GLOBAL BUSINESS & FINANCE REVIEW, Volume. 27 Issue. 1 (FEBRUARY 2022), 95-107
pISSN 1088-6931 / eISSN 2384-1648 | Https://doi.org/10.17549/gbfr.2022.27.1.95

GLOBAL BUSINESS & FINANCE REVIEW

www.gbfrjournal.org

Industrial Linkage Structure between Land Transport Industry and Distribution Industry in Korea

Yong-Jeong Kim[a†], Yi-Peng Sheng[b]

[a]*Business Research Institute, Sogang University, Seoul, Republic of Korea*
[b]*Department of International Business, Chungbuk National University, Cheongju, Republic of Korea*

A B S T R A C T

Purpose: This study analyzes the production inducement effect and industrial linkage structure of the land transport industries using input-output analysis. In particular, the focus of research is to confirm the link between the land transport industries and the distribution industry in the industrial linkage structure.
Design/methodology/approach: The methodology is used by Input-Output Analysis. The analysis focus is calculated the backward linkage effect (BL) and forward linkage effect (FL) using Input Coefficient and Production Induced Coefficient. The analysis data was applied to Korean time-series data from 2000 to 2014 from the World Input-Output Database (Released November 2016).
Findings: In Korea, most domestic transportation needs are land transport, and storage services are also provided in conjunction with this. Therefore, it was found that wholesale and retail businesses (G46, G47) in the distribution industry are widely used as intermediary goods. Without the expansion and development of land transport service networks and courier service facilities in Korea, the current chaos caused by COVID-19 would have intensified.
Research limitations/implications: The limitation of the study was that reliable data from the WIOD were used but failed to exclude the passenger sector contained in the land transport industries data. Therefore, it is necessary to secure more pertinent data and industrial classifications embodied in the land transport industries. Furthermore, with additional research direction, we analyze the structure of the forward and backward industries of each country's logistics industry and propose establishing the logistics service supply chain concept.
Originality/value: Through this study's results, effective industrial policy establishment will be possible considering industries with high production inducement effect to forward and backward industries by the shipping and land transport industries. This study has a meaningful implication that it provides a foundation for understanding the industrial structure linked to the distribution and land transport industries.

Keywords: Land transport industry, Distribution industry, Industrial linkage effect, Input-Output analysis

I. Introduction

Due to COVID-19, the world has fallen into an unprecedented predicament, which tests firms' ability to survive and build resilience (Gracia et al., 2020). First of all, the global supply chain has collapsed, consumer consumption patterns are rapidly changing, industry and distribution structures are also changing (Camba & Camba, 2020; Wolor et al., 2020). Consumers have to stay close to home for a long time, leading to a surge in online orders. The perfect operation of online consumption is based on the distribution

Received: Dec. 10, 2021; Revised: Jan. 11, 2022; Accepted: Jan. 20, 2022

† Yong-Jeong Kim
E-mail: vision-2020@nate.com

and logistics industries. Now in the retail industry, land transport logistics has become a necessity rather than an option. This is not a temporary phenomenon but a starting point that can bring reorganization and even change to the entire economy, industries, and supply chain between countries

South Korea is working to resolve the COVID-19 crisis through K quarantine and its credibility has soared. Korea is facing an excellent opportunity to strengthen the competitiveness of its industries and lead a new global supply chain through new logistics technologies. Without the efforts of the land transport company, the confusion caused by the current COVID-19 would have been aggravated. Therefore, it is hard to deny that the land transport industry has contributed much to prevent the spread of COVID-19.

The transport industry is a critical industry to improve the quality of relationships between each entity, such as supply, manufacturing, distribution, and consumption in the supply chain, and to improve the competitiveness of the entire supply chain. Establishing an efficient transport system will also significantly impact reducing costs and creating competitive advantages in the manufacturing and distribution industries.

This study analyzes the production inducement effect and industrial linkage structure of the land transport industry using input-output analysis. The focus of the research is to confirm the link between the land transport industry and the distribution industry in the industrial linkage structure. Ultimately, the research will provide a foundation for effective industrial policy establishment that can have an economic ripple effect based on an understanding of the relationship between Korea's land transport industries and distribution industries.

The research method is to conduct an input-output analysis. The analysis focuses on calculating the input coefficient, production inducement coefficient, backward linkage effect (BL), and forward linkage effect (FL). The data for empirical analysis uses the National Input-Output Tables (Released November 2016) of the World Input-Output Database (WIOD). It analyzes time series data from 2000 to 2014 in Korea and uses Excel programs.

II. Literature Review

A. Previous Studies on the Logistics Industry

Inter-industry analysis has been applied to a variety of industries in prior studies. Regarding previous research on logistics industry using inter-industry analysis, Lee & Yoo (2016) performed an inter-industry analysis on the logistics industry (expressway, railway, water transport, and air transport) in Korea, and Choi et al. (2008) used inter-industry analysis to examine the economic ripple effects of the ocean transport industry in Korea. In addition, the studies of Park (2019), Kang et al. (2011), Park et al. (2009) provided an inter-industry analysis on the logistics industry in Korea.

