiness appears, at first sight, to be self-evident. An unseaworthy ship is a potential danger to life. To operate an unseaworthy vessel is to invite loss or damage to cargo and damage to the environment. Logic must dictate that those who fail to satisfy the legal requirements deserve to bear the consequences of such failure. The duty to provide a seaworthy vessel should be a deterrent, promoting safe use of the sea and should provide compensation for those who innocently suffer loss in consequence of a breach of the duty. Those who place their lives and property in the hands of others, for the purpose of a marine adventure should be suitably protected by the legal requirement that all vessels be seaworthy. By such reasoning, the need for and the importance of "seaworthiness" is proven.

Reality is somewhat different from this idealized view of seaworthiness. A significant portion of the law has been developed by the courts and by legislators over the last three centuries to address this area. The scope of seaworthiness is not self-evident. The legal rules defining the issues that fall under the umbrella of seaworthiness are technical and complicated. On the other hand, in common law, the obligation of the owner to provide a seaworthy ship is absolute and in the event of breach, the owner will be liable irrespective of fault. It amounts to an undertaking not merely that they should do their best to make the ship fit, but that the ship should really be fit. On the other hand, the owner is not under a duty to provide a perfect ship but merely one that is reasonably fit for the purpose intended (Wilson, 2010). It is wise to insert terms in a contract to clarify the legal relationship.

A ship's seaworthiness is one of the most basic obligations of a shipowner in maritime law, especially in marine insurance and maritime transport contracts. Many modern charter forms expressly include the provisions of the Hague Rules, Hague-Visby Rules, Hamburg Rules or Rotterdam Rules and this practice affects the operation of the implied seaworthiness obligation. Seaworthiness is considered regardless of whether it is a voyage policy or a time policy, and whether or not the policyholder or the insured is at fault for unseaworthiness. Unseaworthiness is often triggered by insurers in marine insurance laws based on either of the two legal mechanisms mentioned above. In other words, s.39(1) of the English Marine Insurance Act 1906 (hereinafter, MIA 1906), states that "in a voyage policy there is an implied warranty that at the commencement of the voyage the ship shall be seaworthy for the purpose of the particular adventure insured." Therefore, the insurer is exempted only if it is proven that there is a lack of seaworthiness, that is, a breach of the warranty of seaworthiness. If there is a breach of the implied warranty for the ship's seaworthiness, the insurer's immunity is recognized without enquiring into the occurrence of an insurance accident due to the breach. This is in keeping with s.39(5) of the MIA, which states that "in a time policy there is no implied warranty that the ship shall be seaworthy at any stage of the adventure, but where, with the privity of the assured, the ship is sent to sea in an unseaworthy state, the insurer is not liable for any loss attributable to unseaworthiness."

The threshold question, so far as the application, as far as the application of s.11 of the English Insurance Act 2015 (hereinafter, 2015 Act) to the implied warranties is concerned, is whether there are terms defining the risk as a whole. The circumstances in which these words came to be inserted in s.11 of the 2015 Act (Gilman et al., 2018). In the absence as yet of any judicial consideration of s. 11 as yet, it is difficult to form definite conclusions as how the opening words in this section are likely to be construed by the courts. However, there is little doubt that the implied warranties under discussion, in ss.39 and 40 of the MIA 1906 are to be regarded as terms defining the risk as a whole, and are, therefore excluded from the scope of s.11 of the 2015 Act, were the point to arise in any future litigation.

As a previous study on the carrier's excepted requirements and the burden of proof for

unseaworthiness, Yang, Seok-Wan (2011) analyses the burden of proof and burden-shifting scheme under s.17 of the Rotterdam Rules comparing with the Hague-Visby Rules. Yang, Seok-Wan (2014) states that this differs from the allocation commonly employed in many jurisdictions to determine fault-based liability under which the plaintiff must prove the defendant's fault as part of its affirmative case in order to recover. Song, Ok-Rial (2009) states that the high amount of limits of carrier's liability may be the obstacle for Korea to endorse this Rotterdam Rules, but it should be more carefully observed whether such move toward shipper's interest might be an international norm in maritime law area. Song, M. (2012) analyses the rules of causation under marine insurance law from the perspective of marine losses and risks. Lee, Phil-Bok (2020) analyses the maritime case study/actual claim based on ship time insurance through governing law of English Law: Korean Supreme Court Decision 2020.6.4. Docket No.2020da204049. Kwon, Kee-Hoon (2007) examines the standpoint of the burden of proof regarding unseaworthiness, and in particular, propose a rational distribution plan of the burden of proof through a critical review of the interpretation of s.789(2) of the Korean Commercial Act. Jo, Jong-Ju (2010) states that s.17 of the Rotterdam Rules expressly states how the burden of proof is allocated between cargo interests and carrier, following the complicated approach of Hague Rules, rather than the simple approach taken in the Hamburg Rules. Jo, Jong-Ju (2016) is considering the carrier's principal recourse for defending himself in most cargo claims. Ji, Sang-Gyu (2010) states that a loss is brought to the ship due to unseaworthiness of the ship and the carrier is charged to compensate the loss, the carrier should submit substantial evidence that carrier had taken every rational and necessary measures to prevent such a loss if carrier tries to be exempted from such responsibility. Choi, Jong-Hyeon (2004) analyses the Seoul District Court Decision (2002) on the exemption of liability of a carrier based on the perils of the sea defense. In this study, it is different from previous studies in analyzing the excepted requirements and burden of proof of carrier caused by unseaworthiness through comparison of marine insurance contracts and marine transport contracts. There is the 2015 Act related to the duty of care for seaworthiness.

This study seeks to set out the parameters of seaworthiness and evaluate its importance at the present time. It explores clear relations between seaworthiness and terms in causing the loss. Furthermore, it analyses the exception requirement and burden of proof of the carrier due to unseaworthiness through comparison between the marine transport contract and marine insurance contract.

## 2. Warranty under English Law and Continental Law

### 2.1. Warranty under English Law

#### 2.1.1. The Test of Materiality

Contractual terms in English are considered conditions, warranties, or innominate. All parties will agree on how to classify each term when they start negotiating a contract (Merkin and Gürses, 2016). Traditionally, contractual terms were classified as either conditions or warranties. The category of innominate terms was created in *Hong Kong Fir Shipping Co Ltd v. Kawasaki Kisen Kaisha Ltd* : [1962] 1 All E.R. 474; [1962] 2 Q.B.26. It is important for parties to correctly identify which terms are to be conditions and which are to be warranties. Where there has been a breach of contract, it is important to determine which type of term has been breached in order to establish the remedy available.

Warranties, on the other end of the spectrum are merely minor contractual terms that are not central (i.e., "the root") to the contract. Accordingly, if a warranty is breached, the

aggrieved party may be able to recover the damages it suffers as a consequence but will not be entitled to terminate the contract, that is, bring it to an end. If the innocent party terminates the contract, they are risk of being sued for unjustified contract termination. What is considered a warranty in one contract could be a condition in a different contract. For example, the case of *Bank of Nova Scotia v. Hellenic Mutual War Risk Association (Bermuda) Ltd (The Good Luck)*: [1992] 1 AC 233, [1991] 2 WLR 1279, [1991] 3 All ER 1. It all depends on how important the term is to the parties involved. It is often the case that statements about factual matters are expressly referred to as "warranties" in a contract, such as a party warranting that it has obtained all the necessary consents in order to start a contract. A condition is part of the contract that the parties consider to be vitally important and that has to be performed. A condition is the heart of the contract and the most important part. In a contract to sell goods, a condition could take the form of a clause that says that says that the goods are required to be delivered by a certain time(e.g., *Aspen Insurance UK Ltd v. Pectel Ltd.* [2008] EWHC 2804 (Comm); [2009] 2 All E.R. (Comm) 873). In a Sale of Goods agreement this may include for example a provision recording that "time is of the essence," that is to say, it is a condition of the contract that the goods must be delivered by a specific time and that is the purpose of the contract, that is, that they arrive on time, since otherwise they may be useless to the customer.

If a breach of condition occurs, the party that is innocent can make a choice: a) End the contract and sue for damages; b) Continue the contract by performing the actions they are contractually obligated to, sue for damages, and pursue other solutions like injunctions. Significantly the type and scale of the damage arising from a breach of a condition is immaterial to the question as to whether there has been a repudiatory breach. A repudiatory breach still gives rise to the innocent party's choices.

Innominate terms or intermediate terms are terms of a contract that are in limbo and are somewhere in between a condition and a warranty. A term becomes innominate when it cannot be shown to be a condition or warranty. An important innominate term, such as one that if breached would deprive one of the parties of the entire benefit of the contract, means that the innocent party is allowed to terminate the contract and find other alternatives. For example *Ronson International Ltd v. Patrick*: [2005] EWHC 1767 (QB); [2006] Lloyd's Rep. I.R. 194, *Friends Provident Life and Pensions v. Sirius International Insurance*: [2005] EWCA Civ 601; [2005] 2 All E.R. (Comm) 145. If the innominate term is not as important, such as a term that would not ruin the entire contract if it were breached, the innocent party is not allowed to terminate the contract. In that case, the innocent party can only sue for damages.

If a breach occurs that deprives the wronged party of the entire benefit of the contract, then the term is considered a condition and would allow the party to terminate the contract (*Hong Kong Fir Shipping Co Ltd v. Kawasaki Kisen Kaisha Ltd* (1962)). If that is not the case, the term would be considered a warranty, and the wronged party would be eligible to claim damages. However, if the breach did not really deprive one party of the benefit of the entire contract, that party could be liable for wrongful termination. Parties give up a degree of certainty because an innocent party could become liable if a third party decides that the breach did not deprive them of the entire value of the contract.

In other words, Continental law, including Korea, has no distinction as described above, and if there is a breach of a contract (default), it is possible to claim damages and cancel or terminate the contract, except in cases due to utmost good faith.

### 2.1.2. Warranty under English Insurance Law

Warranty under English insurance law has a similar meaning to the terms of cancellation under general contract law, but is not the same. Looking at the conditions under the General

Contract Act (not the above conditions), the condition precedent is that the contractual obligation occurs only when the content of the condition is fulfilled, and the condition subsequent is the contractual right and obligation in effect. It occurs, but the contract becomes invalid if the conditions are fulfilled, which is the same as the Continental law.

Warranty under English insurance law is defined as an affirmative warranty (a matter that needs to be satisfied or fulfilled at the time the insurer's responsibility begins) and a promissory warranty (a matter that needs to be met or fulfilled continuously for a certain period of time). MIA 1906, however, does not distinguish between the two and defines both as promissory warranty, so there is no discrimination benefit. Also, it is divided into express warranty and implied warranty depending on whether or not it is stated in the policy.

Implied warranty exists only in marine insurance, and there are warranties of legality and warranties of seaworthiness. The warranty of legality cannot be waived by the insurer, but the warranty of seaworthiness may be waived by the insurer (Seaworthiness Exemption of cargo insurance among others).

Due to the effect of breach of warranty under English insurance law, MIA 1906 stipulates that the insurer is exempt from liability from the time of breach of warranty, but does not affect accidents that occurred prior to breach of warranty.

### 2.1.3. Promissory warranties and other terms

The English law on warranties has long courted controversy primarily because of the consequences of breach. The pre-2015 Act is set out in the MIA 1906, ss.33-41, much of which is unaffected by the new law. A promissory warranty is defined in s.33(1) as an undertaking of the assured : "…that some particular thing shall or shall not be done, or that some condition shall be fulfilled, or whereby he affirms or negatives the existence of a particular state of facts." The nature of the undertaking and consequences of breach were set out in s.33(3) of the MIA 1906, which may be summarized as follows: A warranty must be exactly complied with; it may be material to the risk or not; if not complied with, subject to policy terms, the insurer is discharged from liability from the date of the breach; but the insurer is responsible for liabilities incurred before the date of breach. The discharge from liability occurs automatically and is not dependent on the exercise of an election and/or giving notice (*The Good Luck* (1992)). Further, where there has been a breach, the assured cannot cure the breach by complying with the warranty before loss has occurred (s.34(2)). It is always possible for an insurer to waive a breach of warranty (s.34(3)). Apart from express warranties the MIA 1906 recognizes implied warranties in relation to the seaworthiness of ships (ss.39 and 40(2)) and legality (s.41). In other words, the 2015 Act repeals ss.33(3) and 34 of the MIA 1906. Otherwise the provisions of the MIA 1906 remain in force, including the definition of a promissory warranty and the recognition of implied warranties. The new provisions in the 2015 Act are set out in ss. 10 and 11 and their effect may be presented as follows: Continuing warranties are warranties where the undertaking of the assured extends continuously over the period of the policy or a shorter period specified in the policy. The consequence of breach of this category of warranty is that the liability of the insurer is suspended for the period of the breach. If the breach is remedied, the liability of the insurer is restored from the time of remedy.

The insurer is liable under the policy until the occurrence of a breach of warranty and thereafter liability is suspended until the breach is cured. Once cured the insurer is again at risk. Should the breach not be cured the liability of the insurer is suspended for the remainder of the policy period.

There is, in this regard a technicality to be noted. With regard to the suspension of liability, it is stated that the insurer is not liable for "…any loss occurring, or attributable to something

happening, after the warranty (express or implied) in the contract has been breached but before the breach has been remedied" (s.10(2)).

This provision makes it clear that when the source of loss occurs during the period that an insured is in breach of warranty but the actual loss is suffered after the breach of warranty has been remedied, the insurer is not liable.

There is less clarity about the position when the source of the loss occurs before the breach of warranty but the actual loss is suffered after the breach. Under s.10(4) the insurer appears to be liable, because the loss is attributable to something happening before the breach of warranty. Nonetheless, by s.10(2) of the 2015 Act the insurer appears not to be liable for any loss occurring after the breach of warranty and before there has been a remedy.

In other words, the rule of suspension of liability operates most comfortably with regard to continuing warranties. There is, however a class of warranties where the undertaking of the assured is of a one-off nature, relating, for example, to something specific at a point of time. They are, therefore, not continuing warranties and are defined in the 2015 Act as warranties that require. It is clear that the breach of such a warranty cannot logically be cured in the traditional manner, and, in response to this difficulty, the 2015 Act formulates a specific concept of cure.

This provision is probably best explained by examining an unexceptional example. An insurance policy on a ship contains a warranty "that a specified safety certificate of compliance will be presented to insurers within 14 days of the date of the insurance." The insurance is dated January 1, 2018. The insured fails to present the certificate within 14 days, and consequently there is a breach of warranty with cover suspended. Nonetheless, the insured presents the safety certificate on February 1, 2018. Logically, the breach of the express warranty cannot be cured: There is no way the insured can correct the failure to present the certificate by the due date. Nonetheless, applying the concept in the 2015 Act, the breach is cured on February 1, 2018, on which date the liability of the insurer is revived.

The essential nature of the risk that the insurers were accepting was the insurance of the particular ship in respect to which the specified safety certificate had been issued. When the insureds failed to produce the certificate within 14 days, this ceased to be the case and the liability of the insurers was suspended. On February 1, 2018 however, when the safety certificate was presented the risk became precisely that which the insurers had accepted when agreeing to provide the insurance. The 2015 Act deems this to amount to curing the breach.

## 2.2. Warranty under Continental Law

Continental Law countries such as Germany, and France, including Korea, are not familiar with the term "warranty": instead, the term "coverage" is used in insurance. The meaning of warranty in terms such as "warranty of seaworthiness" is a concept purely relied on in English and American law. Therefore, it is advisable to use the definition of the term when using this term, and it is common to understand the concept of nature or vice of subject-matter insured instead of using the term "warranty" in the Continental law system in terms of a ship's unseaworthiness.

In addition, s.678 of the Korean Commercial Act (Grounds for Exclusion of Insurer's Liability) does not use the term warranty, and stipulates that "no insurer shall be liable to compensate for losses caused by the nature, vice or natural wear and tear of the subject matter insured." However, since most of the marine transport laws and marine insurance laws are based on English law, their actual application is extremely limited.

## 3. Concept of Seaworthiness and Legal Provisions on Unseaworthiness

### 3.1. Concept of Seaworthiness

#### 3.1.1. The Definition of Seaworthiness

Seaworthiness classifies whether a ship has passed the required tests and safety checks to be able to sail without any mishaps. It determines whether or not the ship has been properly assessed, outfitted and maintained in accordance with admiralty law (Menon, 2020). In general, it is an abstract concept used mainly in the field of maritime law. It indicates the condition of the vessel and whether it is safe to sail.

A seaworthy vessel in a contract of affreightment (COA) implies the vessel is "fit to meet and undergo the perils of the sea and other incidental risks to which of necessity she must be exposed in the course of voyage." This renowned definition happens to be in conformity with s.39(4) of the MIA 1906, providing that "A ship is deemed to be seaworthy when she is reasonably fit in all respects to encounter the ordinary perils of the seas of the adventure insured." Sir Chalmers relied upon the ancient case, *Dixon v. Sadler*: (1839) 5M & W 405, affd (1841) 8M & W405*,* when codifying s.39 of the MIA 1906. Moreover, the ninth edition of Black's Law Dictionary defines a seaworthy vessel as one that is "properly equipped and sufficiently strong and tight to resist the perils reasonably incident to the voyage for which the vessel is insured." The only perceptible difference may be the usage of "perils of the sea of necessity", "ordinary perils of sea," and even "reasonably" in the literal sense (Song, 2012).

#### 3.1.2. Seaworthiness as a Warranty

The principle of warranty was not established and formed until the era of Lord Mansfield. His lordship set forth a definitive analysis of the law of warranty in the law of marine insurance, which substantively affected Sir Chalmers' work on the MIA 1906 in this regard (Schoenbaum, 1998). Mansfield's doctrines still remain effective, despite a heated discussion of reform.

According to s.33(1) of the MIA 1906, warranty means "a promissory warranty, that is to say, a warranty by which the assured undertakes that some particular thing should or should not be done, or that some condition should be fulfilled, or whereby he affirms or negatives the existence of a particular state of facts"(*HIH Casualty & General Insurance Ltd v. New Hampshire Insurance Co*: [2001] EWCA Civ 735). Implied warranties were recognized and stipulated by the MIA 1906, including seaworthiness and port worthiness.

In England, the rule of law that had been developed in relation to marine insurance was applied in its full extent to property and life insurance (Vance, 1911). Therefore, the legal effect of warranties and the modification of the law of warranties ought to be critically reviewed, taking seaworthiness as an example in this section (Song, 2012).

#### 3.1.3. Seaworthiness as a Cause of Loss

In s.3(1) of Hague/Hague-Visby Rules seaworthiness was defined in details. First, the physical seaworthiness of the ship itself, that is the physical shape of the ship should be fit in all aspects to carry the out the intended voyage and the manning of the ship. This implies a competent crew and the adequacy of the equipment and the ship's supply. Second, the cargo seaworthiness is important in regard to, making the refrigeration, cool chambers, and all other parts of the vessel in which goods are carried, fit and safe for their reception, preservation and carriage. From the definition it is clear that the ship must be fit for the

intended voyage to withstand the perils of the sea.

When the consignee receives the cargo in a damaged condition it is the responsibility of the carrier to show that it is not at fault for the damage and loss. The shipowner has to prove that he was diligent in providing a seaworthy ship, and the damage or loss was due to one or more of the exemption provided in s.4(2) of the Hague/Hague-Visby Rules.

Failure on the part of the ship owner to prove due diligence will make him liable for the damage and loss to the cargo. In this case, the voyage was in winter and it was windy before the ship left port, as mentioned in the scenario where the seaman was a competent member of the crew. As a competent seaman, he carried out his duty in checking the ballast tank, yet he was not diligent when it came to screwing the ballast pipe lid, for the reason that he had to finish the procedure before the ship proceeded out to sea. This is more a case of mismanagement of the ship rather than due diligence of the ship owner.

It is necessary to distinguish between two main issues when it comes to the ship's crew. The first issue is that if the crew were incompetent, the ship was not seaworthy. The second issue is that if the crew was competent and skilled as required, but negligent in their duty, it reflected ignorance and the ship was unseaworthy.

The ship was seaworthy for the voyage, but the negligence from a competent seaman to fulfill his duty affected the ship's status. However, according to ss.3(1) and 4(1) of Hague/Hague-Visby Rules, it is the responsibility of the shipowner to make sure that the ship was seaworthy in all aspects before and at the beginning of the voyage.

Exercising due diligence on the part of the shipowner can be an impossible task, if he lacks the experience. This is why many of ship owners delegate their duty to the master and the ship's crew, to make sure that the ship is seaworthy. The ship owner delegation of his duty toward due diligence to make the ship seaworthy does not mean the delegation of his responsibility of providing a seaworthy ship, it is the owner responsibility and he cannot escape responsibility by delegating his duty.

For example in the Muncaster Castle case the judge stated "There is nothing, in my opinion, Extravagant in saying that this is an inescapable personal obligation. The carrier cannot claim to have shed his obligation to exercise due diligence to make his ship seaworthy by selecting a firm of competent ship-repairers to make his ship seaworthy. Their failure to use due diligence to do so is his failure" (*Riverstone Meat Co Pty Ltd v. Lancashire Shipping Co (The Muncaster Castle)*:HL1961).

In other words, in a voyage policy of insurance on hull, the undertaking of seaworthiness is clearly defined as a warranty under marine insurance law. The basis for the implied warranty, as only found in voyage policies, is ss.45(1)-(4) of the MIA 1906, but the classic exposition remains that of Parke B in *Dixon v. Sadler* (1839).

The foundation of the implication of the warranty has been stated as being a desire to ensure that persons with an insurable interest arising out of the adventure do not, by reason of their insurance cover, grow careless of the condition of the vessel and the safety of the master and crew (*Wilkie v. Geddes, 1815*). The underwriter, when assessing the risk of a particular voyage, must have the right to assume a certain fitness of the vessel to encounter the ordinary hazards of the adventure in order to fix an appropriate premium (Bennett, 2006). Both the cases and the MIA 1906 make it quite clear that in a voyage policy, there is an implied warranty that, at the commencement of the voyage, the ship shall be seaworthy(s.45(1) of the MIA 1906). The reason for this was the general rule that a loss through decay, waste or inherent vice should not normally fall on the underwriter and the further consideration that the assured could be presumed to be well acquainted with the condition of the ship on sailing (Daimond, 1986).

Causation is a very important part in marine insurance law. The general principle in

English law is that the insurer will only be liable for any loss that is proximately caused by a peril insured against (s.55 of the MIA). At the beginning of the last century, the determination of the proximate cause in common law was considered to be the nearest in time. This approach was changed with ruling in *Leyland Shipping Co v Norwich Union Insurance Co.: [*1918] AC 350 HL, which clarified the meaning, and provided authority: Proximate cause is that which is proximate in efficiency.

The ruling in *Canada Rice Mills v. Union General Insurance Co*.: [1941] AC 55, stated that the proximate cause had to be determined "according to a broad commonsense view of the whole position." Lately, *Bingham LJ in TM Noten BV v. Harding*: [1990]. Lloyd's Rep 283, added that the commonsense view to apply was "of a business or seafaring man".

Finally, *Global Process Systems Inc v. Syarikat Takaful Malaysia Berhad (The Cendor MOPU*: [2011] UKSC5*)* provides new authority: The defense of inherent vice in cargo will be valid only when the sole reason for such loss is the nature of the cargo, without external fortuitous events. When a loss is developed with the assistance of an external circumstance as by action of wind and waves, the dominant cause of the loss is perils of the sea.

This decision refers to a case in which the Insurance Company, Syarikat Takaful, rejected a claim of a loss. On May 2005, Global Process Systems (the assured) bought an oil rig "Cendor MOPU" to be transported on the towed barge "Boagarge 8" from Galveston, Texas (U.S.) to Lumut in Malaysia. The rig had three legs (tubular structures). The oil rig was insured with an all-risk policy that incorporated the Institute Cargo Clauses (ICC A). The moment the barge arrived at Saldanha Bay, some repairs were made according to recommendations by the surveyors approved by the insurers. A considerable degree of fatigue cracking around the pinholes of the legs of the oil rig was found. These repairs did not prevent the failure of the legs. One of the legs first broke off and fell into the sea. The next day, the two other legs fell off as well. The insurers rejected the claim based on inherent vice.

Blair J, in Commercial Court rejected the claim considering that "the proximate cause of the loss was the fact that the legs were not capable of withstanding the normal incidents of the insured voyage from Galveston to Lumut, including the weather reasonably to be expected." He also concluded in fact, that the loss was very probable but not inevitable. The Court of Appeal reversed the decision with the opinion that the "proximate cause of the loss was an insured peril in the form of the occurrence of a leg breaking wave, which resulted in the starboard leg breaking off, leading to greater stresses on the remaining legs, which then also broke off." The insurers appealed before the Supreme Court.

The Supreme Court on February 1, 2011, unanimously dismissed the appeal. The essential question in this case for the Supreme Court was one of causation: The loss was caused by an inherent vice in the legs, or as a consequence of peril of the seas, or the concurrent two competing causes.

The meaning of the words "privity of the insured" was considered by the Court of Appeal in *The Oceanus Mutual Underwriting Association (Bermuda) Ltd. (The Eurysthenes)*: [1976] 2 Lloyds Rep 171. Here, it was decided first, "privity" in this subsection means not only knowledge of the facts constituting the unseaworthiness but also knowledge that those facts rendered the ship unseaworthy. Second that the persons whose knowledge is relevant are the insured himself in the case of an individual insured, or their alter ego in the ca of a company(Gilman et al., 2018).

The principle that "blind eye knowledge" can amount to privity for the purposes of s.39(5) of the MIA 1906 is confirmed by the decision of the Lords in *Manifest Shipping Co Ltd v. Uni-Polaris Shipping Co Ltd and others(The Star Sea):* [2003] 1 AC 469; [2001] 1 All ER (Comm) 193; [2001] 2 WLR 170. Roskill LJ's use of the phrase "had he thought of it" in the cited passage was questioned by both Lord Hobhouse and Lord Scott, in their respective speeches. This

phrase might be read as suggesting that the test is objective. That is not correct the test is subjective. For "blind eye knowledge" to be established, it must be shown that the insured believed or suspected that the vessel was unseaworthy in the relevant respects and made a deliberate decision not to check the ship in order to avoid gaining direct knowledge of what he had reason to believe was her unseaworthy state.

"An imputation of blind eye knowledge," said Lord Scott in *The Star Sea(2001)*, "requires an amalgam of suspicion that certain facts may exist and a decision to refrain from taking any step to confirm their existence." Both requirements must be present, for privity to be established on the basis of blind eye knowledge. The suspicion, according to Lord Scott must be firmly grounded and targeted on specific facts not merely a vague feeling of unease, and the decision to refrain from inquiry must be a deliberate decision to avoid obtaining confirmation of facts in whose existence the insured had good reason to believe. To treat a decision not to inquire into vague speculative suspicions as tantamount to knowledge would allow negligence to become the basis for a finding of privity, which is not warranted by s.39(5) of the MIA 1906(Gilman et al., 2018).

### 3.1.4. Seaworthiness and Cargo- Worthiness

Seaworthiness is the ability of the vessel to safely navigate the intended waters, meaning that its hull, engines and general instruments are in safe condition prior to and during the commencement of the intended voyage. Cargo-worthiness refers to the suitability of the vessel to safely carry out the transportation of the intended cargo for a particular voyage. From the technical perspective, to determine cargo-worthiness, it is very important to consider load distribution, cargo securing, type of cargo, machinery and equipment and good seamanship (Gard, 2020).

Seaworthiness is a relative term, and the ship only needs to be seaworthy for the purpose of the particular voyage. The vessel must be sufficiently seaworthy to meet the perils likely to be encountered on the intended voyage. Seaworthiness embraces not merely the condition of the ship generally but also the suitability and adequacy of her equipment, bunkers, and so on, the sufficiency and competency of her master, officers and crew, and what has been described as cargo-worthiness.

In *Texaco Inc. v. Universal Marine:* 400 F. Supp. 311, 312-13. (E.D. La. 1975) the Court stated that "Since the term seaworthiness is a relative one, its meaning is dependent upon the vessel involved and the service in which it is to be employed. In general, a ship must be sufficiently strong and staunch and equipped with the appropriate appurtenances to allow it to safely engage in the trade for which it was intended. Put in another way, the ship must be fit for the use intended." A vessel can be tight, staunch, strong and in every way, and prepared for safe navigation, but at the same time it may still be unseaworthy in relation to certain cargoes so that the shipowner would be liable for the loss of or damage to cargo resulting from the absence of the attribute of cargo-worthiness necessary for the proper carriage of that particular cargo.

Unseaworthiness of a ship can result in the shippers not paying the freight (if the vessel was unseaworthy before the reception of the cargo on board) or the cargo underwriter voiding his policy; it may affect the responsibility of the vessel in a case of collision, the COA could be void, it may modify the understanding of general average to the executed sacrifices, and it may eliminate the carrier limitation of liability (Gard, 2020).

The carriage of Goods by Sea Act of 1924 modified the law regarding the obligation of the shipowner to provide a seaworthy vessel for the carriage of goods by sea. Substituting the absolute warranty of seaworthiness, an undertaking that the shipowner should exercise due diligence to make the ship seaworthy was agreed upon. This Act governs the contractual

relationship of the shipowner and cargo owner under the COA, and the concession to shipowners means that it is possible for the cargo owner to fall between two stools in the event of the unseaworthiness of the vessel.

Due to the absolute warranty in marine insurance, the underwriters could void their policy if the ship were found to have been unseaworthy at the beginning of the voyage, and his claim for loss or damage to the cargo would be against the shipowner. With the implementation of the Carriage of Goods by Sea Act(COGSA), though the ship may admittedly be unseaworthy, the shipowner may possibly establish that it was not discoverable by the exercise of due diligence and be able to refuse liability (Baatz et al., 2008).

The meaning of due diligence is of key importance in the event of unseaworthiness. It means that reasonable conduct under time and place circumstances was exercised. The Brussels 1967 Conference pointed out that due diligence should not be understood as the action of making vessel seaworthy, but exclusively what is adequate to the particular case. Such diligence must be exercised before and at the commencement of the voyage.

Due diligence is an exclusive responsibility of the shipowner. This responsibility cannot be transferred to another party. Even when the shipowner demonstrates due diligence in the employment of high quality and very professional providers, their failing in their responsibility would still fall onto the shipowner's shoulders. If they did not fail we may still face a case of unseaworthiness undiscovered under the exercise of due diligence the shipowner may refuse liability (Gard, 2020).

## 3.2. Legal Provisions on Unworthiness

### 3.2.1. Development of the Legal Concept of Seaworthiness

The ship owner who is also the captain of a vessel should need little legal incentive to do everything possible to safeguard his own life and that of his crew. Likewise, he would wish to protect his financial investment in the vessel or any other vessels that he might own. If the ship owner also owns the cargo a similar concern for the cargo would apply. The only exception might be where the pursuit of profit tempts a ship owner to throw caution to the wind and take unacceptable risks. No law could protect against the human risk factor. Apart from that, the ship owner does not, in such situations, need any legal incentive to take care. There is no need at that stage for the law to develop the notion of seaworthiness. As far back as the fourteenth century (Hughes, 1994), the courts had to deal with the problem of ensuring that carriers took proper care of their clients' cargo. English law developed the notion of the common carrier, whereby in the absence of an Act of God, King's Enemies, and inherent vice in cargo, liability for any damage to cargo carried on board a vessel rested with the ship owner, provided the vessel operated as a common carrier (*Coggs v. Bernard,* [1703] 2 Ld Raym 909*; Forward v. Pittard,* [1785] 1 TR27). To reiterate, there was no pressing need at this point for the notion of seaworthiness to protect cargo owners' interests (Safewatersmarine, 2016).

The developments of lucrative trades whereby the profits from successful voyages outweighed occasional losses, charter parties that placed the responsibility for loss of a vessel on the charterer, the availability of insurance, and the legal ability to exclude liability for damage to cargo as an uncommon carrier (*Liver Alkali Co. v. Johnson:* [1874] LR EX338*; Paterson Steamship Ltd v. Canadian Cooperative Wheat Producers*, [1934] AC 538) altered this state of affairs. The concept of seaworthiness was developed by the courts to place a legal duty on ship owners and carriers to furnish a vessel fit for its purpose.

The courts have variously described the duty in the context of the issue at hand. The search for a single all-embracing definition of seaworthiness has proved elusive. This is because, while definitions of seaworthiness in relation to marine insurance, carriage of goods, and

simple and demise charterparties, which may be further subdivided into time and voyage charterparties, contain general principles that are interchangeable, the context in which the definition is provided means that certain features are restricted to application in that field alone (Gilman et al., 2018; White, 1996).

### 3.2.2. Unseaworthiness under Marine Transport Law

S.794 of the Korean Commercial Act (Duty of Care for Seaworthiness) stipulates that "A carrier shall be liable to compensate for any damage arising out of the loss of, damage to or late arrival of cargo unless he/she proves that he/she, the crew, or other employees of a ship have not failed to exercise due care concerning the following matters at the time of departure": 1. ensuring the ship voyage to be made safe; 2. boarding of the necessary crew and supply of equipment and necessities of the ship; 3. maintaining the hold, cold storage room, and other parts of the ship to load the cargo suitable for reception, transportation and preservation of the cargo. Therefore, the Korean Commercial Act restricts the warranty of seaworthiness to the time of departure and not as an absolute duty of care. This provision, like the Korean Commercial Act, requires a considerable duty of care (the Korean Commercial Act relies on the Hague-Visby Rules).

Therefore, the shipowner is not liable for all responsibilities due to unseaworthiness, and even if the ship was unseaworthy, the owner is exempted from liability if the ship has fulfilled its obligations to pay attention to seaworthiness before and at the beginning of the voyage. In addition, the carrier cannot claim indemnity or limit liability for accidents caused by breach of the ship's obligation to pay attention to seaworthiness at the time of departure. In the English law, this is considered a fundamental breach, and if there is a basic breach, the permitted immunity cannot be relied on; Korean precedents are also interpreted in the same way in the result.

### 3.2.3. Unseaworthiness under Marine Insurance Law

S.39(4) of MIA 1906 stipulates that "a ship is deemed to be seaworthy when she is reasonably fit in all respects to encounter the ordinary perils of the seas of the adventure insured." This is different from the seaworthiness obligation under the Contract of Carriage Act (Hague-Visby Rules). It means that the vessel is in a condition suitable enough to encounter the ordinary perils arising from repairs, equipment, crew and all other insured voyages at the time of departure (*Dixon v. Sadler* (1839)).

Seaworthiness under the insurance law is considered to have similar contents to seaworthiness under the Contract of Carriage Act, but according to Gow's view, seaworthiness under the English insurance law is as follows (Gow, 1914): "The Vessel's fabric must be fit as far as a vessel of the kind can be: her gear must be sufficient in quantity and quality: she must be completely, commanded, officered and fully manned: she must be properly provisioned: she must not be overloaded; and if she is a steamer, she must be adequately supplied with fuel".

The effect of the warranty is that, if the vessel is not seaworthy, the insurer is not liable for any loss or damage, whether that was proximately caused by unseaworthiness."(*The Cendor MOPU* (2011))

In other words, it is arguably "desirable...as a matter of public policy and concern, that some which obligation of keeping his vessel, as far as it is within his power, seaworthy, should be cast on a shipowner" (*Dudgeon v. Pembroke*: [1877] 2 A.C. 284) under a time policy. However, the existence of such a general rule was denied by the House of Lords in *Gibson v. Small*: [1853] 4HLC 353, where it is stated that, since time policies commonly commenced during

performance of a voyage, it would be wrong to impose an obligation at that time when it would not exist in a voyage policy. At that at that time the assured would generally be unaware of the condition of the vessel, an implied term therefore defeating the object of the insurance, and the advantage of a plain rule outweighing creation of an exception where he was so aware. However, such a rule would not prevent the underwriter from avoiding the policy for fraud or non-disclosure of circumstances actually known to the assured (*Gibson v. Small,* 1853; *Fawcus v. Sarsfield*: [1856] 6E1 & B1192), from covering himself by introducing an express warranty or from insisting on an adequate premium (*Thompson v. Hopper*: [1856] 6. And B.172), or from defending a claim on the ground that the loss was caused by inherent vice (*J. J. Lloyd Instruments Ltd v. Northern Star Co. Ltd. (The Miss Jay Jay),* 1985; 1 Lloyd's Rep. 270; *The Cendor MOPU* (2011)).

Thus, it was established that "the law does not, in the absence of special stipulation in the contract, infer in the case of a time policy any warranty that the vessel at any particular time shall have been seaworthy"(*Dudgeon v. Pembroke*, 1877; *Gibson v. Small*, 1853; *Thompson v. Hopper*, 1856*; Fawcus v. Sarsfield*, 1856). The general rule is therefore that in a time policy there is no implied warranty that the ship will be seaworthy at any state of the adventure (s.39(5) of the MIA 1906).

This is, however, subject to the exception that, "where, the privity of the assured, the ship is sent to sea in a state, the insurer is not liable for any loss attributable to unseaworthiness"(Rose, 2012). To avoid liability, the insurer bears burden of proofing that unseaworthiness was a cause of the loss that the assured was privy to sending the vessel to sea in a unseaworthy state (*Marina Offshore Pte Ltd. v. China Insurance Company (Singapore) Pte Ltd.(The Marina Iris)*: [2006] SGCA 28; (2007) 1 Lloyd's Rep. 66). It has also been accepted that they must prove the identity of the particular person with the requisite knowledge of the vessel's unseaworthiness and, where the defendant is a company, who could be regarded as the company's alter ego (*The Marina Iris,* 2006). In practice, it may be necessary to prove the privity of a particular human agent in order to demonstrate the privity of a corporation. However, since the matter to be proved is the privity of the assured, rather than how the assured came to be privy, it should be sufficient if the insurer can prove that the unseaworthiness must have been with the privity of someone who could be regarded as the company's alter ego, without having also to prove exactly who was the responsible natural person. In *The Eurysthenes* (1977), the Court of Appeal refrained from deciding exactly in whom the relevant privity rested, although Lord Denning M.R. opined that there is privity of "the assured" for this purpose where there is knowledge or concurrence of "the assured personally, or of alter ego". In the context of operating a vessel, this should encompass the ship's managers or superintendent employed by the owners for this purpose.

The assured has the relevant privity if the insurer proves that he has knowledge both of the facts concerning the unseaworthiness and that those facts rendered the ship unseaworthy or that he deliberately refrained from receiving or seeking better knowledge of such facts of which he was unsure (*The Eurysthenes,* 1977; *CN Vascongada v. British & Foreign Mar Co. Ltd. (The Gloria),* 1935; *Frangos v. Sun Ins Office Ltd,* 1934; *Mountain v. Whittel,* 1921; *M Thomas & Sons Shipping Co. Ltd. v. London & Provincial Mar & Gens Ins Co. Ltd.,* 1914). This has been described as fault or misconduct (*Thomas v. Tyne & Wear SS Freight Ins Assn,* 1917). However, it does not include mere omission, negligence, or even willful misconduct, unless the foregoing test is satisfied (*The Eurysthenes,* 1977; *CN Vascongada v. British & Foreign Mar Co. Ltd. (The Gloria)*: [1935] 54 Ll LR 35). It is not equivalent to "actual fault or privity" under the previous law on limitation of liability. Thus, an assured is not deprived of cover where unseaworthiness was due to a latent defect (*The Miss Jay Jay, 1*985). The insurer remains liable where seaworthiness requires a crew of 14 and the assured knows there is a

crew of only 12 but believes this sufficient, but not if in such a case the assured sends only 10 (*The Eurysthenes*, 1977). The assured does not have privity for this purpose simply because he has "blind eye knowledge"-i.e., he has refrained from discovering the truth-unless he is shown to have had a suspicion of or belief in the vessel's unseaworthiness and had deliberately refrained from making relevant enquiries.

Negligence or gross negligence is insufficient (*The Star Sea,* 2001). In particular, the assured should be entitled to disclaim privity to unseaworthiness where the seaworthiness is by warranty to be determined by an expert opinion upon which he relies (*Marina Offshore Pte Ltd. v. China Insurance Company (Singapore) Pte Ltd. (The Marina Iris),* 2006). Nonetheless, the insured should be entitled to the defense if he can show that a favorable expert's report did not, as a matter of construction, relieved the assured of proven privity to unseaworthiness.

Although s.39(5) of the MIA 1906 states that, "where, with the privity of the assured, the ship is sent to sea in an unseaworthy state, the insurer is not liable for any loss attributable to unseaworthiness," it has been held that the insurer is relieved only where the loss was caused by seaworthiness to which the assured was privy (*Thomas v. Tyne & Wear SS Freight Ins Assn*: [1917] 1K.B.938). However, it is not necessary for such unseaworthiness to be the sole cause of the loss, provided it was a proximate cause (*M Thomas & Sons Shipping Co. Ltd. v. London & Provincial Mar & Gens Ins Co. Ltd.,*: [1914] 30 TLR 595). Parties can avoid the effect of the rule under discussion by contracting out of it, either totally or partially.

S.706(grounds for exclusion of marine insurers' liability) of the Korean Commercial Act states that "No insurer shall be liable to compensate for the following losses and expenses: 1. If a ship or freight has been insured, any loss arising from the failure, at the time of departure, to make preparations necessary for a safe voyage or to have necessary documents on board; 2. If cargo has been insured, any loss arising from bad faith or gross negligence of the charterer, consignor, or consignee; 3. Pilotage dues, port charges, light dues, quarantine fees, and other ordinary expenses incurred in relation to the ship or cargo in the course of a voyage". Unseaworthiness requirements under the Korean Commercial Act, applicable only to ship insurance and freight insurance (seaworthiness is not required for cargo insurance) are as follows: The failure, at the time of departure, to make preparations necessary for a safe voyage or to have necessary documents on board. The Korean Commercial Act only stipulates seaworthiness for ships, freight and cargo. It does not stipulate protection and indemnity (P&I) insurance, and applies the insurer's immunity for seaworthiness defects only to ship insurance and freight insurance, and Seaworthiness is not required for cargo insurance.

Continental law regards unseaworthiness as an inherent vice or nature of the subject matter insured (s.678 of Korean Commercial Act). Unless the policy otherwise provides, insurers are not liable for them, but the Continental law requires a causal relationship between unseaworthiness and the occurrence of an accident. The insurer must prove that unseaworthiness is the cause of the accident in order for the insurer to be indemnified (same as the causal requirement under time policy of the English law).

In Korean Supreme Court Decision (Docket No.2020da204059), the issue discussed was whether defendants who are insurers can be exempted due to the unseaworthiness of the ship in this case is the key issue in this case. This is a question of whether the plaintiff breached the warranty of seaworthiness under the MIA 1906 (Lee Phil-Bok, 2020). Decision of the first instance decision denied this, but the decision of Court of Appeals affirmed it, and it was held that this decision judged of the Court of Appeals was legitimate. In the case of the time policy, in principle, implied warranty for seaworthiness does not exist, but the insurer's indemnity is recognized if "the insured makes the ship sail even though he knows that there is no seaworthiness." The burden of proof for this lies with the insurer. According to the MIA 1906, the insured's privity is a concept that includes not only "actively knowing that it is

unseaworthiness", but also "letting it go without taking measures to equip it even though knowing that there may be no seaworthiness." This includes not only the insured's own privity, but also the privity of those who can be regarded as his alter ego (Korean Supreme Court Decision (Docket No.2003da312992005)). In the first instance of this judgment, the grounds that the towing method chosen by the plaintiff was a cause of the incident was insufficient grounds to show that there was no seaworthiness of the ship in this case, or that the plaintiff, who is the insured, was aware of the lack of seaworthiness of the ship in this case. The defendants' defense was rejected. However, decision of the Court of Appeal found that, through a wider examination of evidence, the case vessel was not capable of withstanding ordinary perils on the voyage, in which three barges were towed in winter and transported to Tanzania by sea route. The plaintiff admitted that there was privity as a result of the fact that the plaintiff was aware of this, or at least knew that it may not be seaworthy, but avoided measures to equip it and allowed the ship to leave.

### 3.2.4. The Effect of unseaworthiness in P&I insurance

In the case of P&I Club, which is governed by English law, warranty of seaworthiness is not required because P&I Club is a time policy under the English insurance law. However, given the fact that the ship owner had the privacy of the fact that the ship owner knew that the ship was unseaworthy at the time of departure, it is necessary to prove that the ship's unseaworthiness was an effective cause of the accident, but it is very difficult to prove this in practice (*The Star Sea, 2001, 2003*).