Chiu & Lin (2012a) investigated the economic ripple effects of the logistics industry in Taiwan and revealed that road transport has the strongest impact. Zhao et al. (2007) used inter-industry analysis to compare the transport industry between the U.S. and China, and found that production inducement effects of the transport industry in China is relatively greater than that in the U.S. Morrissey & O'Donoghue (2013) analyzed the economic ripple effects of the ocean transport industry in Ireland. Most of the studies on the logistics industry used input-output table published in the country for analysis. The major studies of Korea's logistics industry using inter-industry analysis stimulated great interest in the field of ocean transport and port logistics, most utilized the input-output tables released by Bank of Korea as data for analysis. Park (2019) and Kang et al. (2011) were the only research that used the EU and OECD world input-output tables conduct an inter-industry analysis on the logistics industry. Table 1 lists the previous studies on the logistics industry by using inter-industry analysis.

B. Recent Studies Using World Input-output Table

Recent studies using World Input-output tables to compare and analyze the characteristics of industries in Korea mainly focused on ICT industries. The studies

of Min et al. (2019). Kim & Lee (2020), Lee et al. (2019), Li et al. (2019), and Yun et al. (2017) are the typical examples. They investigated the ICT industry in Korea from different perspective, but they all used reliable EU and OECD data to conduct the inter-industry analysis. Especially, researchers have been trying to provide meaningful implications through comparative analysis between countries. Min et al. (2019) used EU data to compare forward and backward linkage effects and spillover effects between the ICT and the machinery industries in Korea, China, the United States, Germany, and Japan. Recent studies on inter-industry analysis of industries in Korea are presented in Table 2.

Table 1. Previous Studies on the IO-SDA of Logistics Industry

Researcher	Study Subject
Park (2019)	A study on economic effects of Korean water transport industry using international input-output analysis
Lee & Yoo (2016)	The role of transportation sectors in the Korean national economy: An input-output analysis
Morrissey & O'Donoghue (2013)	The role of the marine sector in the Irish national economy: an input-output analysis
Chiu & Lin (2012a)	Applying input-output model to investigate the inter-industrial linkage of transportation industry in Taiwan
Chiu & Lin (2012b)	The inter-industrial linkage of maritime sector in Taiwan: an input-output analysis
Kang et al. (2011)	The analysis for the structure and spillover effect of logistics service in south Korea, China, and Japan
Park et al. (2009)	A study on the growth contributing factors of the Korean logistics industry by the structural decomposition of input-output tables
Choi et al. (2008)	Analysis of the role of maritime freight transport industry in the Korean national economy
Farooq et al. (2008)	Economic impact/forecast model of intelligent transportation systems in Michigan: an input output Analysis
Zhao et al. (2007)	Analysis on the characteristics of transportation system between China and America based on the input-output theory
Wang (1990)	Analyzing the economic effects of transportation and communications construction

Table 2. Recent Studies Using Input-Output Analysis

Researcher	Study Subject
Kim & Lee (2020)	A comparative study on production inducement effects in key industries of Korea and the Netherlands
Min et al. (2019)	A comparative study on industrial spillover effects among Korea, China, the USA, Germany and Japan
Li et al. (2019)	The industrial impact and competitive advantage of China's ICT industry
Lee et al. (2019)	The relationship among competitive advantage, catch-up, and linkage effects: a comparative study on ICT industry between South Korea and India
Yun et al. (2017)	A Competitive Study on the Linkage Effects between ICT and Automobile Industry
Mattioli & Lamonica (2013)	The ICT role in the world economy: an input-output analysis
Rohman (2013)	The globalization and stagnation of the ICT sectors in European countries: An input-output analysis
Dietzenbacher et al. (2013)	The construction of world input-output tables in the WIOD project
Xing et al. (2011)	Measuring convergence of China's ICT industry: an input-output analysis
Richter & Streb (2011)	Catching-up and falling behind: knowledge spillover from American to German machine toolmakers

III. Research Design and Methodology

A. Analysis Model

The inter-industry analysis model is a linear model that determines output levels according to the interdependencies between different sectors. The model represents the successive changes in demand in all sectors induced by the change in the production level of a particular sector. Like the general equilibrium model, inter-industry analysis emphasizes the relationship between sales and purchases of inputs, so it has been recognized as a valuable method to analyze and predict the overall economic impact (Miller & Blair, 2009). In the context of an economy is divided into n industries, products are used both as final goods and as intermediate goods for the production in other industries. Intermediate good is noted with Z_{ij}, meaning the number of intermediate goods in sector i supplied to sector j.

Intermediate demand (Z_{ij}), final demand (Y_i), import (M_i) and total output (X_i) of sector i are displayed in the input-output table to show the output structure of sector i. The model of output structure is expressed in Formula (1).

$$\begin{aligned} X_i &= \sum_{j=1}^{n} Z_{ij} + Y_i - M_i \\ &= \sum_{j=1}^{n} a_{ij} X_j + Y_i - M_i \end{aligned} \quad (1)$$

The input coefficient a_{ij} corresponds to the aggregate intermediate good i used by sector $\left(a_{ij} = \frac{z_{ij}}{X_j}\right)$. This ratio indicates the relationship between input and output, meaning the outputs in sector i used as intermediate inputs to generate one unit of production in sector j. The total outputs of a particular industry equal the total required inputs in sector i due to the production of outputs, consumption expenditures, exports, investments, and government expenditures to generate one production unit in entire industries.

On the other hand, the input structure of sector j, which includes intermediate input (z_{ij}), value-added (w_j), and total input (X_j), is shown in a row in the input-output table, as presented in Formula (2).

$$X_j = \sum_{i=1}^{n} Z_{ij} + W_j = \sum_{i=1}^{n} r_{ij} X_i + W_j \quad (2)$$

The output coefficient r_{ij} is obtained by dividing intermediate input (row vector) by total input $\left(r_{ij} = \frac{z_{ij}}{X_i}\right)$. It means that the total output of a particular sector equals the sum of the sector's essential input factors/ value-added and payments for purchases from other industries and imports. Table 3 presents the foundation structure of an input-output table that contains n industries within an economy.

B. Coefficient of Calculation

1. Input Coefficient

The input coefficient is divided by the total input (GO: Output at Basic prices) of the industry, such as raw materials purchased by each industry for use in the production of goods or services (Cartwright et al., 1981; Miernyk, 1965; Richardson, 1972). The total output size output depends on the size of the final demand, and the input coefficient is the role

Table 3. Structure of Input-Output Table

Section	Intermediate demand	Final demand	Import	Total output
Intermediate goods	$Z_{11}\ Z_{12}\ \cdots\ Z_{1n}$ $Z_{21}\ Z_{22}\cdots Z_{2n}$ $\vdots\ \ \vdots\ \ \ddots\ \ \vdots$ $Z_{n1}\ Z_{n2}\ \cdots Z_{nn}$	Y_1 Y_2 $\vdots$ Y_n	M_1 M_2 $\vdots$ M_n	X_1 X_2 $\vdots$ X_n
Value added	$W_1\ W_2\ \cdots\ W_n$			
Total input	$X_1\ X_2\ \cdots\ X_n$			

of mediating the size of the final demand, and the level of total output. The input coefficient is expressed as $a_{ij} = X_{ij}/X_j$ and X_{ij} is the intermediate demand of the i industry which has been inputted to produce the j industry.

2. Production Inducement Coefficient

The input coefficient is the parameter used to measure the magnitude of the production inducement coefficient. However, when the number of industrial segments is large, it is not easy to measure the infinite continuous production ripple effects using input coefficients. Therefore, the production inducement coefficient is derived by a mathematical method called the Inverse matrix. The production inducement coefficient is expressed in $(I-A)^{-1}$ and is also called the Leontief inverse. A is the input matrix, and I is the unit matrix with all significant components equal to 1 and the other elements all zero.

3. Industrial Linkage Effects

There are two directions to analyze the degree of interdependence between each industry using the production inducement coefficient. One is the view of industries that demand intermediate goods, and the other is the view of industries that supply intermediate goods. The former is the backward linkage effect, the latter the forward linkage effect. Several studies have been conducted to measure the forward and backward linkage effects, including Chenery & Watanabe (1953), Rasmussen (1957), and Jones (1976), but Rasmussen (1957) methods are generally widely used, and the formula is as follows Table 4.

Table 4. Linkage Effect Formulas

Backward Linkage Effects	Forward Linkage Effects
$BL_j^R = \left(\frac{1}{n}\sum_{i=1}^{n} r_{ij}\right) / \left(\frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} r_{ij}\right)$	$FL_j^R = \left(\frac{1}{n}\sum_{i=1}^{n} r_{ij}\right) / \left(\frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} r_{ij}\right)$

* Where r_{ij} is the element of the ith row and jth column in the production inducement coefficients matrix.

C. Data Collection and Industry Scope

The subject of analysis is Korea's land transport industry. The analysis uses the National IO Tables (Released November 2016) of the World Input-Output Database (WIOD). The land transport industry (H49) and courier service industry (H53) are the subject of analysis in Korea's time series data from 2000 to 2014. The summary is as follows Table 5.

D. Methodology

In order to examine the forward and backward linkage effects of the land transport industry, this study utilized time-series data in WIOD National IO-tables to derive input-output table, input coefficients matrix A, unit matrix I, and $(I-A)$ matrix, production inducement coefficient matrix $(I-A)^{-1}$ in turn. Five matrix tables were made for each year between 2000 and 2014. Input coefficients were obtained by dividing the intermediate inputs utilized in each sector's production activities by total inputs. Because input coefficients are calculated by dividing a particular sector's input structure by output, the output in each sector is defined as the normalized component ratio 1. Production inducement coefficients are expressed in an inverse matrix, which can be obtained by subtracting the input coefficients matrix from the unit matrix.