In *The Eurysthenes* (1976), the contract between the Club and the owners was a time policy within the meaning of the s.25 of the MIA 1906, and that although the Club conditions specifically covered the assured's liability arising out of unseaworthiness or unfitness of the entered ship, the Club was entitled to rely on any defense available under s.39(5) of the MIA 1906. It is necessary for underwriters to prove that the unseaworthiness was an effective cause of the loss. This is frequently very difficult to do in practice (Goodacre, 1981).

Furthermore, the MIA 1906 separately stipulates the insurer's immunity against accidents caused by inherent vice or nature of the subject matter insured, apart from the warranty of seaworthiness (s.55 of the MIA 1906).

It is natural that this is an affirmative warranty in subject matter insured for the purpose of warranty of in case of accidents.

In other words, the Korean Commercial Act does not have rules related to seaworthiness for P&I insurance, and it is questionable whether P&I insurance can apply seaworthiness requirements to ship insurance or freight insurance by analogy. Therefore, it seems that the problem of unseaworthiness should be solved by the nature or vice of subject matter insured or defects unless otherwise specified.

When the problem of seaworthiness is interpreted as the nature or vice of subject matter insured, it occurs in the subject matter insured. The vice of subject matter insured is common to the subject matter insured and similar items. As a result, some scholars distinguish defects that exist by chance from those that have always existed. However it seems that many theories consider the nature of vices as the same concept without distinguishing them.

Since the nature or vice of subject matter insured lacks contingency in the insurance contract, the theory of insurer immunity is common, but it is understood that insurance coverage is possible if the policy holder or insured is not sure that an accident will occur.

However, the nature or vice of subject matter insured, unlike the warranty under the English Insurance Act, require a causal relationship.

In summarizing the above, the continental legal system, including Korea, interprets unseaworthiness as nature or vice of subject matter insured. Unless there is a provision to

warrant it, the insurer is exempt from the liability for compensation. In order for the insurer to be free from liability for compensation, but for the insurer to be exempt from liability for compensation, the insurer must prove that there was unseaworthiness and that the fact and accident was caused by unseaworthiness (a significant causal relationship).

However, if there is any other content in the terms of warranty, regulations, or rules, this content may take precedence. So it seems that determining whether final warranty should be secured is only possible after reviewing all the regulations in full.

### 3.2.5. Consequences of Breach

Where a vessel is delivered to the port of loading in an unseaworthy condition a voyage charterer may choose to refuse to taking delivery of the vessel and treat the breach as bringing the charterparty to an end (*Stanton v. Richardson,* 1874; *Hong Kong Fir Shipping v. Kawasaki Kisen Kaisha* (*The Hongkong Fir,* 1962; *Seachem Tankers, Ltd. v. Oxyde Chemicals, Inc* (*The Peaceventure L. and Prideventure L. SMA No. 3137, 21 Dec 1994*). Whether or not this option is available to the charterer depends on how unseaworthy the vessel is and how long it is likely to take to restore the vessel to a seaworthy condition. Similarly, a voyage charterer is entitled to refuse to load an unseaworthy or uncargo-worthy vessel, at least until it is rendered seaworthy or cargo-worthy by the shipowner *(Cargo Per Maori King v. Hughes: [1895] 2 Q.B. 550)*. Clearly, where it is not possible to return the vessel to a seaworthy or cargo-worthy state, the charterer can reject the vessel and they are under no obligation to load the vessel.

Rejection of the vessel must be on the grounds that the vessel cannot fulfil the contractual voyage within a reasonable time scale due to unseaworthiness (*McAndrew v. Adams:* [1834] 1 Bing N.C. 29). What the courts will or will not consider to be "reasonable" in the circumstances of any particular case provides an unwelcome and unpredictable element of uncertainty (Safewatersmarine, 2016).

A charterer may be able to claim damages for loss suffered due to a delay in sailing brought about by the unseaworthiness of the vessel at the port of loading. The right to damages is not automatic. The purpose of damages in the law of contract is to compensate the innocent party for losses sustained by a breach of contract (*Hadley v. Baxendale:* [1854] 9 Exch 341*; Victoria Laundry (Windsor) Ltd v. Newman Industries Ltd.:* [1949] 2 KB 528). The plaintiff must show that unseaworthiness caused the loss (*The Europa,* 1908). Extended voyage time is likely to increase operational costs for the shipowner rather than the charterer. A shipowner cannot recover demurrage from a charterer for delay occasioned by the shipowner himself (*Abrahams v. Herbert Reiach Ltd:* [1922] 1 KB 477). The most common forms of loss in this context occur when cargo is delivered late and the carrier has to pay compensation to a shipper for late delivery (*SS Ardennes (Cargo Owners) v. SS Ardennes (Owners) (The Ardennes):* [1951] 1 KB 559)*,* or, the market price of goods is adversely affected by late delivery (*Koufos v. C Czarnikow Ltd (The Heron II):* [1876] 1 QBD 377). This is quite common in fluctuating commodity markets. Equally, there are times when the charterer suffers no loss because of unseaworthiness and cannot therefore recover substantial damages.

### 3.2.6. Limitation of liability

Even where a carrier is liable for damage caused by unseaworthiness or uncargoworthiness, whether under the common law implied term or under the Hague-Visby Regime the cargo owner may not be able to recover damages in full. On December 1, 1986 the Convention on Limitation of Liability for Maritime Claims (The Convention) 1976 became law by virtue of Schedule 4 of the Merchant Shipping Act 1979. Ss.1(1) and (2) permits shipowners and charterers to limit liability for claims. Ss.2(1)(a) and (b) state that claims in respect of loss or

damage to property and claims resulting from delay in the carriage by sea of cargo are subject to limitation of liability (Safewatersmarine, 2016).

The Hague-Visby Rules system of limitation continues to apply to those areas governed by it. The right to limit under the Hague-Visby Rules in respect of seaworthiness requires that the carrier have exercised due diligence. In respect of those areas covered by s.3(2)(q) of Hague-Visby Rules a person seeking to avail himself of the limitation rights under the Rules must show that neither the actual fault or privity of the carrier nor the fault or neglect of the agents or servants of the carrier contributed to the loss or damage(Singh, 2011).

S.4 of the Limitation Convention governs situations where limitation is not permitted. S.4 replaces the limitation requirements formerly governed by s.503 of the Merchant Shipping Act 1894, which was also couched in terms of actual fault and privity. These were discussed in the case of *The Erst Stefanie* (1989), which concerned a Gencon voyage charterparty for the carriage of ferrosilicon from Rijeka to Rotterdam. Mr. Baker, a director of Sorek, the owners, regularly inspected the vessel. He did not appreciate the poor condition of the vessel's bottom plating which was defective, or the nature of ferrosilicon which gives off dangerous fumes when exposed to moisture. The accommodation quarters were not gas sealed. The vessel developed serious leaks during a voyage. Fumes killed a crew member and other crew members became seriously ill. The vessel entered three ports of refuge successively and the voyage was abandoned at the third. The charterers and owners cross claimed for damage and General Average. Arbiters found against the owners since the vessel was unseaworthy but permitted limitation of liability under s.503 of the Merchant Shipping Act 1894 finding no actual fault or privity in Mr Baker. On appeal it was held that there was actual fault and privity by Mr Baker who could be considered to have acted on behalf of the governing mind and will of the corporation. Limitation was not allowed (Safewatersmarine, 2016).

It is submitted that it will be far harder to defeat limitation of liability applications under the new rules. Intent to cause loss or recklessness with knowledge' is far harder to establish than "actual fault or privity." Therefore, carriers will find it easier in the future to reduce the extent of their liability for the consequences of operating unseaworthy vessels.

## 4. Burden of Proof of Seaworthiness and its Implications

### 4.1. Burden of Proof of the Unseaworthiness under Marine Transport Contract

The burden of proof of unseaworthiness rests on the part alleging it, although in many cases they may be assisted by inferences drawn by the court. Thus, the presence of seawater in the hold will normally be treated by the courts as prima facie evidence of unseaworthiness (Wilson, 2010). Having established breach of this undertaking, however, it will then be incumbent on the claimant to establish that the unseaworthiness caused the loss of which he is complaining about (The Europa, 1908). In the case of International Packers v. Ocean Steamship Co. (1955) a cargo of tinned meat shipped from Brisbane to Glasgow was damaged by seawater during the voyage as the result of tarpaulins being stripped from the hatch covers during a storm. On hearing that the vessel was equipped with locking bars designed to secure the hatches, the trial judge held that the loss was caused not by the unseaworthiness of the vessel but by the negligence of the crew on failing to make use of the equipment provided (Boyd et al., 2008). Similarly, the cargo owner failed to discharge the burden of proof and it was unclear that the damage resulted from bad stowage rather than from any unfitness of the vessel to receive the contract cargo (The Thorsa, 1916).

If damage occurs due to the unseaworthiness of the ship, the negligence of the carrier is presumed, and in order for the carrier to be exempt from liability, it must be proved that all reasonable steps have been taken to prevent such damage. In other words, the carrier can be exempted from liability for damages by proving that due diligence care has been taken to provide a ship with seaworthiness. S.796 of the Commercial Act, like international conventions, places the burden of proof on the carrier. However, in order for the carrier to use the indemnification provisions or limitation of liability provisions under THE Commercial Act or international agreements, it must be proved that all reasonable and necessary measures have been taken (Ji Sang-Gyu, 2010).

A case for claiming damages due to the loss of a maritime transport or delay in delivery begins with the evidence of a "prima facie case." The Rotterdam Rules codify this prima facie case in s.17(1), enabling the proof of the presumed reason for the carrier with two means: issuance of a non-reserved bill of lading by the consignor and the acceptance of the shipment in good condition (Yang Seok-wan, 2011).

The problem here is regarding who bears the burden of proving the causal relationship between the facts of unseaworthiness and whether the damage to the transport is caused by unseaworthiness. This point is not clear in the Hague-Visby Rules or the Hamburg Rules, and each country's approach to this is different (Choi Jong-Hyeon, 2004; Kwon Kee-Hoon, 2007; Jo Jong-Ju, 2010; Schoenbaum, 2001). The Rotterdam Rules inherits the existing framework of international norms for the occurrence of the carrier's liability, and only requires proof of the fact that the consignor has suffered damage during the storage of the carrier in the case of a duty of caution regarding the shipment. In particular, in the case of duty of seaworthiness, it stipulates that the burden of proof for the breach lies with the shipper (s.17(5)) (Yang Seok-Wan, 2011).

The case where the sea carrier is liable is when there is a breach of duty of seaworthiness and when there is a breach of the duty of care for the shipment. Breach of the duty of seaworthiness and the breach of the duty of care for the goods are both liable for negligence (s.17(2)), and it is assumed that the maritime carrier is at fault (Song Ok-Rial, 2009).

The duty of seaworthiness is the overriding duty for the carrier to enjoy immunity. The Rotterdam Rules impose a special duty on carriers, the duty of seaworthiness (s.14). S.3(1) of the Hague-Visby Rules, s.794 of the Korean Commercial Act, and the Hamburg Rules do not stipulate the duty of seaworthiness, which is not limited to the time of departure, but is intended to continue to bear this duty during voyage. At sea, the carrier must pay due diligence to the following aspects of seaworthiness prior to commencement and during the voyage: a) ensuring that the vessel can withstand the voyage and maintain it; b) ensuring that the crew's embarkation, the ship's design, and the supply of necessary goods are appropriate and that the crew's embarkation, the ship's design and supply of the necessary goods are maintained throughout the entire voyage; c) keeping the hold, the place to load the goods, and all containers for transporting the goods provided by the carrier in a condition suitable for receipt, transportation and preservation of the goods. If this is breached, the person shall be liable for damages caused by loss, damage, or delay in delivery (s.14). The time at which the carrier bears the duty of seaworthiness is before and at the beginning of the voyage under s.3(1) of the Hague-Visby Rules or s.794 of the Korean Commercial Act. That is, it was from the start of shipment to the time of departure, but the Rotterdam Rules expanded it to cover the entire maritime transportation period. However, the burden of proof for unseaworthiness is borne by the shipper (s.17(5)) (Yang Seok-Wan, 2011).

In other words, breach of seaworthiness functions as a basis for causing the carrier to be liable for damages. The Rotterdam Rules stipulate a continuing obligation as a duty of care regarding the seaworthiness of ships used to fulfill the contract of carriage. If the underlying

reason for unseaworthiness appears prominent during the voyage, or if a new reason occurs after the commencement of the voyage, the carrier must show that he has not neglected considerable attention regarding the reason for unseaworthiness. Since the duty of care is relative, the degree or extent of the duty of care for the seaworthiness of the ship will be different when the ship is in port and when it is sailing (Cho Hyun-Sook, 2010). The duty of seaworthiness is a separate duty independent of the duty of care for the shipment (Berlingieri, 2008).

On the other hand, the Rotterdam Rules take over the existing framework of international norms for the occurrence of the carrier's liability. They only require proof that the consignor incurred damage during the storage of the carrier in the case of the duty of due diligence (commercial negligence) on the shipment (Tetley, 2008). In particular, in the case of the duty of seaworthiness, it stipulates that there is a burden of proof for the breach (s.17(5)). In general, if the carrier neglects the duty of seaworthiness they are liable for damages incurred, irrespective of the obligation to pay attention to the cargo, but the Hague-Visby Rules and Hamburg Rules do not clearly stipulate who bears the burden of proof. Under Hague Rules and Hague-Visby Rules, in the case of damage to the shipment, the burden of proof and proof of fact to determine the liability are generally: i) proof of the fact that the damage has occurred, ii) the carrier's cause of damage, and iii) order of proof of performance of the carrier's duty of seaworthiness. However, when the carrier claims immunity, the necessity to prove that the duty of seaworthiness has been fulfilled as a prerequisite is divided into a position denying the premise of duty of seaworthiness and an affirmative position (Yang Seok-Wan, 2011).

In contrast, the Rotterdam Rules specifically stipulate how to distribute the burden of proof between the carrier and the consignor (s.17). Rather than a simple approach to the Hamburg Rules, the ping pong method of burden of proof, which is almost similar to the Hague Rules, is chosen with an important immunity (Maraist, Galligan and Maraist, 2003).

Furthermore, the approach is similar to the Hague-Visby Rules, but the Rotterdam Rules are in contrast to the legal framework and text (Song Ok-Rial, 2009; Jo, Jong-Ju, 2010). According to the Rotterdam Rules, if the shipper proves that damage has occurred to the shipment in transit (s.17(1)), the carrier is not liable for liability if it proves that it has fulfilled its duty of care or that it is a cause for indemnification (s.17(2), (3)) (Yang Seok-Wan, 2011). In this case, in order for the shipper to take responsibility again, it is sequentially stipulated that the carrier must prove that he has breached the duty of seaworthiness (s.17(5)) (Song Ok-Rial, 2009).

However, if the cause of the damage results in being included in the grounds for indemnification, the burden of proof of the carrier's negligence is converted to the shipper. This in turn does not result in the carrier evading responsibility. Even if the cause of the damage is the uninsured risk, if the shipper proves the negligence of the carrier, then the reason for exempt does not protect the carrier's full or partial liability. In addition, the cause of the indemnification is not effectively applied if the consignor proves that the damage is likely caused or contributed to by a breach of the duty of seaworthiness. In such a case, the carrier may seek indemnification if the shipper's claim of unseaworthiness is misrepresented or due diligence of the vessel's seaworthiness has been proved. Caution is required if the shipper has not proven unseaworthiness as the cause of the damage, care should be taken when there is a possibility that unseaworthiness caused damage. The carrier is exempted from part of its responsibility, but has to bear the rest (Jo Jong-Ju, 2010).

However, despite the presence of unseaworthiness, it may not fall under s.17(5) of the Rotterdam Rules. That is, i) there is no causal relationship between unseaworthiness and damage, and ii) although there is a causal relationship between the two, it is the case that the carrier has given due diligence to its seaworthiness.

Therefore, in order to hold the carrier liable under s.17(5) of the Rotterdam Rules, logically, the following step-by-step process must be followed (Yang Seok-Wan, 2011). First, it is necessary to identify the cause of the damage and check whether unseaworthiness exists. Second, if unseaworthiness exists, it is necessary to determine whether there is a causal relationship with damage. Third, even if there is a causal relationship between the unseaworthiness and the damage, it is necessary to examine whether the carrier has fulfilled its due diligence with respect to its unseaworthiness. The burden of proof of unseaworthiness will rest on the part alleging it, although in many cases he may assisted by inference drawn by the court. Thus the presence of seawater in the hold will normally be treated by the courts as prima facie evidence of unseaworthiness (Wilson, 2010). Having established breach of this undertaking, however, it will then be incumbent on the claimant to establish that the unseaworthiness caused the loss of which he complains (*The Europa* (1908)). In the case of International *Packers v. Ocean Steamship Co.* (1955) a cargo of tinned meat shipped from Brisbane for Glasgow was damaged by seawater during the voyage as the result of tarpaulins being stripped from the hatch covers during a storm. On hearing that the vessel was equipped with locking bars designed to secure the hatches, the trial judge held that the loss was caused not by the unseaworthiness of the vessel but by the negligence of the crew on failing to make use if the equipment provided (Boyd et al., 2008). Similarly, the cargo owner will fail to discharge the burden of proof if it is clear that the damage resulted from bad stowage rather than from any unfitness of the vessel to receive the contract cargo (*The Thorsa* (1916)).

If damage occurs due to the unseaworthiness of the ship, the negligence of the carrier is presumed, and in order for the carrier to be exempt from liability, it must be proved that all reasonable steps have been taken to prevent such damage. In other words, the carrier can be exempted from liability for damages by proving that due diligence care has been taken to provide a ship with seaworthiness. The s.796 of the Commercial Act, like international conventions, places the burden of proof on the carrier. However, in order for the carrier to use the indemnification provisions or limitation of liability provisions under Commercial Act or international agreements, it must be proved that all reasonable necessary measures have been taken (Ji Sang-Gyu, 2010).

A case for claiming damages due to the loss of a maritime transport or delay in delivery begins with the evidence of a "prima facie case". The Rotterdam Rules codify this prima facie case in s.17(1), enabling the proof of the presumed reason for the carrier with two means: issuance of a non-reserved bill of lading by the consignor and the acceptance of the shipment in good condition (Yang Seok-wan, 2011).

The problem here is who bears the burden of proving the causal relationship between the fact of unseaworthiness and whether the damage to the transport is caused by unseaworthiness. This point is not clear in the Hague-Visby Rules or the Hamburg Rules, and each country's approach to this is different (Choi Jong-Hyeon; 2004; Kwon Kee-Hoon, 2007; Jo Jong-Ju, 2010; Schoenbaum, 2001). The Rotterdam Rules inherits the existing framework of international norms for the occurrence of the carrier's liability, and only requires proof of the fact that the consignor has suffered damage during the storage of the carrier in the case of a duty of caution regarding the shipment. In particular, in the case of duty of seaworthiness, it stipulates that the burden of proof for the breach lies with the shipper (s.17(5))(Yang Seok-Wan, 2011).

The case where the sea carrier is liable is when there is a breach of duty of seaworthiness and when there is a breach of the duty of care for the shipment. Breach of the duty of seaworthiness and the breach of the duty of care for the goods are both liable for negligence (s.17(2)), and it is assumed that the maritime carrier is at fault(Song Ok-Rial, 2009).

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Rotterdam Rules impose a special duty on carriers, the duty of seaworthiness (s.14). S.3(1) of the Hague-Visby Rules, s.794 of the Korean Commercial Act and Hamburg Rules do not stipulate the duty of seaworthiness, which is not limited to the time of departure, but is intended to continue to bear this duty during voyage. At sea, the carrier must pay due diligence to the following seaworthiness prior to, commencement and during voyage. a) Ensuring that the vessel can withstand the voyage and maintain it, b) Ensure that the crew's embarkation, the ship's design and supply of necessary goods are appropriate, and that the crew's embarkation, the ship's design and supply of the necessary goods are maintained throughout the entire voyage, c) It bears the duty of seaworthiness, which consists of keeping the hold, the place to load the goods, and all containers for transporting the goods provided by the carrier in a condition suitable for receipt, transportation and preservation of the goods, if this is breached, the person shall be liable for damages caused by loss, damage, or delay in delivery(s.14). The time at which the carrier bears the duty of seaworthiness is before and at the beginning of the voyage under s.3(1) of the Hague-Visby Rules or s.794 of the Korean Commercial Act, that is, it was from the start of shipment to the time of departure, but the Rotterdam Rules expanded to cover the entire maritime transportation period. However, the burden of proof for unseaworthiness is borne by the shipper (s.17(5))(Yang Seok-Wan, 2011).

In other words, breach of seaworthiness functions as a basis for causing the carrier to be liable for damages. The Rotterdam Rules stipulate a continuing obligation as a duty of care regarding the seaworthiness of ships used to fulfill the contract of carriage. If the underlying reason for unseaworthiness appears prominent during the voyage, or if a new reason occurs after the commencement of the voyage, the carrier must show that he has not neglected considerable attention regarding the reason for unseaworthiness. Since the duty of care is relative, the degree or extent of the duty of care for the seaworthiness of the ship will be different when the ship is in port and when it is sailing (Cho Hyun-Sook, 2010). The duty of seaworthiness is a separate duty independent of the duty of care for the shipment (Berlingieri, 2008).

On the other hand, the Rotterdam Rules take over the existing framework of international norms for the occurrence of the carrier's liability, and only require proof that the consignor incurred damage during the storage of the carrier in the case of the duty of due diligence [commercial negligence] on the shipment(Tetley, 2008), in particular, in the case of the duty of seaworthiness, it stipulates that there is a burden of proof for the breach(s.17(5)). In general, if the carrier neglects the duty of seaworthiness, he or she is liable for damages incurred irrespective of the obligation to pay attention to the cargo, but Hague-Visby Rules and Hamburg Rules do not clearly stipulate who bears the burden of proof. Under Hague Rules and Hague-Visby Rules, in the case of damage to the shipment, the burden of proof and proof of fact to determine the liability are generally i) proof of the fact that the damage has occurred, ii) the carrier's cause of damage, iii) It goes through the order of proof of performance of the carrier's duty of seaworthiness. However, when the carrier claims immunity, whether it must prove that the duty of seaworthiness has been fulfilled as a prerequisite is divided into a position denying the premise of duty of seaworthiness and an affirmative position (Yang Seok-Wan, 2011).