Production inducement coefficients, defined as the cumulated multiplier, indicate the direct and indirect ripple effects on the productions of each industry when the final demand occurs by one unit. The element (i,j) of the production inducement coefficients matrix $(I-A)^{-1}$ in the i-th row and j-th column means the growth in sector i induced directly or indirectly when final demand in sector j increases by one unit. The sum of a column of the production inducement coefficients

Table 5. Industry Scope

Code	Description of the Land Transport Industry
H49	Land Transport and Transport via Pipelines
H53	Postal and Courier Activities

matrix shows the increase in production in all industries induced by a final demand increase of one unit in sector j. The production inducement coefficient of the manufacturing industry is usually higher than that of the service industry because the coefficient is high if the industry demands a large portion of domestic raw materials in its production process.

IV. Results

This study identified stage 1 of the industrial linkage structure of the land transport industries by figuring out the 10% of its backward and forward industries with the highest production inducement coefficients. Based on the selected backward and forward industries in stage 1, this study then analyzed stage 2 of the industrial linkage structure. This study eventually analyzed stage 3 of the industrial linkage structure based on the selected backward and forward industries in stage 2. The two industries with the highest production inducement coefficients over the study period (2000-2014) as the forward and backward industries of the second and their stages. This study examined and visualized the industrial linkage structure of a total of three stages by this method.

The description of the results focused on the industries in stage 1, which directly link with each land transport industry. Among the linkage industries in stage 1, one is connected with the land transport sectors with a solid line if its production inducement coefficients stayed within the top 10% highest throughout the study period (2000-2014). Otherwise, the connection is represented by a dotted line. Industries connected by dotted lines are the ones with high average production inducement coefficients over the 15 years. Furthermore, among the forward and backward industries in stages 2 and 3, a * is marked on the right side of the industrial code if the industry has a production inducement effect on two or more industries.

A. H49: Land Transport Industry

The backward industries in stage 1 of the forward and backward industrial structure of H49 (land transport) throughout the study period include C19 (petroleum products), C29 (motor vehicles), and H52 (warehousing). The results indicate that warehousing and handling within the logistics industry also have a high production inducement effect in addition to the two manufacturing sectors. The backward linkage effects of sector K64 (finance) imply that vehicles are essential to produce land transport services, while insurance coverage is essential for operating vehicles. Therefore, these industries supply inputs for producing transport services in H49 (land transport).

The forward industries of H49 (land transport) include G47 (retail), B (mining and quarrying), C23 (non-metallic mineral products), and E37-E39 (waste management), meaning that land transport services are utilizing as intermediate goods in these industries. Specifically, it is used as intermediate goods by sector G47 (retail) since many products are being transported. It is attributable to the various delivery services provided by distribution companies in South Korea these days, including one-day delivery, next-day delivery, early morning delivery. Besides, land transport is frequently used for delivering mining products (limestone, stone, construction materials.) in sector B (mining and quarrying) and products in sector C23 (non-metallic mineral products). Moreover, land transport services are used for collecting wastes and recyclable materials, a field within E37-E39 (waste management).

Table 6 presents the forward and backward industrial architecture of H49 (land transport). It is extended to stage 3 and modelized into a supply chain, as illustrated in Figure 1.

B. H53: Courier Service Industry

Stage 1 of the forward and backward industrial structure of H53 (courier service) was analyzed. The backward industry of H53 (courier service) is N (administrative and support), which provides outputs

Table 6. Linkage Industry of Land Transport Service

Section	Linkage Industry	Linkage Industry of Stage 2	Linkage Industry of Stage 3
Backward Industry	C19,C29, H52, K64	B, C20, C24, K64,L68, N	H49, C19, D35, C20,N, L68, I, K64, F
Forward Industry	B,C23, E37-E39, G47	C19, D35, F, C26, C25, C17, J61, C21	C20, H50, C24, C17,L68, O84, C27, J62-J63, C28, C30, C18, J58, G47,G46, Q, M72