In contrast, the Rotterdam Rules specifically stipulate how to distribute the burden of proof between the carrier and the consignor (s.17). Rather than a simple approach to the Hamburg Rules, the ping pong method of burden of proof, which is almost similar to the Hague Rules, is chosen with an important immunity (Maraist, Galligan and Maraist, 2003).

Furthermore, the approach is similar to the Hague-Visby Rules, but the Rotterdam Rules are in contrast to the legal framework and text (Song Ok-Rial, 2009; Jo, Jong-Ju, 2010). According to the Rotterdam Rules, if the shipper proves that damage has occurred to the

shipment in transit (s.17(1)), the carrier is not liable for liability if it proves that it has fulfilled its duty of care or that it is a cause for indemnification(s.17(2), (3)) (Yang Seok-Wan, 2011). In this case, in order for the shipper to take responsibility again, it is sequentially stipulated that the carrier must prove that he has breached the duty of seaworthiness (s.17(5)) (Song Ok-Rial, 2009).

However, if the cause of the damage results in being included in the grounds for indemnification, the burden of proof of the carrier's negligence is places on the shipper. This in turn does not result in the carrier evading responsibility. Even if the cause of the damage is the uninsured risk, if the shipper proves the negligence of the carrier, then the reason for exemption does not protect the carrier's full or partial liability. In addition, the cause of the indemnification is not effectively applied if the consignor proves that the damage is likely caused or contributed to by a breach of the duty of seaworthiness. In such a case, the carrier may seek indemnification if the shipper's claim of unseaworthiness is misrepresented or due diligence of the vessel's seaworthiness has been proved. Caution is required if the shipper has not proven unseaworthiness as the cause of the damage. Care should be taken when there is a possibility that unseaworthiness caused damage. The carrier is exempted from part of its responsibility, but has to bear the rest (Jo Jong-Ju, 2010). However, despite the presence of unseaworthiness, it may not fall under s.17(5) of the Rotterdam Rules. That is, i) there is no causal relationship between unseaworthiness and damage, and ii) although there is a causal relationship between the two, it is the case that the carrier has given due diligence to its seaworthiness. Therefore, in order to hold the carrier liable under s.17(5) of the Rotterdam Rules, logically, the following step-by-step process must be followed (Yang Seok-Wan, 2011). First, it is necessary to identify the cause of the damage and check whether unseaworthiness exists. Second, if unseaworthiness exists, it is necessary to determine whether there is a causal relationship with damage. Third, even if there is a causal relationship between the unseaworthiness and the damage, it is necessary to examine whether the carrier has fulfilled its due diligence with respect to its unseaworthiness.

## 4.2. Burden of Proof of the Unseaworthiness under Marine Insurance Contract

The burden of proof with regard to unseaworthiness is on the insurer (*Parker v. Potts* (1815)). However, where a ship founders soon after sailing or becomes so leaky or disabled as to be unable to proceed, and this cannot be ascribed to any violent storm or other adequate cause, the fair presumption is that it arose from causes existing at the time of her sailing, and consequently that she was not then seaworthy. That, however, is but an inference from the facts, and not a presumption of law (Gilman et al., 2018).

In such cases, the inference that the ship was unseaworthy when she sailed may be drawn even though it may be impossible to identify the nature of the defects which rendered her unfit to perform the voyage and gave rise to the casualty (*Eridania SpA v. Oetker (The Fjord Wind):* [1999] 1 Lloyd's Rep. 307).

Unseaworthiness may, of course, be in issue for more than one reason. Unseaworthiness will also, in many situations, affect the issue of whether the loss was caused by an insured peril. The lack of evidence may leave the court in doubt as to the true reason for the loss and the insured may not succeed in their claim (*European Group Ltd. v. Chartis Ins UK Ltd.:* [2013] EWCA Civ 224). When the vessel is lost without trace and nothing is known about the circumstances prevailing at the time of her loss, a presumption of loss due to perils of the seas can be made if she is shown to have been seaworthy on sailing; the onus will then switch to the insurer to rebut that presumption by presenting evidence of her unseaworthiness

(*Lamb Head Shipping Co. Ltd. and Others v. Jennings (The MAREL):* [1994] 1 Lloyd's Rep. 624). When it is known that the vessel sank in calm waters as a result of an incursion of seawater in a particular part of the vessel, the cause of which is uncertain, there is no room for any presumption of a fortuitous loss. Typically, in cases of this type, the insurer will seek to establish a positive case of unseaworthiness as a likely cause of loss, but he need not do so; the insured has to prove loss by a peril insured against.

However, where the loss is of a type which must on the face of it, either have resulted from a peril of the sea or from unseaworthiness the insurer cannot simply put the plaintiff to proof. The court must proceed on the basis that the vessel was seaworthy and that her loss was therefore by perils of the seas. The clause was designed so that in such cases there would be a deemed loss by perils of the seas. However, where there are grounds for supporting that the loss was due to some cause outside the scope of the clause (Munro Brice & Co. v. Marten: (1920) 3 K.B. 94), t, to which the admission of seaworthiness would be irrelevant, the insured's claim would fail unless he were able to establish that the loss was actually caused by an insured peril.

In other words, a breach of the implied warranty may be waived, expressly or by conduct, after it is known to have occurred. Equally, such waiver may take place after the occurrence of a loss. Whether the implied warranty has been so modified, by terms in apparent conflict with it or with its being given its full scope, is of course a question of construction. The general principle, that terms should not be implied that are inconsistent with the express terms of a contract applies to the implied warranty as it does to any other kind of putative implied term. The cases in point suggest that stipulations contained in the policy are unlikely to be construed as excluding or modifying the warranty of seaworthiness unless the language used clearly demonstrates that such an effect was intended or is clearly inconsistent with the implied warranty.

## 5. Conclusions

The bottom line is that seaworthiness is an abstract concept used in maritime law that indicates how safe and ready a ship is to sail. Regular checks must be carried out to ensure that the highest standards are maintained onboard the vessel at all times. If found to be negligent, the owners are liable to face strict action. Before accepting or assessing a ship, it is important to check with experts and marine professionals regarding the state of the ship.

The Merchant Shipping Act makes it a criminal offence to send an unseaworthy and unsafe ship out to sea. In the event that crew or passengers deem the ship to be unsafe, they can approach the relevant authorities to register a complaint. In the case of crew members, there must be at least five members who agree on the unseaworthy nature of the vessel.

Only then will a complete investigation be launched. Unsatisfactory safety measures and faulty equipment etc. are considered to be unsafe. Since ships often spend days at sea without docking at land, it is important that the highest safety standards be maintained. Thus, inspections can be used to ensure that the vessel is properly equipped to handle the perils of the sea, as well as to ensure the safety of its crew, passengers and the property on board.

Opinions of those in the industry are varied. In recent years the English courts have been critical of the harsh and arbitrary effect of seaworthiness warranties. As a consequence, the modern tendency is for hull policies to include, in their place, promises that spell out the consequences of breach, make those consequences more appropriate to the breach, and re-establish full cover after the breach is remedied. It is the opinion of the author that the unreliable ship owners are not going to change, chameleon-like, its skin just to toe the party

line of its hull policy.

The burden of proof on the issue of unseaworthiness is on the insurer. However, where a ship soon sailing founders, or become so leaky or disabled as to be unable to proceeds, and this cannot be ascribed to any violent storm or other adequate cause, the fair presumption is that it arose from causes existing at the time of her sailing, and consequently that she was not then seaworthy. That, however, is but an inference from the facts, and not a presumption of law. In such cases, the inference that the ship was unseaworthy when she sailed may be drawn even though it may impossible to identify nature of the defects which rendered her unfit to perform the voyage and gave rise to the casualty.

S.34(3) of the MIA 1906 provides generally that a breach of warranty may be waived by the insurer. S.34 is omitted under the regime of s.10(7)(b) of the 2015 Act, but the same principle that a breach of warranty may be waived is re-enacted at a s.10(3)(c) in different wording. S.39(5) of the MIA 1906 remains in place in relation to policies to which the new regime of the 2015 Act, applies. Its application is not affected by the 2015 Act. It is not necessary, in order to exonerate the insurer from liability, that the unseaworthiness should be the sole cause of the loss; it is sufficient that the unseaworthiness was a proximate causes of the loss.

The large corporate structures that own and manage ships, such as those uncovered in *The Star Sea*, are complex and time-consuming for a court to navigate, and often do not result in a clear-cut answer. The job of classifying societies' inspectors is becoming more taxing, due to there being greater numbers of ships to inspect. There is hardly enough time to walk from bow to stern of the larger bulk carriers.

However, the converse argument is that seaworthiness warranties are the only effective remedy that insurers can use to protect themselves from the unreliable operators that exist within the industry.

While there is a broad consensus that the provisions of the MIA 1906 dealing with seaworthiness warranties are capable of operating in an unfair manner, and that fair outcomes may require insurers to "do the right thing" even where they may have no legal obligation to honor a claim. Where a policy issued by the insurer stated that "the Insured should prove that such loss or damage happened independently of the existence of such abnormal conditions" which refers to the excluded perils, the court held that the clause effectively reversed the onus of proof. It has been further clarified that in order to benefit from this type of clause, the insurers must produce prima facie evidence demonstrating that the loss was caused by an excepted peril, and only when the cause of loss becomes arguable should the assured disapprove the exclusions.

The importance of seaworthiness cannot be doubted. It has a fundamental role to play in the regulation of relationships between charterer and shipowner, between cargo owner and carrier, and between underwriter and assured. Quantifying its significance is difficult in that its application varies as between the various relationships, and much depends on the circumstances of each individual case. If nothing else, an understanding of the complexities of seaworthiness is a central ingredient of the maritime lawyer's stock in trade, and helps to ensure lawyers have an important contribution to make to the maritime industry.

Under a voyage policy which is subject to the regime and which does not contain an admission of seaworthiness, the principle enshrined in s.18(3)(d) of the MIA 1906 would operate so as to relieve the insured from a duty of disclosure with regard to the vessel's condition, in the absence of inquiry. This subsection does not apply to proposals for insurance governed by the new regime of the 2015 Act, nor did it apply under the old regime in cases where the insurance which was proposed was to incorporate an admission of seaworthiness. The duty of disclosure has its normal scope, where the policy is to include a seaworthiness admitted clause. It should be noted, however, that in the case just cited where this point was

established, the circumstances (including the fact that a seaworthiness admitted policy was being requested) were such as to put the insurers on inquiry and to relieve the insured from and duty of disclosure he would otherwise have owed with regard to the vessel's unseaworthy condition. The insurer knew he was being asked to insure a vessel of unusual construction (a floating dock), and the insured was requesting a policy in non-standard terms, containing the admission of seaworthiness, evidently designed to avoid disputes about its fitness to undertake the voyage.

The first part of the Seaworthiness Admitted Clause, therefore, had three main consequences: (1) it dispensed with the warranty of seaworthiness; (2) it enabled the insured to recover, in appropriate circumstance, for a deemed loss by perils of the seas, which the insurer (having admitted the vessel's seaworthiness) would be unable to challenge; and (3) it meant that the insured would in certain circumstances owe a duty of disclosure during the negotiation of the insurance, when he would not otherwise do so if the implied warranty remained in place.

It should also be noted that there is a seaworthiness admitted clause in a policy of reinsurance, but no such clause is contained in the underlying policy, it is open to the reinsurer to dispute the reinsured's claim on the ground that there was no liability under the original policy, by reason of the vessel's unseaworthiness.

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# The Role of Corporate Image and Brand Personality in Global Consumer Choice: An Empirical Exploration

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## Abstract

***Purpose*** – This study aims to analyze consumer in the multidimensional aspect of a combination of corporate image and brand personality in order to identify the structural causal relationship between consumer choice and corporate image and brand personality.

***Design/methodology*** – This study combined theoretical literature studies with empirical field studies using questionnaire survey methods. To achieve this objective, a hypothetical causal model consisting of three potential variables and nine measurement variables was created based on prior research, and a structural equation model was used to identify the suitability of the model.

***Findings*** – The hypothetical model established by this study was judged to be generally appropriate. In particular, corporate image was shown to have significant static direct effects on consumer choice and brand personality. It was also shown that brand personality had a direct static effect on consumer choice, and that corporate image has an indirect significant impact on consumer choice by moderating brand personality.

***Originality/value*** – Previous papers have mainly focused on one-dimensional studies of various images, such as companies and brands. However, this paper used a model that analyzed consumer choice through multi-clue information rather than corporate images as the only clue to consumer choice.

**Keywords**: Brand Personality, Consumer Choice, Corporate Image
**JEL Classifications**: F10, F23, M30, M31

## 1. Introduction

The global market is facing a drastic change. With the advent and dissemination of digital interactive technologies such as mobile and social media, the global market faces confusion and uncertainty due to the democratization of information, diversification of consumer needs, and competitiveness among companies. With the development of technology and the strengthening of global competition, companies are moving toward an era where it is increasingly difficult to differentiate products and services. Although companies need a proper use of technology to meet the needs of individual consumers, they need a product that makes this technology shine.

It is time for companies to focus on the sensibility and appeal of corporate and brand images. Consumers choose the image of corporations and brands that feel friendly. Past paradigms of one-sided relationships with an unspecified number of consumers no longer work. It is necessary to build a deeper and meaningful relationship with each individual consumer. Through this, companies can gain support even in rapidly changing business

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environments. In addition, consumers have simultaneously compared and selected corporate and brand images, as well as quality, when purchasing products due to changes in the purchasing environment.

Image is different from stimulation targets. In recent years, how image affects consumer behavior in global marketing has become important. In addition, companies carry out various communication strategies to maintain a reciprocal relationship with the public and related organizations, while the public and organization accept and handle messages. In this process, the public recognizes the message of the company and has favorable or unfavorable feelings about it.

Companies carry out various communication strategies to maintain a reciprocal relationship with the public and related organizations, and the public and organization accept and process messages that arise. In this process, the public recognizes the message of the enterprise and has favorable or unfriendly feelings toward the entity. On this basis, the company decides how to act in the direction that the message leads. Image plays an important role in this process because even if a company provides identical products and services, consumers often perceive them differently by virtue of corporate or brand image. Thus, companies make efforts to build a discriminatory image compared to competitors.

From this point of view, this paper seeks to verify how multidimensional images affect consumer product choice factors. In particular, we want to find the relationship between corporate image and brand personality, which is one of brand image.

Since the mid-1980s, there has been research on this and the importance of corporate image in global marketing. These studies empirically demonstrated that corporate image affects various aspects of consumer perceptions and behaviors. Furthermore, studies have observed that corporate image affects consumer purchase intentions and improves the reliability of company communication. Thus, the formation of corporate image has a close relationship with how a company's various activities respond to consumers and determines the dimensions of corporate image.

Meanwhile, as research on brand personality grew in the mid-1990s, certain brands were personified, and were able to exert influence by powerful means. At a time when the difference in product quality is weaker due to the improvement of technology, brands that stimulate identity are eventually likely to succeed. A brand that consumers want to pursue lasts longer than the brand that consumers just want. As a result, consumer views on brands are changing to relationships and emotions rather than function and rationality. The focus of brand management is also. In other words, non-product related factors are becoming more important to the brand than product related factors. Brand personality is the most representative of the non-product-related elements of the brand. Brand personality refers to a set of human characteristics that consumers associate with a particular brand. With technology leveling in many markets, performance or quality alone is not enough to maintain a competitive edge. Thus, brand personality can be a powerful weapon to build loyalty.

In this context, corporate image and brand personality have something in common that can directly affect consumer choice through inferential beliefs as external clues, but they were mainly studied as individual elements rather than comprehensive research. Research through individual factors deals with causal relationships so simply that there is a limit to understanding complex phenomena systematically.

Therefore, the study aims to analyze within a theoretical framework how multidimensional variables that provide a combination of corporate images and brand personality affect consumer choice. In other words, the purpose of this study is to develop a relationship model that can explain consumer choice and reveal the impact of brand personality on the relationship between corporate image and consumer choice.

First, the concepts of consumer choice and measurement reference values are presented. Second, analysis of the correlation between corporate image, brand personality and consumer choice is performed. Third, the impact of brand personality on the relationship between corporate image and consumer choice is examined. This study uses a survey method based on theoretical literature research.

## 2. Theoretical Review and Hypotheses Development

### 2.1. Corporate Image

A corporation has the characteristics of an open system, which grows through interaction with an environment. The stakeholders related to the corporation have a certain image of the company. This corporate image becomes a critical factor in determining attitudes and behaviors toward the enterprise. Therefore, if the stakeholders have a favorable image of a corporation, the positive interaction between the related parties and the corporation is enhanced, which would in turn increases the company's growth potential.

An image is an aggregate of beliefs, ideas, and impressions that an individual has on a particular subject, which can be defined as a sensory impression, especially in older years (Kotler, 1984). Corporate image is a combination of the beliefs, attitudes and impressions that customers have about an entity that are subject to sensory impressions (Barich & Kotler, 1991; Dichter, 1985; Kotler, 1982). From a learning theory perspective, corporate image can also be described as strengthening the expectations that form in a customer's mind of a particular entity (Kunkel and Berry, 1968). It was also argued that corporate image has a positive and direct impact on customer loyalty, which requires a commitment to customer satisfaction through emotional images. Because corporate image has a positive influence on perceived quality, customer satisfaction, and loyalty (Giovanis et al., 2014; Leaniz & Bosque, 2016), companies spend much time and resources to achieve a positive corporate image.

In addition, many companies are interested in how to enhance their images because corporate image has a positive impact on marketing activities. In addition, researchers have been studying the factors that make up corporate image as a way to enhance image. In addition, many studies have identified and measured specific corporate image components to help enhance the image of an entity by identifying which factors are vulnerable.

A study by Erickson et al. (1984) defined the combination of product characteristics that identify the product, although different from physical products, as a combination of tradition, ideology, business name, reputation, price levels, various services, quality, corporate identity, level and quality of advertising, and delivery systems. In a study on the components of corporate image, Winters (1986) presented three components: corporate behavior, social behavior, and corporate contribution. Here, the corporate action element forms the company's marketing image by providing quality and service, setting price, and providing high quality products. Social behavioral factors form an image of social practice from interest in environmental protection, and payment of appropriate taxes. Donation factors refer to material support such as investment in culture and arts, health education, and donations to social welfare programs. In particular, he explained that the most important factor in the formation of a company's overall image is its marketing image via corporate behavior, and that the image of social practice is the most important factor when the attitude toward the company is low, or public relations issues take up a large portion.

Marken (1990) argued that corporate image consists of everything the company says and does, and saw that products, services, finances, and employees constituted it. Formbrun and

Shanley (1990) presented management characteristics, quality of products and services, financial status, long-term investment value, innovation, employee employment and management, social responsibility, and the use of corporate assets. Barich and Kotler (1991) insisted that corporate image was formed by making consumers see the corporation as a good citizen by communicating with the public through public activities. Herbig and Milewicz (1995) confirmed that the better a company's reputation, the more likely it is to earn favor with new products. It also studied how important corporate image was to company and product success. Brown and Dacin (1997) divided corporate schema into the two important attributes of corporate social responsibility and association, and studied the relationship between association and overall assessment. As a result, we verified that two attributes of a company's association provide a significant context that has a significant impact on evaluation.

Lantos (2001) said that the performance of strategic social responsibilities enhance public interest, and corporate image, and increase the loyalty of business members and consumers. Dowling (2001) viewed corporate image as the aggregate of subjective beliefs, ideas, and impressions that were cumulative results of its ideas, characteristics, and behaviors. These corporate images have emotional rather than logical characteristics because they are the public image of the company. Therefore, it provided implications for the importance of managing image around controllable variables that could affect the formation of corporate image.

In terms of influential factors on corporate image, Kotler (2003) mentioned product communication, price, distribution channel, sales representatives, management resources, business activities and corporate social responsibility. Furthermore, Hsieh et al. (2004) verified the effect of corporate image, country image and product image on consumer purchase behavior against various countries in a multidimensional manner. In addition, if businesses are economic players concerning public households and governments in interrelationships with them, public image plays an important role in the development of corporate survival. Furthermore, the development of consumerism and the increase in corporate social responsibility further highlights the need for management of corporate image. This is because corporate image is a very important concept that responds to the public's demand for corporate social responsibility and connects public perception with the company.

Looking at the above studies, corporate image is not part of the target, but the image of the entire company. Moreover, it has the same direction as attitude. In this study, corporate image is defined as the sum of impressions made up of the characteristics of the company and the psychological characteristics of consumers.

## 2.2. Brand Personality

The era of one-sided relationships between faceless brands and unspecified individuals has gone. The relationship is stronger and maintained longer when brands with human faces and consumers have meaningful relationships. From this point of view, brand individualization should not only be perceived as a mere trimming of image, but as the humanistic task of defining the core values of the brand and building true relationships with consumers at a fundamental level. When consumers meet a brand that fits their personality, they feel a sense of unity with the brand, and recognize the brand as an expanded self.

In the 1950s and early 1960s, a self-expression model emerged that was stimulated in part by motivation research. It hypothesized that an individual's personality would match that of the product classes or brands used. First, a series of studies empirically explored this

hypothesis by relating a person's current or ideal self-image with the brand personality of brands purchased. The general conclusion was that although a relationship existed, it was relatively inconsistent. Second, to test the premise that people use brands to express self, and that this self-changes across situations, a laboratory experiment was conducted in which respondents indicated preferences for brands with certain personalities in specific situations. The study found that brand preferences changed when situations changed.

In this context, both brand image and brand personality are emotional responses to a brand, and if the brand image is relatively comprehensive, brand personality can be seen as a brand personified image on a strategic level (Keller, 2003).

A brand personality can be defined as the set of human characters associated with a given brand (Aaker 1995). Thus, it includes such characteristics as gender, age, and socioeconomic class, as well as such classic human personality traits as warmth, concern, and sentimentality. The brand personality construct can help brand strategists by enriching the understanding of perceptions of and attitudes toward a brand, contributing to a differentiating brand identity, guiding the communication effort, and creating brand equity.

The anthropomorphic relationships that consumers and brands can establish depend on (1) love/passion, (2) self-connection, (3) interdependence, (4) commitment, (5) intimacy, and (6) brand partner quality (Fournier, 1998). If the brand's personality is clearly established, not only will the brand's clear target customer be introduced, consumers will also feel a sense of unity with the brand, which will greatly increase the possibility of intimacy and love for the brand.