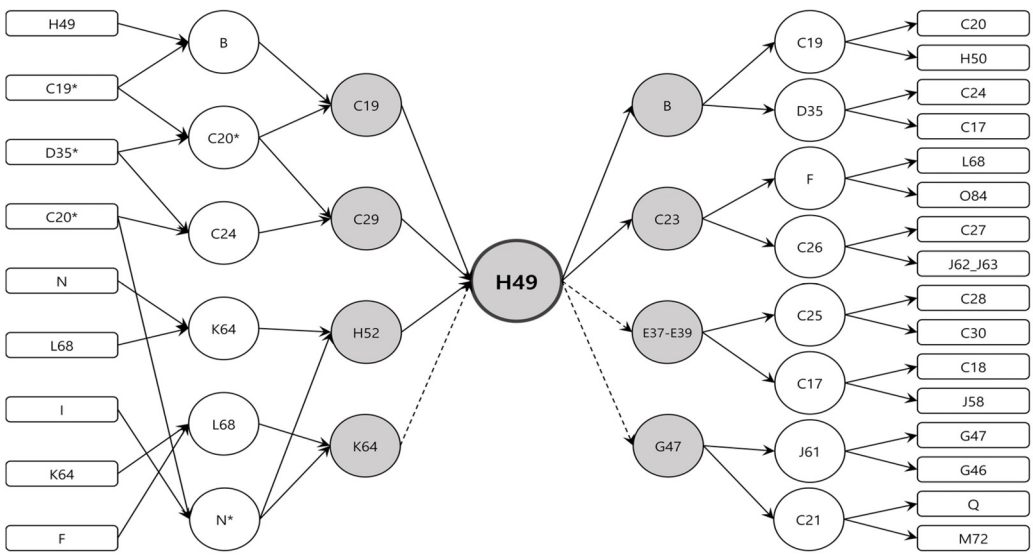

Figure 1. Industrial Linkage Architecture of Land Transport

to be used as intermediate goods in the production of H53 (courier service). Distribution sectors, including G47 (retail), C26 (computer and electronic products), and K64 (finance), are backward industries with production inducement effects. The relationship between H53 (courier service) and G47 (retail) can be explained by that the growth in H53 (courier service) is supported by the increase in demand for sales logistics. A nationwide logistics base and delivery network must be tightly built to enable the door-to-door delivery service in H53 (courier service). In conjunction with the physical transport network, the construction of a communication network is essential. Sufficient communication equipment must be provided in transport vehicles and logistics centers to ensure courier services. Thus, H53 (courier service) is closely related to C26 (computer and electronic products) as a backward industry. Furthermore, because many transport vehicles and handling equipment are being operated in logistics centers and sales offices, K64 (finance) and K66 (insurance) are also affected by the production inducement effects.

On the other hand, the forward industries that use the output of H53 (courier service) as intermediate goods are identified. The final output Door-to-Door service is utilized by G47 (retail) and G46 (wholesale) as intermediate goods. Interestingly, G47 (retail) and K64 (finance) have a significant influence on all forward and backward industries of H53 (courier service). It may be due to the close relationship between the Door-to-Door delivery service and the retail function of the distribution. In other words, H53 (courier activities), G47 (retail), and K64 (finance) are complementary industries. G47 (retail) provides cargos for courier services, while the distribution for retail uses a large number of courier services.

On the one hand, financial products in K64 (finance)

are used to produce courier services. On the other hand, courier services are widely used in K64 (finance). It is also related to the decrease in offline face-to-face financial services and the increase in internet and mobile banking usage due to the growth in IT technologies. Thus, there is an increase in courier services in financial services, such as card issuance and document delivery. Table 7 presents the forward and backward industrial structure of H53 (courier service). It is extended to stage 3 and modelized into a supply chain, as illustrated in Figure 2.

C. Industrial Linkage Structure of Land Transport Industries

Based on the analysis of the land transport industry (H49, H53), this study computed the production inducement coefficients of each land transport sector to identify the 3-stage linkage structure. This study then attempted to identify the land transport industries' forward and backward industrial structures in common. According to the analysis, the backward industry was K64 (financial), and the forward industry was G47 (retail), in common in stage 1 of land transportation industries.

Typical industries in stage 2 and 3 that have an indirect effect were examined. In stage 2, common backward industries of land transport sectors are C20 (chemical products), K64 (finance), L68 (real estate), and N (administrative and support). In stage 3, common backward industries of land transport sectors are C19 (petroleum products), C20 (chemical products), D35 (electricity and gas), F (construction), I (accommodation and food), K64 (finance), L68 (real estate), and N (administrative and support).

Regarding the common forward industries, G47 (retail) is the industry in stage 1 that has a direct effect

Table 7. Linkage Industry of Courier Service

Section	Linkage Industry	Linkage Industry of Stage 2	Linkage Industry of Stage 3
Backward Industry	N, G47, C26, K64	C20, I, L68, K64, C27, N	C19, D35, C10-C12, A01, K64, F, N, L68, C24, C20, I
Forward Industry	G47, K64, K66, G46	J61, C21, L68, H52	G47, G46, Q, M72, H50, H51

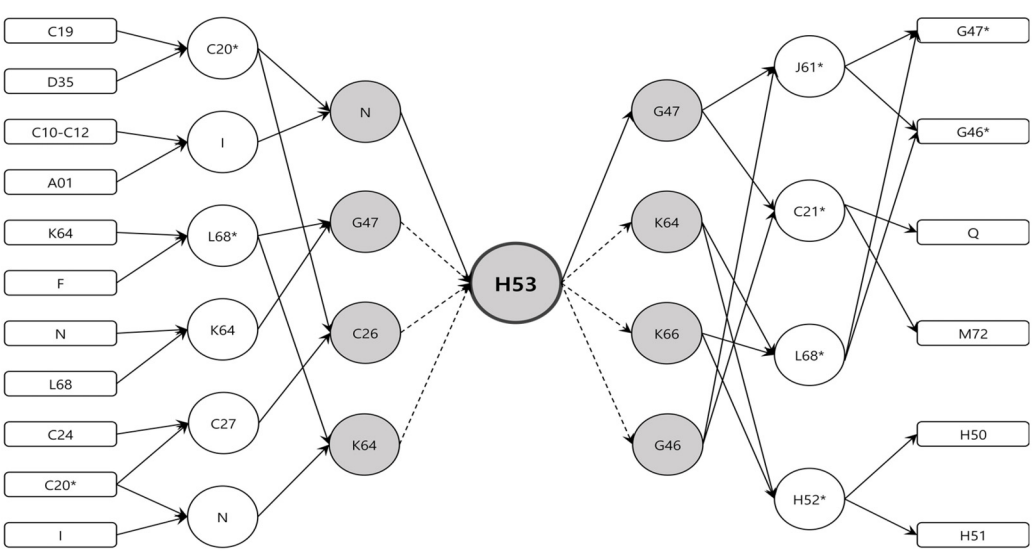

Figure 2. Industrial Linkage Architecture of Courier Service

on H49 (land transport) and H53 (courier activities). Unlike backward industries, not many common industries are found to be the forward industries in stage 2 and 3 that have an indirect effect, confirming that services provided by each land transport sector are used in diverse fields. G46 (wholesale) and G47 (retail) are the only forward industry in stage 3 related to land transport sectors. Figure 3 shows the industrial linkage structure centered on stage 1 of industries with forwarding and backward linkage effects in land transportation industries. Common links to land transport industries included K64 (financial) and G47 (retail). In particular, the G47 (retail industry) is a forward industry for land transportation industries. Therefore, it can be seen that the land transportation industries and the distribution industries are closely related to growing together. Moreover, Table 8 shows the common backward and forward industries in the industrial linkage structure by stage.

Table 8. Common Forward and Backward Industries

	Backward Industry	Forward Industry
Stage 1	K64	G47
Stage 2	C20, K64, L68, N	C21, J61
Stage 3	C19, C20, D35, F, I, K64, L68, N	G46, G47, H50, M72, Q

V. Conclusion

In terms of research methodology, this study adopted the inter-industry analysis in economics to examine the concrete industrial structure of land transport and courier service. Based on the analysis, this study identified the forward and backward industries of the land transport industries and calculated the production inducement coefficients of the land transport industries on other industries to check the existence and degree of the forward and backward linkage effects. This study used time series data in WIOD over 15 years (2000-2014). Based on WIOD's industrial classification, the transport industry was classified into two sectors (H49, H53). The main focuses of the analysis include the computation of production inducement coefficients by using input coefficients and the computation of forwarding and backward linkage effects by using production inducement coefficients to identify the forward and backward industries affected by the production inducement effects of the and transport industries. In particular, the focus of research is to confirm the link between the land transport industries and the distribution industries in the industrial linkage structure.

Moreover, this study calculated the production inducement coefficients of each logistics sector to identify the 3-stage industrial linkage structure. This

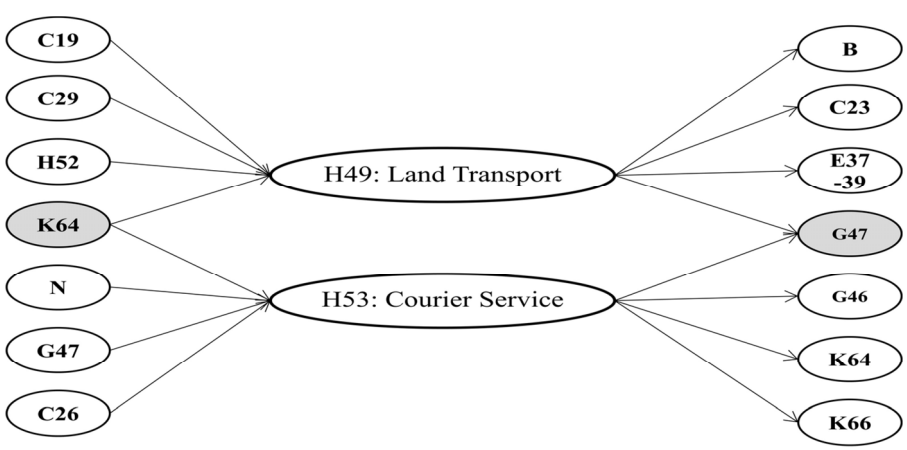

Figure 3. Structure of Linkage Industries in Stage 1

study then identified the industrial structure common to forward and backward of the land transport industries based on the structure. The analysis results disclosed that K64 (finance) links to the two land transport sectors in common are backward industries, while G47 (retail) is the only forward industry.

As a result of the analysis of the production inducement coefficient, the production inducement effect was confirmed by the backward linkage effect in which the products of other industries were inputted as intermediate goods for the production activities of the land transport industries. The land transport industry (H49) had a production inducement effect in manufacturing (C19, C29) over the entire period. In particular, it has been confirmed that there are significant ripple effects on the manufacturing of vehicles, such as the manufacture of motor vehicles (C29). There was also a production inducement effect on storage and handling (H52). The courier service industry (H53) was found to have production inducement effects in wholesale and retail (G47).