This approach to personifying a brand and comparing it to a personal relationship began with a study on brand personality, and brand personality focuses on how consumers express a specific aspect of their actual or ideal self by using a product (Aaker, 1997). In other words, in everyday life, people have personal relationships with the products or brands they purchase.

The tendency to expand relationships appears to have originated for two main reasons. First, not only do humans instinctively tend to infer human characteristics from things, they also want to find a means in the brand to replace modern loose human relationships. For businesses, the individualization of a brand may be an effective strategy. Human decision-making may seem very reasonable, but emotional factors have a decisive effect. Brand individualization helps build emotional bonds by inducing a warmer and friendlier relationship. When consumers match a brand with their own personality, they feel a sense of unity with the brand, and perceive the brand as an extended self (Belk, 1988).

Thus, brand personality is defined by a series of human characteristics associated with a given brand, which is a component of brand image and a powerful differentiator, while also having a significant impact on the brand attitude of consumers. In other words, brand personality affects consumer choice and can further increase loyalty. Factors that can affect brand personality include product category, package, and price, and the attributes of user image, sponsor, symbol, age, advertising style, production site, corporate image, CEO, and celebrity reputation as non-related product characteristics.

Although previous studies have used a mixture of brand image and personality, the distinction was ambiguous. However, Aaker (1997) developed a framework for brand personality factors for Americans to develop a generalized measurement scale that met the reliability and validity of these factors. She used 114 personality traits to survey consumer perceptions on 37 familiar brands, and found five basic brand personality dimensions. The five dimensions were sincerity, excitement, competence, sophistication, and ruggedness. Subsequent studies have identified peacefulness, passion, and ruthlessness as additional dimensions (Aaker et al., 2001;Davis et al., 2004).

Phau and Lau (2000) pointed out that because consumers use brand personalities to express themselves, some brand personalities serve as protective devices for the category of market failure as brands and are used to expand brand names and new product categories based on brand personalities. Freling and Forbes (2005) analyzed the impact relationship between brand personality and brand recognition and preference, and verified the correlation between brand personality and perceived quality at the product-level.

In summary, a brand personality can help a brand in several ways. First, it can provide a vehicle for customers to express their identity. Second, a brand personality metaphor helps suggest the kind of relationship that customers should have with a brand, modeled after personal relationships. Third, band personalities serve to represent and cue functional benefits and product attributes effectively. The important aspect of a brand personality is that it is often a sustainable point of differentiation. It provides a powerful vehicle to develop an identity, a communications effort, and a complete marketing program.

From the consumer point of view, brand personality is a means for consumers to express characteristics through a brand, so it plays an important role in creating brand assets. Furthermore, if the personality of brand is favorable, it will have a positive effect on the related product. In other words, every brand has a certain type of personality, and at the corporate level, it is essential to strategically manage and develop it into something unique compared to the brand personality of competitors.

In addition, brand personality tends to be perceived as an abstract concept in international marketing, but it is a matter of a very practical and specific approach. In marketing, it can be the core of brand differentiation and further become an important competitive edge. Managers should not neglect an area.

## 2.3. Consumer Choice

According to the Diffusion Theory of Evert Rogers (1962), adoption is the mental stages through which an individual passes from the time of his or her first knowledge of an innovation to the time of product adoption or purchase. Rogers suggests that an individual passes through five different stages: awareness, interest, evaluation, trial, and adoption.

Awareness is the first step, which occurs when the consumer first recognizes the product or innovation. Studies have shown that at this stage, impersonal sources of information such as mass-media advertising are important. Second, the interest stage is noted by a consumer interest in finding more information on a product. The customer has focused his or her attention on communication related to the product, and will engage in research activities and seek out additional information. Third, in the evaluation stage, the individual mentally assesses the product's benefits in relation to present and anticipated future needs, and based on this judgment, decides whether to try it. Fourth, the trial stage sees direct experience. Most customers will not purchase expensive products without experience or a trial. Fifth, in the adoption step, the individual either makes an initial purchase or continues to purchase, and adopts and exhibits brand loyalty to the less expensive product.

Meanwhile, research on consumer choice has centered on studies on product perception, product attitude, and purchase intent. Before a consumer chooses a product, the consumer forms new beliefs or changes existing beliefs. These beliefs, whether favorable or unfavorable, form the attitude toward a product. Generally, a favorable attitude forms the intention to purchase, and this intention implies a subjective possibility of causing a particular action, but the relationship between attitude and intention to purchase does not coincide. Until recently, studies to establish this relationship have been extensive, and many studies have confirmed a correlation.

Perceived Consumer Effectiveness means believing that individual efforts play an important role in solving problems (Kinnear et al., 1974). If an attitude is defined as the assessment of an issue or problem, a consumer effectiveness perception can be defined as a subjective measure of the extent to which an individual's consumption behavior contributes to problem resolution. In other words, consumer effectiveness perception can be expressed as a self-assessment of the problem (Berger and Corbin 1992). According to many early studies, consumer effectiveness perception has been considered a component or measure of attitudes or has been known as a direct predictor of environmentally conscious behavior (Antil, 1984). This has been recognized as an important variable prior to building consumer attitudes, and is an important factor for explaining consumer choice.

It is also important to consider what innovations consumers perceive and how they are structured. Rogers (1962) presented five characteristics of innovation that consumers perceive as new: relative advantage, compatibility, complexity, trial ability, and observability. Based on this, many studies have been actively conducted on many innovative products regarding the perceptions of the general nature of an innovation.

An attitude is a learned tendency to respond in a consistent way to a given object or entity. Attitudes are clusters of interrelated beliefs. Fishbein and Ajzen (1975) conducted the representative study and their attitude models showed the overall evaluation of a product or brand, its belief in whether the product or brand has a specific attribute, and its relationship to the importance of the attributes. Following this, many studies have expanded attitudes into multidimensional concepts, but pointed out the limitations that they have to be inferred from the speech or behaviors of individuals because they are the result of human psychological processes and are difficult to observe directly. Brand attitudes are a predictor of consumer behavior, and the prevailing view is that research consists of cognitive, emotional, and behavioral factors. The cognitive component is based on the subjective knowledge or beliefs of the individual about an object. An emotional component is the feeling for a particular product or brand. This is based on experiences and feelings through actions such as pleasure or anger as well as overall evaluation of a brand (Hawkins and Hoch 1992).

Purchase intent is the subjective possibility that perceptions and attitudes will lead to action. This is recognized as an intermediate variable between consumer attitudes and behaviors. It also refers to a state within the subjective possibility dimension that includes the relationship between personal knowledge and behavior. Assael (1998) suggested that a reasonable model of behavior is a factor in determining purchase intention and further argued that purchase intention is a transfer step that leads to the purchase action. Because intentions are a direct factor in determining purchasing behavior, it is considered possible to predict actual purchasing behavior intention to purchase. Consumer decision making is mainly done with predictions of purchasing behavior. In general, it was noted that if a favorable attitude toward the attributes of a product was formed, it was more likely that a higher intention to purchase would be formed. Therefore, it is appropriate to use purchase intention as a measure of consumer decision making.

Skořepa and Pícha (2016) defined the degree of personal purchase ability at the subjective level of an individual as an intention to buy, and viewed this as an important factor in attracting purchasing behavior as an intermediate variable between attitude and purchasing behavior. It is often found by measuring purchase intention as a prediction of consumer purchasing behavior, and is used as the most appropriate and easy-to-measure variable as a tool to predict actual purchasing behavior. In this study, it is assumed that the more favorable the consumer's attitude toward the target, the more likely a purchase, and the higher the willingness to buy. Thus, consumer choice for global products in this study consisted of three items based on prior research results.

## 2.4. Design of Research Model

Since 2000, studies on the image of companies, and brands have been conducted in a one-dimensional manner. In particular, analysis has mainly been made on how important corporate image is to consumer choice. However, this study used a condensed model of constraints to analyze consumer choice through various information rather than simply viewing corporate image as the sole clue to consumer choice.

The image of the company perceived by the company and the consumer do not always match. However, when consumers perceive that their preferred brand, along with a positive corporate image, offers differentiated value from other brands, they have a pride in the product. A corporate image can add credibility to an identity. It can also generate a strong personality that provides not only a quality cue but also an important point of differentiation that can lead to an effective marketing and communication program. In other words, consumers are aware of the differentiation of global products in corporate image and brand personality through direct and indirect experience, and the perception of such differentiation increases. In the end, it benefits from brand trust and brand sensitivity, which are leading factors in brand loyalty to a product (Sung & Kim, 2010).

In order to achieve the research objectives, the hypotheses were set based on the hypothesized causal model for the influencing factors of consumer choice and the modulating effect hypothesis model of brand personality for consumer choice as follows:

*Hypothesis 1: The overall goodness of fit of causal models devised to illustrate the impact of corporate image, and brand personality on consumer choice will be well matched by empirical data.*

*Hypothesis 2: Corporate images will have an indirect significant effect on consumer choice with brand personality as a parameter.*

*Hypothesis 3: The relationship between corporate image and consumer choice will be moderated by brand personality.*

## 3. Methodology

### 3.1. Analysis Targets and Methods of Investigation

Survey research via questionnaires were used this study, and the countries surveyed were Korea and the United States. The products studied were durable consumer goods to reduce possible deviations as brand personality effects might be larger for visible, involved products like cars and smartphones. When the fit between brand personality, context, and self-expression need is right, however, any brand personality may facilitate identity expression.

Another selection background is to assume innovative product types based on new technologies, the novelty of consumer awareness, and to demonstrate how perceptions of the general characteristics of innovative products will differ in consumer choice. As a result, the selected products were smartphones from Apple (iPhone) in the U.S. and Samsung (Galaxy) in South Korea. The reason for choosing these products was that they gave users a high degree of involvement and that consumers were socially aware of corporate and brand images. In particular, the effect of corporate image and brand personality is even greater in visibly committed tangible products such as smart phones. In addition, mobile phones can be positioned by combining these products with fashion elements that can highlight outstanding performance and user personalities, including both high technology and touch.

The research data were collected according to a questionnaire, and the main points related to the data collection are as follows. First, the research population was adults aged 18 or older living in Seoul, South Korea, and New York, the United States, who were economically relatively middle- and upper-income consumers. Second, in terms of sampling method, random sampling was used. A total of 360 questionnaires (180 copies each) were distributed from July to August of 2019. Some were collected on the spot, and others were collected by mail. Third, among the distributed questionnaires, 270 total copies were collected (recovery rate: 75%). Among these, 217 questionnaires were used for analysis are excluding those unanswered and poorly answered.

## 3.2. Design for Empirical Analysis

### 3.2.1. Operational Definition

As a measure of corporate image, Feber (1974) presented products, corporate leadership, customer trust, ethics, social responsibility, employee relations, negative relations, and public relations. Winters (1986) divided the components of corporate image into three categories: corporate behavior factors, social behavior factors, and corporate contribution factors. Barich and Kotler (1991) communicate more specifically about corporate image, contributions to social activities, and contributions to corporate activities. Therefore, based on prior research, this study set the dimensions of corporate image as social responsibility, business reliability, and publicity. In addition, a five-point scale was measured using 10 items describing these three elements. The average values of these items were standardized and used for hypothesis testing.

In Aaker (2001), measurement variables for brand personality were based on eight distinct factors: sincerity, excitement, competence, sophistication, ruggedness, peacefulness, passion, and ruthlessness. These were measured on a five-point difference scale using 37 items, and the average values of these items were standardized and used for hypothesis testing.

The measurement variables of consumer choice first consisted of amendments made to the items used in the study by Teisl et al. (2006) to measure consumer effectiveness perception. Attitude variables used items on the evaluation of alternatives in the consumer decision-making process model of Engel and Blackwell (1982). These items were measured on a five-point scale to describe 12 factors, including product performance, design, reliability, quality, price, attitude, feeling, symbolism, evaluation, experimental use, use image, and purchase intention.

### 3.2.2. Feasibility Analysis

No separate measurement tools have been developed to achieve the objectives of this study. Instead, the researchers selected and recycled questions that they thought were suitable for the purpose of this study from those developed for existing research.

The results of the factorial analysis for each measurement variable for the 217 parts are as shown in Table 1. As a result, 56 questions were selected due to the deletion of two questions with a load value of less than 0.40 or with a variation of more than two dimensions. Whether each factor dimension had an independent meaning was analyzed by applying varimax rotation factor analysis.

**Table 1.** Results of Factor Analysis for the Variables

| **Corporate Image** | | | | **Brand Personality** | | | | **Consumer Choice** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Factor 1 | Factor 2 | Factor 3 | | Factor 1 | Factor 2 | Factor 3 | | Factor 1 | Factor 2 | Factor 3 |
| Respo nsibi lity | .784 (1) .771 (2) .790 (3) .723 (5) .736 (7) .755 (9) .763 (8) | | | Sophi stica tion | .626 (34) .412 (30) .583 (54) .551 (55) .717 (69) .674 (72) .617 (74) .673 (70) .707 (71) .684 (73) | | | Percep tion | .657 (10) .792 (11) .844 (12) .820 (13) .793 (14) .697 (16) .865 (15) .525 (28) | | |
| Reliab ility | | .833 (31) .424 (32) .676 (37) | | Comp etence | | .411 (40) .523 (38) .493 (61) .574 (62) .512 (63) .587 (64) .677 (65) .621 (66) .544 (68) .472 (85) | | Attitu de | | .469 (21) .615 (22) .779 (23) .664 (24) .513 (26) .525 (29) | |
| Publi city | | | .427 (4) .684 (39) .711 (44) .727 (42) | Rugge dness | | | .521 (46) .612 (51) .734 (49) .650 (50) | Pur chase | | | .657 (90) .705 (93) .674 (95) .468 (27) |
| E. V. | 5.428 | 2.137 | 1.991 | E. V. | 7.296 | 5.381 | 4.433 | E. V. | 5.380 | 3.355 | 2.929 |
| V. R | 36.175 | 14.261 | 13..269 | V. R. | 20.848 | 15.358 | 12.661 | V. R | 26.901 | 16.777 | 43.678 |
| A % | 36.195 | 50.447 | 63.726 | A % | 20.851 | 36.223 | 48.878 | A % | 26.901 | 43.678 | 58.322 |

### 3.2.3. Reliability Analysis

It is necessary to analyze whether each question selected through factor analysis contains inconsistent errors and accurately connotes the concepts or attributes to be measured. There are several methods for measuring this reliability, but in this study, the Cronbach alpha coefficient was calculated by selecting the reliability verification method by internal consistency. To increase the reliability of the lower scale, we wanted to exclude questions that shows inappropriate correlation with the overall correlation in the process of calculating the alpha coefficient, the factor of the corresponding measurement variable, or questions with a confidence coefficient of 0.60 or less. However, the 56 questions were appropriate, so we confirmed these 56 questions, as shown in Table 2. The reliability coefficient of the analysis tool by sub-area was 0.73 to 0.92, indicating that it has strong cohesion between the relevant variables.

**Table 2.** Results of Reliability Analysis

(N=217)

| Measurement Variables | | No | α |
|---|---|---|---|
| Corporate Image | Social Responsibility | 7 | .9052 |
| | Corporate Reliability | 3 | .7423 |
| | Publicity | 4 | .7335 |
| Brand Personality | Sophistication | 10 | .9114 |
| | Competence | 10 | .8474 |
| | Ruggedness | 4 | .7713 |
| Consumer Choice | Perception | 8 | .9227 |
| | Attitude | 6 | .7585 |
| | Purchase Intention | 4 | .7411 |
| | Total | 56 | .9211 |

### 3.2.4. Data Analysis

A factor analysis and reliability analysis were conducted to select questions to be used for final analysis, and a correlation analysis was conducted to determine the relationship between the measures of each research unit. In addition, a covariate structural analysis was conducted using LISREL to verify the suitability of the hypothetical causal model presented, and a regression analysis was conducted to determine the control effect of the regulatory variables.

To test the hypotheses set in this study, the following two data analysis methods have been used. First, the appropriateness of the hypothetical causal model has been tested. Second, the significance and explanatory power of the paths, which exist in each variable, were tested to examine the hypotheses. For the test, the variables were divided into measurement variable-latent variable relations and causal relations among latent variables. Then, the significance and explanatory power of the paths, which exist between each variable, were verified by estimates of the factor coefficients and t-values.

## 4. Empirical Results

### 4.1. Correlation Analysis

The results of the correlation analysis are as shown in Table 3 to determine the extent to which sub-variables have a relationship among corporate image as an independent variable, with consumer choice as a dependent variable, and brand personality as a control variable. As a result, all sub-variates show significant static correlations. This significant correlation of all variables indirectly reveals that the constituent variables form a single component of the organic relationships between each factor.

Concerning corporate image, it can be seen that there is also a significant static correlation between brand personality and consumer choice. However, it is premature to draw conclusions based on correlation because such a relationship can be a spurious effect from a third variable.

### 4.1.1. Correlation between Corporate Image and Consumer Choice

Corporate image and consumer choice also show a high static correlation of r = .687. In correlations among sub-variables, the social responsibility variable has a high static correlation of r = .506 for perception, r = .467 for attitude evaluation, and r = .501 for purchase intention. In addition, corporate reliability has a high static correlation of r = .647 for perception, r = .519 for attitude and r = .559 for purchasing intention. The publicity variables are r = .462 for perception, r = .407 for attitude, and r = .549 for purchase intention.

### 4.1.2. Correlation between Corporate Image and Brand Personality

Corporate image shows a high static correlation of r = .839 between brand personalities. However, in the case when brand personality is set as a moderating variable, the correlation with the corporate image is relatively high, which is expected to cause an issue of correlation like multicollinearity among independent variables. With this in mind, an analysis of the multicollinearity problem found that the tolerance was 0.30 or higher, indicating that the correlation among the independent variables was not a problem.

In the correlations among the sub-variables, the social responsibility variable has a relatively high static correlation of r = .662 in sophistication, r = .609 in competence, and r = .549 in ruggedness, and the corporate reliability variable has a high static correlation of r = .719 in sophistication, r = .728 in competence, and r = .749 in ruggedness. In addition, publicity variables have relatively high static correlations with r = .641 in sophistication, r = .629 in competence, and r = .639 in ruggedness.

**Table 3.** Results of Related Variables Correlation Results

(N=217)

| | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Responsibility(1) | 3.365 | .794 | 1.000 | | | | | | | | | | | |
| Reliability(2) | 3.276 | .626 | .681*** | 1.000 | | | | | | | | | | |
| Publicity(3) | 3.517 | .626 | .682*** | .587*** | 1.000 | | | | | | | | | |
| Sophistication(4) | 3.184 | .591 | .662*** | .719*** | .641*** | 1.000 | | | | | | | | |
| Competence(5) | 3.374 | .523 | .609*** | .728*** | .629*** | .743*** | 1.000 | | | | | | | |
| Ruggedness(6) | 3.382 | .567 | .549*** | .749*** | .639*** | .677*** | .662*** | 1.000 | | | | | | |
| Perception(7) | 2.893 | .790 | .506*** | .647*** | .462*** | .731*** | .559*** | .560*** | 1.000 | | | | | |
| Attitude(8) | 3.314 | .552 | .467*** | .519*** | .407*** | .469*** | .520*** | .405*** | .570*** | 1.000 | | | | |
| Purchase(9) | 3.553 | .591 | .501*** | .559*** | .549*** | .639*** | .569*** | .536*** | .595*** | .499*** | 1.000 | | | |
| Corporate Image(10) | 3.383 | .602 | .917*** | .854*** | .854*** | .771*** | .749*** | .732*** | .611*** | .532*** | .610*** | 1.000 | | |
| Brand Personality(11) | 3.327 | .503 | .686*** | .826*** | .719*** | .909*** | .892*** | .875*** | .699*** | .519*** | .655*** | .839*** | 1.000 | |
| Consumer Choice(12) | 3.249 | .543 | .588*** | .694*** | .563*** | .751*** | .653*** | .605*** | .893*** | .795*** | .820*** | .687*** | .749*** | 1.000 |

**Note:** 1) *p < 0.05, **p < 0.01, ***p < 0.001, 2) All variables were measured on a 5-point scale

### 4.1.3. Correlation between Brand Personality and Consumer Choice

Brand personality and consumer choice show a high static correlation of r = .749, so brand personality is judged to have potential explanatory power in explaining consumer choice. The sophistication variable correlation among sub-variables had a high static correlation of r = .731 in perception, r = .469 in attitude, and r = .639 in purchasing intention. On the other

hand, the competence variable has a high static correlation of r = .559 in perception, r = .520 in attitude, and r = .569 in purchase intention. The ruggedness variable had a static correlation of r = .560 in perception, r = .405 in attitude, and r = .536 for purchase intention.

## 4.2. Verification of Research Hypotheses

### 4.2.1. Verification of Hypotheses 1 and 2

*Hypothesis 1: The overall goodness of fit about causal models devised to illustrate the impact of corporate image, and brand personality on consumer choice will be appropriately consistent with the empirical data.*

The results of the analysis on the effect of corporate image on consumer choices and goodness-of-fit of the hypothetical causal model in terms of the moderation effect of corporate image are stated in Table 4. Chi-square ($\chi^2$) was 97.68 (p<0.001) with RMSEA=0.103, NNFI=0.908, NFI=0.939, GFI=0.923 and RMR=0.039. In other goodness-of-fit indexes except for the chi-square and RMSEA, it was concluded that the hypothetical model is appropriate.

**Table 4.** Goodness-of-Fit Indices on the Hypothetical Casual Model

| Goodness of Fit Index | $\chi^2$(df)/ significance | RMSEA | NNFI | NFI | GFI | RMR |
|---|---|---|---|---|---|---|
| Goodness of Fit | 97.68(24)/p<.001 | .103 | .908 | .939 | .923 | .039 |
| Fit Standard | p >.05 | <.05 | >.90 | >.90 | >.90 | <.05 |
| Judgement Result | unfit | unfit | fit | fit | fit | fit |

It appears that the chi-square ($\chi^2$) and RMSEA were inappropriate because of the large sample size. Chi-square tends to sensitively respond to sample size. If the sample size (200 or higher) is very large even when the model is good and the conditions for the model verification are met, the $\chi^2$ values tend to have statistical intentions. It is easy to dismiss the null hypothesis that the model is suitable. Conversely, if the number of samples decreases to less than 100, the null hypothesis is likely not to be rejected, as it tends to indicate an insignificant level of probability. Therefore, we propose not to apply the $\chi^2$ index too strictly if the sample is sufficiently large enough and the theoretical support of the model under analysis is significant. The RMSEA also determines that the model of this study was inadequate because it is based on $\chi^2$ statistics.

Four models except for the chi-square and RMSEA, which could not be applied to a hypothetical model from the strict perspective, are appropriate so that it appears that the model is a good fit from the general aspects. In addition, the hypothesis that the overall goodness-of-fit of the causal model was designed to explain the effect of corporate image on consumer choice would be a good fit for the experimental data was positive. The path diagram of a hypothetical model whose goodness-of-fit was determined and the significance of the path coefficients are shown in Fig. 1.

*Hypothesis 2. Corporate images will have an indirect significant effect on consumer choice with brand personality as a moderator variable.*

**Fig. 1.** Results of Hypothetical Causal Model Test



The whole effect of corporate image (independent variable) on brand personality (intervening variable) and independent variable on the dependent variable are described in Table 5. Corporate image explained 92% of brand personality while brand personality explained 34% of the total variation of consumer choice. In addition, it has been confirmed that corporate image has a statistically significant indirect effect on consumer choice ($\beta$=.29) with brand personality as an intervening variable.

These results are critical variables in order for independent variables to determine intervening variables and to prove that independent and intervening variables are important in determining dependent variables. Therefore, the hypothesis that corporate image would have an indirect significant effect on consumer choice using brand personality as an intervening variable was positive.

**Table 5.** Effects Among Consumer Choice Related Variable

| Path | Direct Effect | Indirect Effect | Total Effect |
|---|---|---|---|
| Corporate Image($\xi_1$) → Consumer Choice($\eta_1$) | 0.86** | - | 0.86** |
| Corporate Image($\xi_1$) → Brand personality($\eta_2$) | 0.70** | 0.29** | 0.92** |
| Brand Personality($\eta_2$) → Consumer Choice($\eta_1$) | 0.34** | - | 0.34** |

*p < 0.05, **p < 0.01, ***p < 0.001

### 4.2.2. Verification of Hypothesis 3

*Hypothesis 3. The relationship between corporate image and consumer choice will be controlled by brand personality.*

A hierarchical regression analysis was conducted to determine whether brand personality controls corporate image and consumer choice as an adjustment variable. The $R^2$ of the result of the regression analysis (A, B) using consumer choice as the dependent variable and corporate image and brand personality (moderating variable) as independent variables and $R^2(\Delta R^2)$ which increased with the addition of an interaction term (A×B) between corporate image and brand personality were 0.03. It was proven that the moderation effect of brand personality exists between corporate image and consumer choice as shown in Table 6.

**Table 6.** Moderation Effect of Brand Personality between Corporate Image and Consumer Choice

| Dependent Variable | Independent Variable | $R^2$ | $\Delta R^2$ | $\Delta F$ | Sig.F |
|---|---|---|---|---|---|
| Consumer Choice | Corporate Image(A), Brand Personality(B) | 0.573 | 0.032 | 40.798 | .000 |
| | A, B, A×B | 0.621 | | | |

## 5. Conclusion

In order to achieve the purpose of this study, corporate image and brand personality were selected first among the variables that could affect consumer choice through prior research. After setting the concept of variables and measurement criteria, relevance among these variables was examined. In addition, a hypothetical causal model and a control effect model were constructed by comprehensively summarizing assumptions about causality among each variables.

The findings and conclusions obtained from this study are as follows.

First, perception, attitude and intention to purchase were selected as criteria for measuring consumer choice. In terms of measurement criteria for brand personality, sophistication, competence, and ruggedness were selected. Lastly, the measurement criteria for corporate image included social responsibility, corporate reliability, and publicity.

Second, a significant correlation was identified among all sub-variables presented in the study. In addition, significant correlations were detected among corporate image, consumer choice and brand personality.

Third, the hypothetical model in this study was judged to be generally suitable, and corporate image had direct significant static effects on consumer choice and brand personality respectively. Brand personality has a direct static effect on consumer choice. In addition, corporate image was shown to have an indirect significant influence on consumer choice with brand personality as a moderating variable.

Fourth, brand personality had a significant adjustment effect in the relationship between corporate image and consumer choice. The greater the brand personality, the greater the impact of corporate image on consumer choice. In other words, it has been confirmed that if brand personality levels are high, corporate image may guide consumer choice.

The results of this study provide implications for foreign and domestic enterprises as

follows:

First, a dominant corporate image strategy may be more useful. Therefore, in order to boost exports, a strategy to promote corporate image through various forms of media is effective. In particular, the government should use its corporate image as a means of enhancing and promoting competitiveness with products from advanced countries, where overseas production is increasing.

Second, corporate image and brand personality should be included. The explanation for this finding was that when a product is launched in a foreign market, there will be little or no awareness of the specific brand. However, there may be reasonably high levels of awareness of the company from which the product originates. In such cases, it makes sense to capitalize on corporate image and brand personality perceptions in order to establish the product in its new market. In other words, it is necessary to seek new transformations through the establishment of the identity of brand personality at the corporate level so that consumers can develop a favorable impression of the corporate image.

Third, when developing export promotion campaigns as a component of overall image strategy, companies should carefully evaluate which brand personality aspect will most significantly benefit from initiatives highlighting corporate image. In addition, companies should make active use of corporate image and brand personality for international marketing strategies such as price policy, market segmentation and target customers.

Fourth, when a company strives to symbolize a differentiated culture along with the establishment of corporate image, corporate image has a positive influence on consumer choice, and will increase this positive effect if it develops brand personality aspects that can be symbolized via representation.

Fifth, brand managers need to conduct contextualized brand-specific research in order to ascertain which demographic segments of their targeted markets are influenced by the brand personality.

Sixth, with consumption styles becoming more diverse, this study confirmed that the higher the level of brand personality, the more corporate image leads to consumer choice. Therefore, when brand managers advertise during the product introduction period, they need to build a brand personality that matches the existing corporate image. In particular, a consistent setting of corporate image and brand personality is very important.

Finally, this study has the following limitations. First, because this study handled one product, the results can differ if other products are considered. Future research is expected to produce results that are more meaningful if the study is expanded to a wider variety of products and consumers. Second, the study did not take into account many variables. Therefore, follow-up studies need to consider more variables.

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# The Effects of Managerial Attributes on Cost Stickiness: An Empirical Analysis of Korean Exporters and Implications for Start-ups

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## Abstract

*Purpose* – We attempted to empirically verify the effects of managerial attributes on cost stickiness in exporters. Exporters are often affected not only by external factors such as exchange rate but also by internal factors such as managerial attributes regarding their business activities. Because cost stickiness is the product of a manager's decision-making, it has been considered that managerial attributes have a great influence on the behavior. Therefore, our study was intended to find out whether cost stickiness shows differentiated aspects depending on managerial attributes in exporters.

*Design/methodology* – We considered two managerial attributes: CEO power and managerial overconfidence. First, CEO power was measured as CEO pay slice. In addition, managerial overconfidence was measured based on three methodologies presented by previous studies. To measure cost stickiness, we used multiple methodologies presented by prior research.

*Findings* – The results of our empirical analysis are as follows. First, in export firms, the greater CEO power is, the greater cost stickiness is. This result suggested that export managers with great influence little respond to temporary sales decrease promptly, little reduce related production costs flexibly in preparation for future sales recovery, but leave room to endure costs for idle resources. Second, the greater managerial overconfidence is, the greater cost stickiness is. This result indicated that export managers with great overconfidence on their decision-making often view the prospect for sales recovery positively; therefore, they little respond to temporary sales decrease immediately, little reduce related production costs flexibly for future sales recovery, but leave room to endure costs for idle resources. Third, export managers with great influence in their businesses and great overconfidence in their decision-making tend to show relatively great cost stickiness. The results proposed that the combination of the two factors functions to make cost stickiness greater.

*Originality/value* – Our study is differentiated from extant studies in that we provided empirical evidence of the effects of managerial attributes on their business activities in exporters. Specifically, we verified the effects of managerial attributes on cost stickiness in Korean exporters. The results of our study are expected to contribute to providing useful information for exporters and start-ups.

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# 1. Introduction

As the Comprehensive Economic Partnership (hereinafter referred to as RCEP), a free trade agreement (hereinafter referred to as FTA), was launched on November 15, 2020, the export expansion of Korean companies is expected. The RCEP accounts for about 30% of the world from the aspects of trade volume and gross domestic product (hereinafter referred to as GDP), and the establishment of the RCEP has established a free trading zone with a population of 3.4 billion , $10 billion and $131 million of trade volume (about one billion and 1,043 trillion won) and 19 trillion and $764 billion of GDP valued at current prices. This is the launch of the biggest world economic bloc that exceeds the North America Free Trade Agreement (hereinafter referred to as NAFTA, $18 trillion) and European Union (EU, $17 trillion and $600 billion) based on GDP at current prices. The launch of the RCEP is expected not only to diversify Korea's export market and trade structure but also to lower the tariff threshold greatly in the ASEAN market, mainly on automobiles and steel industries, expanding export routes.

As shown above, the launch of ESRP will be a turning point for Korean export companies struggling from deteriorated profitability caused by the fall in the exchange rates and the increase of raw material prices accordingly in addition to negative business sentiment due to the spread of COVID-19 in 2020. Actually, in the Business Survey Index (hereinafter referred to as BSI) conducted by the Korea Economic Research Institute on the 600 biggest companies based on sales on November 25, 2020, the observation value of December was 98.9, which was 0.6% lower from November (99.5).

Specifically, the negative business sentiment is expected to continue in 2021 as the uncertainty increases due to COVID-19, so the response of export companies is more important. While companies engage in decision making toward enhancing investment by increasing facilities in economic prosperity and employing additional manpower in order to prepare for sales increases, during a recession, they tend to reduce facilities and manpower, or lower maintenance costs through liquidation of idle resources to cope with sales decreases.

Decision making appears differently according to managerial attributes, the highest decision makers in companies. First, managers with high influence in companies possibly maintain available assets and investment levels in preparation for economic prosperity after a recession instead of retrenchment for a temporary recession from the long-term management prospect. On the other hand, those with less influence respond to each year's business performance sensitively, and greatly lower the current available assets and investment levels during a recession. Therefore, production cost behaviors can be different depending on the influence of managers. In addition, if managers have high overconfidence in their decision making, they tend to consider the current recession a temporary transition period, or a chance for aggressive management, despite the negative prospect, and maintain the current available assets and investment levels in preparation for a future economic boom instead of retrenchment for the recession.

Thus, our study intends to investigate whether the influence of managers in export companies have a differentiated effect on production cost behaviors, whether the overconfidence of managers has a differentiated effect on production cost behaviors, and whether the interactions of the above factors have a differentiated effect on production cost behaviors. The results are expected to contribute to the development of a sound capital market by providing useful information about business activities of export companies to participants of capital markets. Our study is also expected to be differentiated from precedent studies in that it comprehensively verifies effects of managerial attributes on the business activities of export companies.

Our study consists of the following chapters. In Chapter 1, the introduction presents the backgrounds and objectives of this study. In Chapter 2, related precedent studies are presented based on which hypotheses are established. In Chapter 3, the research model is presented, along with research model's variable definition and the process of selecting research sample. In Chapter 4, the empirical analysis results of descriptive statistics, correlation analysis, and hypothesis verification multivariate regression analysis are presented. In Chapter 5, we summarize the results and present managerial implications for start-ups, and note the limitations of our study.

## 2. Literature Review and Hypothesis Development

### 2.1. Literature Review

#### 2.1.1. Managerial Attributes

This study focuses on the influence and overconfidence tendency of managers as managerial attributes. Therefore, prior studies are classified into influence and overconfidence tendencies of managers.

*CEO Power*. As the importance of managers is emphasized, there have been various analyses and studies on their influence and ability (Lee Kang-Young and Yun Sung-Man, 2011; Kim Seong-Gap et al., 2017; Kim Hyung-kook, 2018; Bukangkang and Lee Chan-Ho, 2018). However, it is not easy to measure the influence of managers involved with many factors objectively. Meanwhile, as Bebchuk et al. (2011) presented the measured value "CEO Pay Slice" (hereinafter referred to as CPS) that simply digitizes management concentration levels with the ratio of CEO's salary among total wages of the top five wage ranks, there are multiple studies that utilize this as a vicarious variable of a CEO's influence. In Korea, as the wage information of registered individual executives was noted in accordance with the revision of the Capital Market Act in 2013, many studies using the methodology of Bebchuk et al. (2011) have been made. A representative study in Korea that uses the methodology of Bebchuk et al. (2011) was by Kwak Young-Min and Kim Hyun-Jin (2017). They verified the influence of CPS on company value and excessive investment, and found that when the CPS level was higher, the company value deteriorated, and inefficient decision-making levels, like excessive investment, became higher. Mun Bo-Young and Chun Hong-Min (2018) reported that as CPS increased, the cost of equity capital increased. Kim Ji-Young and Ji Sang-Hyun (2018) verified the correlation between CPS and Book-Tax Difference (BTD), and reported that companies with high CPS were high in BTD, and managerial transparency was lower. Kim Young-Sik (2018) suggested that companies with higher agency costs, like family-run companies, have a high possibility to allocate internal resources, but as the quality of corporate governance is higher, management concentration can be effectively controlled. Kim Yu-Jin (2018) reported that as CPS increased, the credit rating was lower, and CPS was recognized differently in owner manager companies and professional management companies. An Jung-In and Kim Yu-Jin (2018) reported that companies with higher CPS tended to evade information disclosure obligations related to executive wages. Yun Woo-Young et al. (2019) verified the correlation between CPS and earnings management from the aspects of the accounting earnings management and the real earnings management, and reported that companies with higher CPS have higher earnings management levels. An Sang-Bong et al. (2019) reported that an increase in CEO influence in the service industry can have a negative effect on the reliability of accounting information. The results of the above

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precedent studies using CPS information show that in companies with great CPS, a strong influence of managers had a negative effect on overall company management.

*Managerial Overconfidence.* Prior studies on managerial overconfidence tendency are broadly divided into four subjects.

The first subject is the relevance between managerial overconfidence and investments. Hayward and Hambrick (1997) suggested that when managers were overconfident about decisions in mergers and acquisitions, there was a higher possibility that they would overestimate the synergy effects of M&A, and that the cost of business rights would be excessively great. Heaton (2002) mentioned that companies with managers with high overconfidence tendencies were underestimated, and internal capital was used to compensate investment related cost. Malmendier and Tate (2005) argued that managers with high overconfidence in future profits tended to overestimate investment profit rate. Malmendier and Tate (2008) claimed that managers with high overconfidence did not try M&As very often, but they possibly paid excessive amounts to incorporated firms and participated in M&As that reduced company values. Ben David et al. (2012) said that managers with overconfidence create more debts. Kim Hui-Jung and Park Won (2019) said managerial overconfidence and excessive investment activities had a positive (+) effect on company values.

The second subject is the relevance between managerial overconfidence and dividend policy. Deschmukh et al. (2013) said that as executives had higher overconfidence, the dividend ratio was lower. Hwang Gyu-Young and Kim Eung-Gil (2018) claimed that managers with high overconfidence decided dividends passively for aggressive investments, and tried to secure surplus funds. On the other hand, Choi Hae-Rin et al. (2020) claimed that dividend ratio, dividend yield ratio, and manager overconfidence (optimism) had positive (+) relevance, so managers with higher overconfidence paid more.

The third subject is the relevance between managerial overconfidence and accounting information. Schrand and Zechman (2012) claimed that overconfident managers brought about more accounting errors. Hirschleifer et al. (2012) claimed that when managers were more overconfident, they spent more on research and development costs, tried to acquire more patents, and had higher possibilities to enjoy innovative success. On the other hand, Kang Shin-Hee (2019) claimed that when managerial overconfidence was greater, the accounting ratio of research and development costs was higher. Ahmed and Duelman (2013) and Ryu Hae-Young and Kim Sae-Ro-Na (2015) said when managerial overconfidence was higher, accounting was less conservative. Hribar and Yang (2013) claimed that managers with higher overconfidence tended to open business forecasting information, and enhance company profits. Bouwman (2014) said managers with higher overconfidence were optimistic about future performance, so they executed earnings smoothing in order to increase profits during poor performance periods. Schrand and Zechman (2011) and Gau and Han Kil-Seok (2018) claimed that managerial overconfidence and earnings management had a positive (+) relevance, so when managerial overconfidence was higher, the level of earnings management was higher. Lee Jin-Su and Oh Sang-Hee (2020) claimed that when managerial overconfidence was higher, cost asymmetry was higher, but this tendency could be partially controlled through a control system. Kim Na-Youn and Hwang Kook-Jae (2020) claimed that the level of competition in an industry functions as a controller on the tendency of upgrading profits through discretionary accruals of managers with high overconfidence.

The fourth is the relevance between managerial overconfidence and tax information. Cha Myun-Ki, Kim Su-Sung, and Hwang Kook-Jae (2016) and Jang et al. (2017) claimed that managers with higher overconfidence had lower tax avoidance, which led to a higher quality

of profits. Jang et al. (2017) claimed that managers with higher overconfidence were more active in tax avoidance, and this tendency was lower when governance was good. Kim Sang-Myeong, Park Sung-Ook, and Chung Hee-Sun (2019) said that managers with high overconfidence gave more weight to the reduction effect of non-tax costs expected as book reporting earnings were upgraded than to the increased effect of tax costs by the increase of taxable income, so they were passive in tax avoidance. Nam Hye-jeong (2019) claimed that when managers were more overconfident, they had higher tax risks, and when manager ownership percentages were higher, the positive (+) relation between overconfidence and tax risk was reinforced. Ji Sang-Hyun (2020) claimed that when managerial overconfidence as greater, Book-Tax Difference (BTD) was greater, so managers with higher confidence tended to be involved with accounting. Park Jong-Il and Kim Su-In (2020) claimed that both financial constraint and managerial overconfidence had a positive (+) relation with tax avoidance, and the interaction of these also had a positive (+) relation with tax avoidance.

Other studies are on the relevance between managerial overconfidence and audit quality (Kim Sang-Mi, Shin Hee-Jung and Kim Su-In, 2019; Shin Bo-Sun and Woo Yong-Sang), the relevance between managerial overconfidence and profit forecasting (Kim Sung-Hwan, 2018; Lee Da-Hye and Byun Sang-Hyuk, 2020), and the relevance between managerial overconfidence and market response (Kim Byung-Mo, 2016; Lee Hye-Mi and Hong Chang-Mok, 2018; Kim Sung-Hwan, 2019).

### 2.1.2. Cost Stickiness

Anderson et al. (2003) discovered that Selling, General, and Administrative Costs (SG&A costs) decrease less when sales decrease than the increase of Selling, General, and Administrative Costs when sales increase, and defined this phenomenon as cost stickiness. Since they presented the concept of cost stickiness, it has gathered the most attention in management accounts in Korea. Domestic studies on cost stickiness can be divided into three groups.

Firstare studies that measure domestic company cost stickiness. An Tae-Sik et al. (2004) analyzed domestic cost stickiness using the methodology of Anderson et al. (2003), and claimed that manufacturing costs and SG&A costs showed cost stickiness. Baek Won-seon (2017) claimed that sales elements that are correlated with costs when sales decrease compared to those when sales increase show downward elasticity, but sales elements that were not correlated with costs showed cost stickiness.

Second are studies on factors that affect cost stickiness. Jang Seung-Hyun and Baek Tae-Young (2009) claimed that the various management conditions (e.g., cash flow, financial condition, business growth, R&D investment, equipment investment) of a company affect a manager's decision-making, so there can be different cost behaviors in SG&A costs. Chi Sung-Kwon, Shin Sung-Wook, and Choi Won-Ju (2009) claimed that the cost stickiness of SG&A costs was greater when the ratio of tangible assets was higher, surplus cash flow was greater, and investment opportunities were greater, but the cost stickiness of SG&A costs was less when inventories assets turnover periods were longer. Park Ae-Young(2014) claimed that KOSDAQ companies with CEO embezzlement had greater cost stickiness in the year when the embezzlement occurs than those with no embezzlement, and when the amount of embezzlement was greater, and when the embezzlement was through collusion, and when the time gap until the embezzlement disclosure was greater, cost stickiness became greater. Yim Sang-Giun, Park Jin-Ha, and Hwang In-Y (2014) claimed that there was a positive correlation between cost stickiness and the change of internal cash reserves, so companies that dispose of resources tended to reserve cash assets for future investments. Park Ae-Young and Kwak Ji-Young (2014) claimed that when the level of overall governance structure was fair, cost

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stickiness was relieved, and when governance structure improved, cost stickiness was relieved. Yang Dae-Cheon (2015) claimed that optimistic forecasting during growth periods could affect decision making on expansive resources and production costs. Lee Sang-Cheol and Kim Suk-Yeon (2015) claimed that companies with higher levels of social responsibility activities showed greater cost stickiness, but the continuity of performance on social responsibility activities was not related to cost behavior. Son Jae-Seong, Lee Yong-Kyu, and Park Jin-Ha (2019) claimed that cost stickiness at the company level appeared in bank branches , and branches valued less in the current year than in the previous year showed lower cost stickiness in response to the current year's sales decrease. Noh Gil-Kwan (2019) claimed that differentiated relations existed in earnings management types and cost behaviors, and this tendency was different between Korean and Japanese companies. Moon Hye-Won, Goh Chang-Youl, and Jung Hoon (2020) claimed that digital companies with important R&D tended to less reduce R&D costs than other companies when sales decreased.

Third, extant studies verified whether cost stickiness affected business activities. Park Yeon-Hee, Koo Jung-Ho, and Pae Su-Il (2012) claimed that cost stickiness indirectly provided intentional decision making that future profits would increase, and this had an information effect in the market. Lee Mi-Yeong, Hong Young-Eun, and Park Jong-Kook (2015) claimed that cost stickiness was when managers maintained production costs to cope with future demand increases, the market judges this as rational decision making, and this information effect was not relieved by a labor union. Kim Tae-Seong et al. (2015) claimed that credit rating institutions judge the quality of accounting incomes differently according to the degree of cost stickiness, and this was reflected in credit ratings. Jeong Sung-Hwan (2015) claimed that when cost stickiness was based on agency matter in the decrease of current year's sales from the previous year increases, the ratio of costs rises, and discretionary accruals increase. Hong Yeung-Eun, Kim Soo-Jin, and Park Jong-Kook (2020) claimed that when the level of cost stickiness was high, a risk of a sharp drop in stock price was low.