In addition, industries with production inducement effect by forwarding linkage effect, in which products of land transport industries are put into intermediate goods of other industries, were identified. Services in the land transport (H49) and courier service (H53) are commonly used as intermediate goods in retail (G47). And the courier service (H53) has been widely used in the financial sectors (K64, K66) since 2008, as well as in the distribution industries (G46, G47).

This study attempted to analyze the industry association with the land transport industries, a service industry with insufficient research on inter-industry correlation. Through this, the production inducement effect on the fields of the forward and backward industries of the land transport industries was confirmed. Therefore, it is meant that it provides a foundation for understanding the industrial structure linked with the land transport industries. In addition, It seems clear that the forward industries of the land transport industries are the distribution industries such as wholesale and retail.

In Korea, most domestic transportation needs are land transport and courier (H49, H53). It can also be seen that the wholesale and retail businesses (G46, G47) are widely used as intermediary goods. Without the expansion of land transport service networks and courier facilities in Korea, the confusion caused by the current COVID-19 would have been aggravated. Without properly equipped land transport services, it can be assumed that many problems would have occurred in the purchase of daily necessities and the distribution of masks. Due to COVID-19, online purchases have skyrocketed in Korea. In addition, distribution companies have created various delivery services such as one-day delivery, overnight delivery, and early morning delivery. This was supported by Korea's land transport (H49) and courier service (H53). It has been the role of Korean land transport companies to bring the necessary products to consumers who make online purchases, and that it plays an essential role in minimizing the spread of COVID-19 under current circumstances. The development of land transport services is exerting maximum capacity in the national emergency.

Through the results of this study, it will be possible to establish efficient and effective policies for the land transport industries by taking into account industries with significant ripple effects due to the land transport industries and those with many uses of the land transport industries. The limitation of the study was that reliable data from the WIOD were used but failed to exclude the passenger sector contained in the land transport industries data. Therefore, it is necessary to secure more pertinent data and industrial classifications embodied in the land transport industries. Furthermore, with additional research direction, we analyze the structure of the forward and backward industries of each country's logistics industry and propose establishing the logistics service supply chain concept.

References

Cartwright, J. V., Beemiller, R. M., & Gustely, R. D. (1981). *Regional Input-output Modeling System.* Washington, D.C.: U.S Department of Commerce.

Chenery, H. B., & Watanabe, T. (1953). International comparisons

of the structure of production. *Econometrica, 26*(4), 487-521.

Chiu, R. H., & Lin, Y. C. (2012a). Applying input-output model to investigate the inter-industrial linkage of transportation industry in Taiwan. *Journal of Marine Science and Technology, 20*(2), 173-186.

Chiu, R. H., & Lin, Y. C. (2012b). The inter-industrial linkage of maritime sector in Taiwan: an input-output analysis. *Applied Economics Letters, 19*(4), 337-343.

Choi, Y. Y., Ha, H. K., & Park, M. Y. (2008). Analysis of the role of maritime freight transport industry in the Korean national economy. *Journal of International Logistics and Trade, 6*(1), 23-44.

Camba, A. L., & Camba, A. C. J. (2020). The Effect of COVID-19 Pandemic on the Philippine Stock Exchange, Peso-Dollar Rate and Retail Price of Diesel. *The Journal of Asian Finance, Economics and Business, 7*(10), 543-553.

Dietzenbacher, E., Los, B., Stehrer, R., Timmer, M., & DeVries, G. (2013). The Construction of World Input-output Tables in the WIOD Project. *Economic Systems Research, 25*(1), 71-98.

Farooq, U., Hardy, J. L., Gao, L., & Siddiqui, M. A. (2008). Economic impact/forecast model of intelligent transportation systems in Michigan: an input output Analysis. *Journal of Intelligent Transportation Systems, 12*(2), 86-95.

Gracia, O., Timotius, F. C. W. S., Teofilus, T., & Charly, H. (2020). Adaptive supply chain management under severe supply chain disruption: evidence from Indonesia. *Journal of Distribution Science*, *18*(11), 91-103.

Jones, L. P. (1976). The measurement of hirschmanian linkages. *Quarterly Journal of Economics, 90*(3), 323-333.

Kang, J. G., Lee, H. S., & Jeong, S. Y. (2011). The analysis for the structure and spillover effect of logistics service in south Korea, China, and Japan. *Review of International and Area Studies, 20*(4), 39-64.

Kim, A. H., & Lee, S. G. (2020). A comparative study on production inducement effects in key industries of Korea and the Netherlands. *Global Business & Finance Review, 25*(1), 13-32.

Lee, D. H., Hong, G. Y., & Lee, S. G. (2019). The relationship among competitive advantage, catch-up, and linkage effects: a comparative study on ICT industry between South Korea and India. *Service Business, 13*(3), 603-624.

Lee, M. K., & Yoo, S. H. (2016). The role of transportation sectors in the Korean national economy: an input-output analysis. *Transportation Research Part A: Policy and Practice, 93*, 13-22.

Li, Y., Lee, S. G., & Kong, M. (2019). The industrial impact and competitive advantage of China's ICT industry. *Service Business, 13*(1), 101-127.