## 2.2. Hypothesis Development

Exporters are more likely to perform business activities under complicated external environments of business fluctuations, exchange rates, language barriers, cultural differences, and regional risks compared to domestic companies. Therefore, the roles and importance of managers are more highly regarded in these companies than domestic companies. Managers, the highest decision, play very important roles not only in business activities but also in business forecasting and responses. In other words, the greater CEO power, the greater their influence is reflected in business forecasting and responses, and managers with higher confidence in their decision making more likely to put importance on their own judgment in business forecasting and responses.

Exporters are very sensitive to external business fluctuations, and the differentiation of decision making can be very critical in economic prosperity and recessions. In economic prosperity, production equipment should be expanded for future sales increases, and various countermeasures, such as personnel development, should be prepared. In recession, the reduction of idle resources should be considered for sales decreases. These resilient business behaviors are very helpful for management, and ultimately, they have a direct effect on the survival of companies. Meanwhile, resilient business behaviors do not always have a positive effect on future business performances. A high level of time use and costs could be required to replenish idle resources that have been reduced due to sales decreases during recession. In addition, business behaviors sensitive to business fluctuations can be a negative factor that lower the stability of a company. These management strategies are the products of company

decision-making, and they become concrete as opinions of various interest parties are reflected, but the judgment of a manager accounts for the highest portion. In other words, company management strategies are established according to manager decision-making, and therefore, in comprehending a management behaviors, it is helpful to focus on managerial attributes. Thus, this study intends to find whether cost behavior can be differentiated depending on manager characteristics.

Under the traditional cost system, costs were assumed to show symmetrical behavior regardless of the increase/decrease in activity level, but decreasing costs when activity level low is more difficult than increasing costs when activity level is high, which leads to cost stickiness (Cooper and Kaplan 1998). Anderson et al. (2003) focused on the response of a manager to increases and decreases in product demand as the major cause of cost stickiness. They explained that when increased product demand exceeded supply, the manager promptly expanded definite resources, but when product demand does not reach supply due to a decrease in product demand, the manager decides to reduce surplus resources, and the CEO responds to the reduction of surplus resources passively in consideration with opportunity cost and others in case of an increase in product demand, so there is cost stickiness.

This study focuses on the following two matters as important considerations when companies handle adjustment costs by reducing surplus resources as sales decrease, or endure maintenance costs by holding surplus resources. First is the influence of the CEO in the decision-making process of a company. If the CEO has enough influence to handle a short-term loss, the CEO does not react to short-term maintenance costs sensitively, but can manage the company from a long-term perspective. In this case, there will be cost stickiness. In other words, the higher a CEO's influence, the greater cost stickiness. Thus, a research hypotheses can be established as follows.

*H1. When CEO power in export companies is higher, the tendency of cost stickiness is higher.*

Second is the level of managerial overconfidence in future sales trends. If a manager is firmly confident that the current sales decrease is temporary, and a future sales increase is expected, the manager is willing to endure the maintenance costs for the surplus resources incured due to the current sales decrease (Park Yeon-Hee, Koo Jung-Ho, and Pae Su-Il, 2012). In this case, there will be cost stickiness. That is, when managerial overconfidence is greater, cost stickiness is higher. Therefore, the following research hypothesis can be established.

*H2. When  export company managers have greater overconfidence, the tendency for cost stickiness is higher.*

If the tendency of cost stickiness is higher when CEO power is greater and managerial overconfidence is higher, cost stickiness can be even greater with managers with greater influence and overconfidence. Managers with greater influence and overconfidence in their decision-making have a stronger intention to endure maintenance costs of surplus resources caused by an immediate sales decrease under a positive prospective for future sales. In other words, when CEO power influence and overconfidence are greater, cost stickiness is higher. Thus, the following hypothesis can be established.

*H3. When CEO power and managerial overconfidence in export companies are higher, cost stickiness is higher.*

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## 3. Research Design

### 3.1. Sample and Data

The samples used in this study are companies that satisfy all following conditions among securities market listed companies from 2013 to 2017.

    (1)   Non-financial company in the settlement of accounts in December
    (2)   Not designated with impaired capital or issues for administration
    (3)   Company with current year exports
    (4)   Financial information can be gathered at FnGuide

First, regarding resources, financial materials were gathered from FnGuide, and companies with current year exports only were selected. Among 3,353 companies that satisfied sections (1) and (2), 1,311 companies with no current year exports, and 75 companies whose financial information could not be gathered, were excluded, so a total of 1,967 companies were selected.

Meanwhile, manager influence was measured with the methodology of Bebchuk et al. (2011), overconfidence was measured with the methodology of Ahmed & Dullman (2013) and Schrand and Zechman (2012), and cost stickiness was measured with the methodology of Homburg and Nasev (2008) and Weiss (2010). However, in measuring the influence of managers with the methodology of Bebchuk et al. (2011), the missing value was very large due to an omission of disclosure data, and in measuring cost stickiness by the methodology of Weiss (2010), the missing value was very large as well. Therefore, when all the missing values are removed at the same time in the calculation process of measured values, there is a possibility that convenience from missing values of research samples can appear. Thus, in this study, based on the first research samples, research samples were selected differently according to research methodologies, and the second research samples were selected as follows.

First, to verify Hypothesis 1, Research Samples 1-1 and 1-2 were organized in Table 1. In Research Sample 1-1, the influence of managers was calculated with CPS according to the methodology of Bebchuk et al. (2011), 845 samples that were excluded when cost stickiness was calculated according to the methodology of Homburg and Nasev (2008), and 102 samples that had outliers in each variable were removed (average±3×standard deviation exceeding samples), so a total of 1,110 companies are final samples.

In Research Sample 1-2, the influence of managers was calculated with CPS according to the methodology of Bebchuk et al. (2011), 671 samples were excluded when cost stickiness was calculated according to the methodology of Weiss (2010) along with 68 samples with outliers in each variable (average±3×standard deviation exceeding samples), so a total of 671 companies are final samples. Table 1 presents the result of final selection of research samples.

Next, Table 2 shows the organization for Research Sample 2-1 and 2-2 for verification of H2. In Research Sample 2-1, 11 samples were excluded when cost stickiness was calculated according to the methodology of Homburg and Nasev (2008), and 235 samples with outliers for each variable (average±3×standard deviation exceeding samples) were excluded, so a total of 1,721 companies comprise the final sample. In Research Sample 2-2, 1,296 samples were excluded when cost stickiness was calculated according to the methodology of Weiss (2010), and 68 companies with outliers for each

variable (average±3×standard deviation exceeding samples) were excluded, so a total of 603 companies comprise the final sample.  Table 2 presents the final selection of research samples.

**Table 1.** Sample for the H1 Test

| Research Sample 1-1 | |
|---|---|
| Non-financial enterprises listed on Korea Exchange as of December, 2013~2017 | 3,353 |
| Companies whose financial information could not be gathered from FnGuide | (75) |
| Non-exporters with no current year exports | (1,311) |
| Companies whose CPS could not be calculated with the methodology of Bebchuk et al. (2011) | (845) |
| Company samples that are outliers [average ±3(standard deviation)] | (102) |
| Final Samples | 1,110 |
| **Research Sample  1-2** | |
| Non-financial enterprises listed on Korea Exchange as of December, 2013~2017 | 3,353 |
| Companies whose financial information could not be gathered from FnGuide | (75) |
| Non-export companies with no current year exports | (1,311) |
| BCompanies whose CPS could not be calculated with the methodology of Bebchuk et al. (2011), and whose cost stickiness could not be calculated with the methodology of Weiss (2010) | (1,296) |
| Company samples that are outliers [average ±3(standard deviation)] | (68) |
| Final Samples | 603 |

**Table 2.** Sample for H2 Test

| Research Sample 2-1 | |
|---|---|
| Non-financial enterprises listed on Korea Exchange as of December, 2013~2017 | 3,353 |
| Companies whose financial information could not be gathered from FnGuide | (75) |
| Non-export companies with no current year exports | (1,311) |
| Companies whose cost stickiness could not be calculated with the methodology of Homburg and Nasev (2008) | (11) |
| Company samples that are outliers [average ±3(standard deviation)] | (235) |
| Final Samples | 1,721 |
| **Research Sample 2-2** | |
| Non-financial enterprises listed on Korea Exchange as of December, 2013~2017 | 3,353 |
| Companies whose financial information could not be gathered from FnGuide | (75) |
| Non-export companies with no current year exports | (1,311) |
| Companies whose cost stickiness could not be calculated with the methodology of Weiss (2010) | (1,296) |
| Company samples that are outliers [average ±3(standard deviation)] | (68) |
| Final Samples | 603 |

On the other hand, H3 is relevant to CEO power  and managerial overconfidence. In this respect, we attempted to test the hypothesis with Research Samples 1-1 and 1-2, respectively.

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### 3.2. Research Model

The objective of this study is to verify the effects of manager characteristics in export companies on cost stickiness. Managerial attributes, which are independent variables, are CEO power and managerial overconfidence, and the dependent variable is cost stickiness that shows cost behavior. For verification of interaction effects among managerial attributes, the interaction variables of CEO power and managerial overconfidence were added. The research model is as follows.

First, the following equation $(1)$ is the verification model of H1.

$\textbf{Sticky\_(1),(2)}_{i,,t}$
$$= a_0 + \beta_1 CPS_{i,,t} + \beta_2 SIZE_{i,,t} + \beta_3 LEV_{i,,t} + \beta_4 ROA_{i,,t} + \beta_5 R\&D_{i,,t} + \beta_6 GRW_{i,,t}$$
$$+ \beta_7 FirmAge_{i,,t} + \beta_8 BIG4_{i,,t} + \sum IND + \sum YEAR + \varepsilon_{i,,t,t} \qquad (1)$$

Stick\_(1),(2) $_{i,t}$ : Two measurements of cost stickiness.

Stick\_(1) $_{i,t}$ : A measurement of cost stickiness measured via the method
of Homburg and Nasev (2008)

Stick \_(2) $_{i,t}$ : A measurement of cost stickiness measured by the method of Weiss (2010)

CPS $_{i,t}$ : A measurement of CEO power measured by the method of Bebchuk et al. (2011)

SIZE $_{i,t}$ = Natural log values of total assets

LEV $_{i,t}$ = Total amount of dabt divided by equity

ROA $_{i,t}$ = Net income divided by total assets

R\&D $_{i,t}$ = R&D cost divided by sales

GRW $_{i,t}$ = Total assets growth year on year

FirmAge $_{i,t}$ = Natural log values of the number of days listed

BIG4 $_{i,t}$ = Dummy variables with a value of 1 if the audit firm is one of the BIG 4 (Samil, Samjeong, Anjin, Hanyoung), and otherwise 0.

∑IND : Industrial dummy variables

∑YEAR : Year dummy variables

Here, if $\beta_1$ of manager-governance variable, which is independent variable, has a statistically significant positive value, H1 is supported. Therefore, managers with higher influence do not respond to short-term maintenance costs, but are expected to perform business activities from a long-term perspective. The following equation (2) is the verification model of H2.

$\textbf{Sticky\_(1),(2)}_{i,t}$
$$= a_0 + \boldsymbol{\beta_1 OverConf\_(1),(2),(3)}_{i,,t} + \beta_2 SIZE_{i,,t} + \beta_3 LEV_{i,,t} + \beta_4 ROA_{i,,t} + \beta_5 R\&D_{i,,t}$$
$$+ \beta_6 GRW_{i,,t} + \beta_7 FirmAge_{i,,t} + \beta_8 BIG4_{i,,t} + \sum IND + \sum YEAR + \varepsilon_{i,,t} \qquad (2)$$

OverConf\_(1),(2),(3) $_{HøA}$ : Three measurements of managerial overconfidence

OverConf\_(1) $_{HøA}$ = A measurement of managerial overconfidence measured by the method
of Ahmed and Dullman (2013). Dummy variables have a value of 1 if the
managerial overconfidence is higher than the median, and otherwise 0.

OverConf \_(2) $_{HøA}$ = A measurement of managerial overconfidence measured by the method
of Schrand and Zechman (2012). Dummy variables have a value of 1 if the
managerial overconfidence is higher than the median, and otherwise 0.

OverConf \_(3) $_{HøA}$ = A measurement of managerial overconfidence measured by the method
of Ahmed & Dullman (2013) and Schrand & Zechman (2012). Dummy
variables have a value of 1 if the managerial overconfidence is higher than
the median, and otherwise 0.

Here, if $\beta_1$ of the managerial overconfidence [OverConf_(1),(2),(3)] variable, which is independent variable, has a statistically significant positive (+) value, H2 is supported. Therefore, managers with higher overconfidence do not respond to short-term maintenance costs, but are expected to perform business activities from a long-term perspective under confidence in their own judgment. The following equation (3) is the verification model of H3.

$$\begin{aligned}
\text{Sticky\_(1),(2)}_{i,t} \\
= a_0 + \boldsymbol{\beta_1[CPS}_{i,t}\boldsymbol{\times OverConf\_(1),(2),(3)}_{i,t}\boldsymbol{]} + \beta_2 CPS_{i,t} + \beta_3 OverConf\_(1),(2),(3)_{i,t} \\
+ \beta_4 SIZE_{i,t} + \beta_5 LEV_{i,t} + \beta_6 ROA_{i,t} + \beta_7 R\&D_{i,t} + \beta_8 GRW_{i,t} + \beta_9 FirmAge_{i,t} + \beta_{10} BIG4_{i,t} \\
+ \sum IND + \sum YEAR + \varepsilon_{i,t},
\end{aligned} \tag{3}$$

$CPS_{H\emptyset A} \times OverConf_{H\emptyset A}\_(1),(2),(3)$ = the interaction between CEO power and managerial overconfidence[$OverConf_{H\emptyset A}\_(1),(2),(3)$].

Here, if $\beta_1$ of the interaction variable [$CPS_{i,t} \times OverConf\_(1),(2),(3)$] between CEO influence (CPS) and overconfidence tendency [OverConf_(1),(2),(3)], which is independent variable, has a statistically significant positive value, H3 is supported. Therefore, managers with higher influence and overconfidence do not respond to short-term maintenance costs, but are expected to perform business activities from a long-term perspective under strong leadership and confidence in their own judgment.

### 3.3. Operational Definition of Variables

#### 3.3.1. Dependent Variable: Cost Stickiness

Most precedent studies on cost behavior have used the methodology of Anderson et al. (2003) to measure cost behavior. However, this defines cost stickiness as the increase rate of costs when sales increase is greater than the decrease rate of costs when sales decrease, and has the limitation that cost changes for direct sales changes cannot be measured at the individual company level. Thus, this study uses both the methodology of Homburg and Nasev (2008), which can measure cost stickiness at the individual company level, and the methodology of Weiss (2010) as a compensation and revision method.

*Methodology of Homburg and Nasev (2008)*: The methodology of Homburg and Nasev (2008) is used to measure cost stickiness. They measured the ratio increase of SG&A cost for sales when sales decreased from the previous year in Formula (4) as cost stickiness. In Equation (4), the ratio of costs for current year sales has greater value than the ratio of costs for previous year sales unless the production cost was aggressively reduced when sales decreased, so companies with cost stickiness show a positive (+) value (Park Yeon-hee, Koo Jung-Ho and Pae Su-Il, 2012). Therefore, in this study, cost stickiness measured with the methodology of Homburg and Nasev (2008) was given a value of 1 if positive(+), and 0 if negative(-).

$$\text{Sticky\_}(1)_{i,t} = \text{Cost Signal}_{i,t} \times \text{DSale}_{i,t} \times \text{DCost}_{i,t}, \tag{4}$$

Sticky _(1)$_{i,t}$ : Homburg and Nasev(2008) stickiness of firm i, year t;
Cost_Signal $_{i,t}$ = [ Cost$_{i,t}$ / Sales $_{i,t}$ ] - [ Cost$_{i,t-1}$ / Sales $_{i,t-1}$ ]
Dsales$_{i,t}$ : Dummy variables with a value of 1 if sales are smaller than those of the previous year, otherwise 0.
DCost$_{i,t}$ : Dummy variables with value of 1 if cost_signal is smaller than zero, otherwise 0.

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*Methodology of Weiss (2010)*: In the following equation (5) in the methodology of Weiss (2010), cost stickiness was defined as the difference between the cost increase rate of the latest quarter when sales increased and the cost decrease rate of the latest quarter when sales decreased. In other words, in equation (5), cost stickiness is the difference between the cost increase rate (slope of cost function) when sales increased in the latest quarter and the cost decrease rate (slope of cost function) when sales decreased in the latest quarter during 16 quarters (from t-3 year to t year). Therefore, if there is cost stickiness, the cost increase rate when the sales increase is greater than the cost decrease rate when sales decrease, so the measured value is negative. Thus, in this study, cost stickiness was adjusted to be high if the measured value was positive when the measured value was multiplied by a negative value, and cost stickiness was low if the measured value was negative to enhance the recognition degree of the results, and to accord with the measured value of the methodology of Homburg and Nasev (2008).

$$\text{Sticky\_(2)}_{i,t} = \text{Log}(\triangle\text{Cost} / \triangle\text{Sales})_{i,\gamma} - \text{Log}(\triangle\text{Cost} / \triangle\text{Sales})_{i,\mu}$$
$$\gamma, \mu \in \{t, \cdots t\text{-}3\} \tag{5}$$

### 3.3.2. Independent Variable: Managerial Attributes

*CEO Power*: CEO power was measured with the methodology of Kwak Young-Min and Kim Hyun-Jin (2017), a revised form of the methodology of Bebchuk et al. (2011) for the situation of Korea. Bebchuk et al. (2011) measured CPS and understood it as the influence of the CEO. To measure CPS, we defined 'manager' as a top ranked full-time executive with the job title of 'CEO'. Based on compensation data of individual executives, CPS was measured as the percentage of CEO total pay in the total pay of all registered full-time executives.

*Managerial Overconfidence*: Managerial overconfidence is a human characteristic, and it is related to an individual's thinking, so it is not easy to measure objectively. There are some overseas studies that measure managerial overconfidence. First, the study of Hribar and Yang (2013) measured manager media exposure and overconfidence tendency. However, manager media exposure can be affected not only by their own will but also by external factors, so it is subjective. Second, in studies of Malmendier and Tate (2005), Malmendier and Tate (2008), and Chen et al. (2013), managerial overconfidence was measured with stock option exercise behaviors. Nonetheless, in Korea, manager stock options are provided in very limited industries and companies, so it is not sufficient for empirical analysis (Kim Saerona and Yoo Hye-Yeong, 2014). Third, Ahmed and Duellman (2013) measured managerial overconfidence with capital expenditure size for industry average based on Malmendier and Tate (2005), which claimed that managers that were overconfident about profits engaged in more capital expenditures. Fourth, Schrand and Zechman (2012) performed regression analysis on sales growth rate (independent variable) and asset growth rate (dependent variable) by each industry and year, extracted residuals, and then considered companies with a positive residual value as having managers with high overconfidence because they invested more in asset expansion than other companies in the same industry.

Therefore, this study measures managerial overconfidence with the use of the methodologies of Ahmed and Duellman (2013) and Schrand and Zechman (2012). The measured values based on the two methodologies are dummy variables, and are 1 if managerial overconfidence is high, otherwise 0. In addition, in both the methodologies of Ahmed and Duellman (2013) and Schrand and Zechman (2012), if managerial overconfidence is high, the measured value is 1, otherwise 0, which are used for additional

analysis. Therefore, there are three measured values of managerial overconfidence in this study.

### 3.3.3. Control Variables

In this study, the variables that can affect cost stickiness are included to control variables. First, size of company (hereinafter referred to as SIZE) is measured with the natural log value of basic total assets (Lee kyun-Bong, 2018). Second, debt ratio (hereinafter referred to as LEV) is measured with the value of total debt divided by owned capital (Park Jeong-Hwan, 2019). Third, return on assets (hereinafter referred to as ROA) is measured with current year sales cash divided by total basic assets (Han Young-Hee, 2019). Fourth, R&D cost is measured with total R&D cost divided by sales (Lee Gyun-bong and Ryu Ye-Rin, 2019). Fifth, growth rate of total assets (hereinafter referred to as GRW) is measured by the current year total asset growth rate compared to the previous year (Park Jeong-Hwan and Ryu Ye-Rin, 2018). Sixth, the period of listing (hereinafter referred to as Firm Age) was measured with the natural log value of total listing days (Yang Hae-Myun and Rho Gil-Kwan, 2019). Seventh, size of audit companies (hereinafter referred to as BIG4) is a dummy variable; the value is 1 if a company was audited by Samil, Samjeong, Anjin, and Hanyeong, and otherwise is 0 (Park Ju-Cheol, 2019).

## 4. Analysis and Results

### 4.1. Descriptive Statistics

Table 3 are the descriptive statistics of the major variables. The average values of cost stickiness values, which is the dependent variable, are approximately 0.008 [Sticky_(1)] and 0.272 [Sticky_(2)]. Next, the average value of manger governance (CPS) among independent variables is about 0.505, so managers in Korea receive about half of whole pay amounts. In addition, the average value of managerial overconfidence was about 0.355 [OverConf_(1)], 0.347 [OverConf_(2)] and 0.314 [OverConf_(3)].

**Table 3.** Descriptive Statistics

|  | Mean | Median | Std. Deviation | 25% | 75% |
|---|---|---|---|---|---|
| Sticky_(1) | 0.008 | 0.000 | 0.031 | 0.000 | 0.006 |
| Sticky_(2) | 0.272 | 0.241 | 1.810 | -0.658 | 1.248 |
| CPS | 0.505 | 0.504 | 0.198 | 0.378 | 0.644 |
| OverConf_(1) | 0.355 | 0.000 | 0.479 | 0.000 | 1.000 |
| OverConf_(2) | 0.347 | 0.000 | 0.477 | 0.000 | 1.000 |
| OverConf_(3) | 0.314 | 0.000 | 0.464 | 0.000 | 1.000 |
| SIZE | 28.034 | 27.858 | 1.603 | 26.882 | 29.120 |
| LEV | 0.487 | 0.502 | 0.193 | 0.333 | 0.638 |
| ROA | 0.050 | 0.047 | 0.045 | 0.026 | 0.070 |
| R&D | 0.005 | 0.001 | 0.010 | 0.000 | 0.006 |
| GRW | 0.041 | 0.038 | 0.099 | -0.008 | 0.090 |
| FirmAge | 8.742 | 8.967 | 0.882 | 8.246 | 9.525 |
| BIG4 | 0.813 | 1.000 | 0.391 | 1.000 | 1.000 |

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The descriptive statistics of the control variables are as follows. The average value of LEV was about 48.7%,  and the average value of ROA was approximately 0.050. The average of R&D was about 0.005, which indicates that about 0.5% of total sales are spent on R&D. The average value of GRW was about 0.041, and about 81.3% of all sample companies are audited by the BIG 4. Meanwhile, when standard deviation is considered, the average and median values are not very different, so there is no problem in assuming a normal distribution of research samples.

## 4.2. Correlation Analysis

Table 4 shows the results of Pearson correlation analysis among research model variables prior to the verification of the research hypotheses, and this is the bivariate correlation coefficient with the influence of control variables uncontrolled. The results are as follows.

First, CEO power and cost stickiness (2) [Sticky_(2)] have a positive correlation at the 5% level. Therefore, when CEO power was higher, cost stickiness was expected to be higher according to the methodology of Weiss (2010). Second, the correlation result of managerial overconfidence and cost stickiness is as follows. First, the measured value of managerial overconfidence (1) [OverConf_(1)] and cost stickiness (2) [Sticky_(2)] have a positive correlation at a 10% significance level. In addition, the measured value of managerial overconfidence (2) [OverConf_(2)] and cost stickiness (1) [Sticky_(1)] show a positive correlation at the 10% level. The measured value of managerial overconfidence (3) [OverConf_(3)] and cost stickiness (2) [Sticky_(2)] show a positive correlation at the 10% level.

Thus, when managerial overconfidence was higher, cost stickiness was expected to be higher. In the above results, the effects of control variables that are expected to affect export company cost stickiness are not considered, so there is limit in the interpretation (Kim Ji-Young and Ji Sang-Hyun, 2018).

**Table 4.** Pearson Correlation

| | Sticky_(1) | Sticky_(2) | CPS | OverConf_(1) | OverConf_(2) | OverConf_(3) | SIZE | LEV | ROA | R&D | GRW | FirmAge |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CPS | 0.048 | .099** | | | | | | | | | | |
| | 0.282 | 0.026 | | | | | | | | | | |
| OverConf_(1) | 0.039 | 0.046 | -0.006 | | | | | | | | | |
| | 0.377 | 0.300 | 0.886 | | | | | | | | | |
| OverConf_(2) | 0.064 | 0.032 | -0.007 | .836*** | | | | | | | | |
| | 0.152 | 0.472 | 0.871 | 0.000 | | | | | | | | |
| OverConf_(3) | 0.052 | 0.047 | -0.012 | .911*** | .927*** | | | | | | | |
| | 0.240 | 0.292 | 0.788 | 0.000 | 0.000 | | | | | | | |
| SIZE | -0.068 | -0.033 | -0.053 | .093** | 0.056 | 0.067 | | | | | | |
| | 0.129 | 0.452 | 0.232 | 0.037 | 0.207 | 0.132 | | | | | | |
| LEV | 0.032 | -0.039 | 0.007 | 0.019 | -0.032 | -0.006 | .369*** | | | | | |
| | 0.470 | 0.380 | 0.878 | 0.666 | 0.473 | 0.896 | 0.000 | | | | | |
| ROA | -.120*** | 0.022 | 0.082* | .170*** | .224*** | .199*** | -0.038 | -.343*** | | | | |
| | 0.007 | 0.624 | 0.065 | 0.000 | 0.000 | 0.000 | 0.397 | 0.000 | | | | |
| R&D | .099** | -0.064 | 0.044 | .106** | .105** | .108** | 0.053 | -0.005 | -0.037 | | | |
| | 0.026 | 0.149 | 0.325 | 0.017 | 0.018 | 0.015 | 0.231 | 0.919 | 0.403 | | | |
| GRW | -.120*** | -0.080* | 0.023 | .089** | .126*** | .119*** | 0.003 | 0.001 | 0.081* | 0.025 | | |
| | 0.007 | 0.073 | 0.613 | 0.045 | 0.005 | 0.007 | 0.938 | 0.978* | 0.070 | 0.580 | | |
| FirmAge | 0.067 | -0.027 | -0.018 | -.126*** | -0.079* | -.093** | 0.066 | 0.062 | -.214*** | 0.051 | -.134*** | |
| | 0.136 | 0.553 | 0.687 | 0.005 | 0.078 | 0.038 | 0.143 | 0.168 | 0.000 | 0.254 | 0.003 | |
| BIG4 | 0.036 | 0.019 | 0.048 | 0.054 | 0.036 | 0.027 | .222*** | -0.043 | -.097** | 0.033 | 0.006 | 0.012 |
| | 0.416 | 0.676 | 0.279 | 0.223 | 0.424 | 0.542 | 0.000 | 0.329 | 0.029 | 0.465 | 0.896 | 0.793 |

**Notes:** *, **, *** Significant in significance levels of 10%, 5%, 1% respectively.

## 4.3. Results of Hypothesis Tests

### 4.3.1. CEO Power and Cost Stickiness

Table 5 shows the results of verifying the relationship between CEO influence and cost stickiness. The results are as follows. First, CPS shows a positive relationship with cost stickiness (1) [Stick_(1)] at an insignificant level. Second, CPS shows a positive relationship with cost stickiness (2) [Stick_(2)] at the 5% level. The coefficient value was 0.841, which is very high; the greater CEO power, the higher cost stickiness. Therefore, H1 is partially supported.

Next is the result of analyzing control variables. First, ROA shows a negative relationship with cost stickiness (1) [Stick_(1)] at the 1% level, which indicates that export companies with ROA flexibly reduce expenditure in preparation for a reduction of sales. Second, R&D cost shows a positive relationship with cost stickiness (1) [Stick_(1)] at the 10% level, thereby indicating that companies with greater R&D investments spend a certain amount on R&D costs regardless of sales, so cost stickiness is relatively high. Third, GRW shows a positive relationship with cost stickiness (1) [Stick_(1)] at the 5% level, thereby indicating that export companies with higher growth rates maintain a certain level of expenditure, which can be a driver of continuous growth. Fourth, BIG4 has a negative relationship with cost stickiness (1) [Stick_(1)] at the 5% level, and with cost stickiness (2) [Stick_(2)] at the 10% level.

**Table 5.** CEO Power and Cost Stickiness

|  | **Dependent Variable: Cost Stickiness** | | | | | |
|  | **Sticky (1)** | | | **Sticky (2)** | | |
|  | Coef. | t | P | Coef. | t | P |
|---|---|---|---|---|---|---|
| Intercept | 0.003 | 0.349 | 0.727 | -0.403 | -0.227 | 0.821 |
| CPS | 0.005 | 1.447 | 0.148 | 0.841 | 2.022 | 0.044 |
| SIZE | 0.010 | 0.212 | 0.832 | 0.043 | 0.670 | 0.503 |
| LEV | -0.004 | -1.478 | 0.140 | -0.321 | -0.651 | 0.515 |
| ROA | -0.029 | -2.810 | 0.005 | -0.259 | -0.124 | 0.902 |
| R&D | 0.072 | 1.769 | 0.077 | -9.906 | -1.211 | 0.227 |
| GRW | -0.009 | -2.116 | 0.035 | -1.052 | -1.191 | 0.234 |
| FirmAge | 0.000 | 0.967 | 0.334 | -0.083 | -0.865 | 0.388 |
| BIG4 | -0.003 | -2.111 | 0.035 | -0.452 | -1.803 | 0.072 |
| IND/YEAR |  | Included |  |  | Included |  |
| Adj-R² |  | 0.064 |  |  | 0.013 |  |
| F-value |  | 4.136*** |  |  | 1.282*** |  |
| Sample |  | Sample <1-1> |  |  | Sample <1-2> |  |

**Notes:** *, **, *** The correlation coefficient is significant at the levels of 0.10, 0.05 and 0.01;
The maximum value of VIF is 4.046

### 4.3.2 Managerial Overconfidence and Cost Stickiness

Table 6 presents the results of verifying the relationship between managerial overconfidence and cost stickiness. First, managerial overconfidence (1) [OverConf_(1)], managerial overconfidence (2) [OverConf_(2)], and managerial overconfidence (3) [OverConf_(3)] had positive relationships with cost stickiness (1) [Stick_(1)].

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Second, managerial overconfidence (1) [OverConf_(1)] showed a positive relationship with cost stickiness (2) [Stick_(2)]. Managerial overconfidence (2) [OverConf_(2)] showed a positive relationship with cost stickiness (2) [Stick_(2)] at the 10% level. Managerial overconfidence (3) [OverConf_(3)] showed a positive relationship with cost stickiness (2) [Stick_(2)] at the 5% level. Therefore, H2 was supported only in an analysis when the methodology of Weiss (2010) used.

**Table 6.** Managerial Overconfidence and Cost Stickiness

| | Dependent Variable: Cost Stickiness | | | | | |
|---|---|---|---|---|---|---|
| | Sticky (1) | | | Sticky (2) | | |
| | Coef. | t | P | Coef. | t | P |
| Intercept | 0.023 | 2.600 | 0.009 | -0.230 | -0.229 | 0.819 |
| OverConf_(1) | 0.001 | 0.561 | 0.575 | 0.174 | 1.462 | 0.144 |
| SIZE | 0.000 | -0.920 | 0.358 | 0.033 | 0.910 | 0.363 |
| LEV | -0.006 | -2.713 | 0.007 | -0.051 | -0.177 | 0.859 |
| ROA | -0.086 | -9.748 | 0.000 | -2.016 | -1.561 | 0.119 |
| R&D | 0.114 | 2.941 | 0.003 | 1.495 | 0.271 | 0.786 |
| GRW | -0.008 | -2.157 | 0.031 | -0.152 | -0.298 | 0.765 |
| FirmAge | -0.000 | -0.593 | 0.553 | -0.000 | -0.006 | 0.995 |
| BIG4 | -0.001 | -1.418 | 0.156 | -0.155 | -1.226 | 0.221 |
| IND/YEAR | Included | | | Included | | |
| Adj-R² | .078 | | | .031 | | |
| F-value | 10.297*** | | | 2.490*** | | |
| Sample | Sample <2-1> | | | Sample <2-2> | | |

| | Dependent Variable: Cost Stickiness | | | | | |
|---|---|---|---|---|---|---|
| | Sticky (1) | | | Sticky (2) | | |
| | Coef. | t | P | Coef. | t | P |
| Intercept | 0.023 | 2.612 | 0.009 | -0.231 | -0.230 | 0.818 |
| OverConf_(2) | 0.001 | 0.916 | 0.360 | 0.216 | 1.767 | 0.078 |
| Control Variables | Included | | | Included | | |
| Adj-R² | .078 | | | .032 | | |
| F-value | 10.319*** | | | 2.530*** | | |
| Sample | Sample <2-1> | | | Sample <2-2> | | |

| | Dependent Variable: Cost Stickiness | | | | | |
|---|---|---|---|---|---|---|
| | Sticky (1) | | | Sticky (2) | | |
| | Coef. | t | P | Coef. | t | P |
| Intercept | 0.023 | 2.573 | 0.010 | -0.229 | -0.229 | 0.819 |
| OverConf_(3) | 0.001 | 1.586 | 0.113 | 0.168 | 2.174 | 0.030 |
| Control Variables | Included | | | Included | | |
| Adj-R² | .078 | | | .033 | | |
| F-value | 10.305*** | | | 2.577*** | | |
| Sample | Sample <2-1> | | | Sample <2-2> | | |

**Notes**: *, **, *** The correlation coefficient is significant at the levels of 0.10, 0.05 and 0.01;
The maximum value of VIF is 4.050.

### 4.3.3. CEO Power, Managerial Overconfidence, and Cost Stickiness

Table 7 shows the results of verifying the relationship between cost stickiness and the interaction of CEO influence and managerial overconfidence. First, the interaction variable (1) [CPS×OverConf_(1)] of CEO power (CPS) and CEO overconfidenc1(2) had a positive (+) relation with cost stickiness (1) [Stick_(1)] at a statistically insignificant level. However, CEO power (CPS) showed a positive relationship with cost stickiness (1) [Stick_(1)] at the 10% level.

Another interaction variable, (2) [CPS×OverConf_(2)] of CEO power (CPS) and managerial overconfidence(2), also showed a positive relationship with cost stickiness (1) [Stick_(1)] at a statistically insignificant level. CEO power (CPS) showed a positive relationship with cost stickiness (1) [Stick_(1)] at the 10% level.

The third interaction variable (3) [CPS×OverConf_(3)] of CEO power (CPS) and managerial overconfidence (3) also showed an insignificantly positive relationship with cost stickiness(1) [Stick_(1)]. Nevertheless, CEO power (CPS) had a positive relationship with cost stickiness (1) [Stick_(1)] at the 10% level.

Second, the interaction variable (1) [CPS×OverConf_(1)] of CEO power (CPS) and managerial overconfidence (1) had an insignificant positive relationship with cost stickiness (2) [Stick_(2)]. Nonetheless, CEO power (CPS) had a positive relationship with cost stickiness (2) [Stick_(2)] at the 5% level.

Another interaction variable (2) [CPS×OverConf_(2)] of CEO power (CPS) and managerial overconfidence(2) showed a positive relationship with cost stickiness (2) [Stick_(2)] at the 5% level. In addition, CEO power (CPS) had a positive relationship with cost stickiness (2) [Stick_(2)] at the 5% level.

The third interaction variable (3) [CPS×OverConf_(3)] of CEO power (CPS) and managerial overconfidence (3) showed a positive relationship with cost stickiness (2) [Stick_(2)] at the 5% level. In addition, CEO power (CPS) showed a positive relationship with cost stickiness (2) [Stick_(2)] at the 5% level.

Accordingly, when CEO power was greater, and managerial overconfidence was higher, cost stickiness was higher, so cost stickiness is expected to appear differently depending on managerial attributes. Thus, Hypothesis 3, which verifies the relationship between cost stickiness and the interaction variable of CEO power and managerial overconfidence, is supported only in the analysis with the methodology of Weiss (2010).

According to the above hypothesis verification, when CEO power was greater, managerial overconfidence was higher, and both CEO power and managerial overconfidence were higher, cost stickiness was higher. This means cost behavior can appear differently depending on managerial attributes.

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**Table 7.** Relationships among Cost Stickiness, CEO Power, and Managerial Overconfidence

| | Dependent Variable: Cost Stickiness | | | | | |
|---|---|---|---|---|---|---|
| | Sticky_(1) | | | Sticky_(2) | | |
| | Coef. | t | P | Coef. | t | P |
| Intercept | 0.001 | 0.139 | 0.890 | -0.540 | -0.304 | 0.761 |
| CPS×OverConf_(1) | 0.001 | 1.420 | 0.156 | 0.462 | 1.513 | 0.131 |
| CPS | 0.001 | 1.733 | 0.084 | 0.968 | 2.277 | 0.023 |
| SIZE | 0.001 | 0.282 | 0.778 | 0.051 | 0.796 | 0.426 |
| LEV | -0.004 | -1.472 | 0.141 | -0.271 | -0.548 | 0.584 |
| ROA | -0.028 | -2.724 | 0.007 | -0.031 | -0.015 | 0.988 |
| R&D | 0.074 | 1.820 | 0.069 | 8.571 | 1.042 | 0.298 |
| GRW | -0.009 | -2.062 | 0.039 | -0.956 | -1.081 | 0.280 |
| FirmAge | -0.000 | -0.886 | 0.376 | -0.094 | -0.979 | 0.328 |
| BIG4 | -0.003 | -2.148 | 0.032 | -0.486 | -1.933 | 0.054 |
| IND/YEAR | Included | | | Included | | |
| Adj-R² | 0.065 | | | 0.015 | | |
| F-value | 4.161*** | | | 1.315*** | | |
| Sample | Sample <1-1> | | | Sample <1-2> | | |

| | Dependent Variable: Cost Stickiness | | | | | |
|---|---|---|---|---|---|---|
| | Sticky_(1) | | | Sticky_(2) | | |
| | Coef. | t | P | Coef. | t | P |
| Intercept | 0.002 | 0.181 | 0.857 | -0.496 | -0.279 | 0.780 |
| CPS×OverConf_(2) | 0.001 | 1.588 | 0.113 | 0.401 | 2.062 | 0.040 |
| CPS | 0.001 | 1.769 | 0.077 | 0.954 | 2.236 | 0.026 |
| Control Variables | Included | | | Included | | |
| Adj-R² | 0.064 | | | 0.013 | | |
| F-value | 4.141*** | | | 1.288*** | | |
| Sample | Sample <1-1> | | | Sample <1-2> | | |

| | Dependent Variable: Cost Stickiness | | | | | |
|---|---|---|---|---|---|---|
| | Sticky_(1) | | | Sticky_(2) | | |
| | Coef. | t | P | Coef. | t | P |
| Intercept | 0.002 | 0.177 | 0.859 | -0.516 | -0.291 | 0.771 |
| CPS×OverConf_(3) | 0.000 | 1.531 | 0.126 | 0.491 | 2.177 | 0.035 |
| CPS | 0.001 | 1.947 | 0.052 | 0.960 | 2.265 | 0.024 |
| Control Variables | Included | | | Included | | |
| Adj-R² | 0.064 | | | 0.015 | | |
| F-value | 4.139*** | | | 1.315*** | | |
| Sample | Sample <1-1> | | | Sample <1-2> | | |

**Notes:** *, **, *** The correlation coefficient is significant at the levels of 0.10, 0.05 and 0.01;
The maximum value of VIF is 1.664.

## 5. Discussion

### 5.1. Research Results

COVID-19 was a crisis for the Korean economy and export industry. The travel limitations and self-quarantine obligations hampered the business activities of export companies. If each country reinforces protective trade policies in order to promote the domestic economy, the external environments of export companies will be worsened. Nevertheless, Korean export companies tried to overcome these difficulties by exerting potential energy to change crisis into opportunity. Fields such as eco-friendly automobiles, semiconductors, computers and bio-health, whose demands have increased since the spread of COVID-19, have increased sales thanks to the prompt crisis response of managers. The bio-health field, which is considered a future food source, shows very different performance depending on manager responses.

In times of crisis, managers are more important. The growth of a company can be very different after a crisis situation is over depending on how an export manager copes with the crisis. Therefore, our study focuses on managers whose importance was more emphasized in recent circumstances. It focuses on managerial attributes, which are classified into CEO power with external characteristics and managerial overconfidence as internal characteristics, and verifies the effects of these characteristics on cost behavior.

For CEO power, the measured value of CPS presented by Bebchuk et al. (2011) was used, and for managerial overconfidence, the measured value of managerial overconfidence presented by Ahmed and Dullman (2013) and Schrand and Zechman (2012) was used. In addition, for cost stickiness, the measured value of cost stickiness presented by Homburg and Nasev (2008) and Weiss (2010) was used. In calculating each measured value, total four research samples are organized in order to control the difference of omission samples.

The results of our study are as follows. First, when CEO power in export company was greater, cost stickiness was greater. This means that managers with high influence did not respond to temporary sales decreases immediately, and did not reduce related production costs flexibly in preparation for future sales recovery, but endured costs for idle resources. Second, when managerial overconfidence was higher, cost stickiness was greater. This indicates that managers with greater confidence in their decision making were optimistic about future sales recovery, so they did not reduce related production costs in preparation for future sales recovery, but endured costs for idle resources. Third, when CEO power was greater, and managerial overconfidence was greater in decision making, cost stickiness was higher. This means when CEO power and managerial overconfidence were greater, the two factors comprehensively work together, resulting in greater cost stickiness. Our study is expected to provide useful information to future management predictions of exporters by reporting that the greater CEO power and overconfidence, the more aggressive export strategies they choose.

In addition, it can serve as an opportunity to expand export management-related studies by expanding managerial overconfidence related precedent studies and by providing additional information. This study intended to secure the robustness of research results using various values in measuring major variables and subdividing research samples according to the measured values.

### 5.2 Implications for Start-ups

Recently, because of COVID-19, a global demand slump, economic recession, and the fourth industrial revolution have occurred. This business environment is clarifying the

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existing large-scale export structure and the limits of quantitative growth. In this situation, relatively small and medium-sized start-ups with the world's best technology are finding a way to recover exports. Specifically, the growth of start-ups can play a role as the middle of the domestic corporate ecosystem, and is expected to revitalize the export structure centered on large companies, facing the limits of quantitative growth.

In reality, start-ups are responsible for more than 20% of exports to new industries, such as next-generation semiconductors, bio-health, robots, aviation, and drones. By country, exports to China have steadily declined, and exports to advanced countries such as the U.S. and some European countries have continued to rise and diversify based on technology, in contrast to large companies that still show high Chinese dependence.

Start-ups have succeeded in overseas markets based on technology with consistent R&D investments, regardless of whether sales are strong or sluggish, under the common perception that the technology is competitive. Specifically, from the beginning of firm establishment, it has been shown making efforts to commercialize products, such as product concepts and designs, can lead to increased sales.

Nonetheless, there are concerns that future growth will be delayed through a closed research and development method centered on self-development, with a lower proportion of R&D investment compared to large firms and small and medium-sized start-ups. To foster more small and medium-sized start-ups with global technology, the Korean government should expand policy support, such as taxation related to corporate R&D, and provide continuous technology development power through open innovation using external networks.

In addition, start-ups often have a greater influence on management decisions by CEOs than large firms. The results of this study indicated that the greater the influence of the CEO, the greater cost stickiness, and that the greater the overconfidence tendency and the greater the combination of the two factors, the greater cost stickiness. Therefore, we believe that the managerial attributes of a start-up could be an important factor in the success of the firm.

## 5.3. Research Limitations

The limitation of our current research is indicated as follows. First, research results could be different according to the sample used for analysis. In the present research, the sample is limited because of the increase in many firms removed in the process of calculating various values. Second, research results could be different depending on the measurements of cost stickiness that researchers employ. Therefore, future research should check the robustness of our research results with different measures of cost stickiness. Finally, in calculating CPS information to measure CEO power, we did not include pay information of non-registered executives after 2017. This choice could be disadvantageous in the reliability of measured values. Thus, there should be a follow-up study with the latest pay information of executives added.

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