Mattioli, E., & Lamonica, G. R. (2013). The ICT Role in the World Economy: An Input-output Analysis. *Journal of World Economic Research, 2*(2), 2-25.

Miernyk, W. H. (1965). *The Elements of Input-output Analysis.* New York.: Random House.

Miller, R. E., & Blair, P. D. (2009). *Input-Output Analysis: Foundations and Extensions*. NJ: Cambridge University Press.

Min, Y. K., Lee, S. G., & Aoshima, Y. (2019). A comparative study on industrial spillover effects among Korea, China, the USA, Germany and Japan. *Industrial Management & Data System, 119*(3), 454-472.

Morrissey, K., & O'Donoghue, C. (2013). The role of the marine sector in the Irish national economy: an input-output analysis. *Marine Policy, 37*, 230-238.

Park, J. U., Won, H. Y., & Lee, D. S. (2009). A study on the growth contributing factors of the Korean logistics industry by the structural decomposition of input-output tables. *The Journal of Shipping and Logistics, 25*(4), 935-962.

Park, S. Y. (2019). A study on economic effects of Korean water transport industry using international input-output analysis. *The Journal of Shipping and Logistics, 35*(4), 555-576.

Rasmussen, P. N. (1957). Studies in inter-sectoral relations. *The American Economic Review, 47*(3), 432-435.

Richardson, H. W. (1972). *Input-output and Regional Economics*. London: Weidenfeld and Nicolson.

Richter, R., & Streb, J. (2011). Catching-up and Falling behind: Knowledge Spillover from American to German Machine Toolmakers. *The Journal of Economic History, 71*(4), 1006-1031.

Rohman, I. K. (2013). The Globalization and Stagnation of the ICT Sectors in European Countries: An Input-output Analysis. *Telecommunications Policy, 37*, 387-399.

Wang, T. F. (1990). Analyzing the economic effects of transportation and communications construction. *Economic Research, 30*, 79-125.

Wolor, C. W., Solikhah, S., Fidhyallah, N. F., & Lestari, D. P. (2020). Effectiveness of E-Training, E-Leadership, and Work Life Balance on Employee Performance during COVID-19. *The Journal of Asian Finance, Economics and Business, 7*(10), 443-450.

Xing, W., Ye, X., & Kui, L. (2011). Measuring Convergence of China's ICT Industry: An Input-output Analysis. *Telecommunications Policy, 35*(4), 301-303.

Yun, E. G., Kim, S. M., & Lee, S. G. (2017). A competitive study on the linkage effects between ICT and automobile industry. *Information Systems Review, 19*(4), 111-134.

Zhao, X., Xu, Y. E., Wang, J., & Yang, Z. (2007). Analysis on the characteristics of transportation system between China and America based on the input-output theory. *Proceedings of the Eastern Asia Society for Transportation Studies, 6*, 20-30.

Appendix 1. Industrial Classification of WIOD

Section	Code	Description
1	A01	Crop and animal production, hunting and related service activities
2	A02	Forestry and logging
3	A03	Fishing and aquaculture
4	B	Mining and quarrying
5	C10-12	Manufacture of food products, beverages and tobacco products
6	C13-15	Manufacture of textiles, wearing apparel and leather products
7	C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
8	C17	Manufacture of paper and paper products
9	C18	Printing and reproduction of recorded media
10	C19	Manufacture of coke and refined petroleum products
11	C20	Manufacture of chemicals and chemical products
12	C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
13	C22	Manufacture of rubber and plastic products
14	C23	Manufacture of other non-metallic mineral products
15	C24	Manufacture of basic metals
16	C25	Manufacture of fabricated metal products, except machinery and equipment
17	C26	Manufacture of computer, electronic and optical products
18	C27	Manufacture of electrical equipment
19	C28	Manufacture of machinery and equipment n.e.c.
20	C29	Manufacture of motor vehicles, trailers and semi-trailers
21	C30	Manufacture of other transport equipment
22	C31-32	Manufacture of furniture; other manufacturing
23	C33	Repair and installation of machinery and equipment
24	D35	Electricity, gas, steam and air conditioning supply
25	E36	Water collection, treatment and supply
26	E37-39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
27	F	Construction
28	G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
29	G46	Wholesale trade, except of motor vehicles and motorcycles
30	G47	Retail trade, except of motor vehicles and motorcycles
31	H49	Land transport and transport via pipelines
32	H50	Water transport
33	H51	Air transport
34	H52	Warehousing and support activities for transportation
35	H53	Postal and courier activities
36	I	Accommodation and food service activities
37	J58	Publishing activities
38	J59-60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities

Appendix 1. ConTinued

Section	Code	Description
39	J61	Telecommunications
40	J62-63	Computer programming, consultancy and related activities; information service activities
41	J64	Financial service activities, except insurance and pension funding
42	K65	Insurance, reinsurance and pension funding, except compulsory social security
43	K66	Activities auxiliary to financial services and insurance activities
44	L68	Real estate activities
45	M69-70	Legal and accounting activities; activities of head offices; management consultancy activities
46	M71	Architectural and engineering activities; technical testing and analysis
47	M72	Scientific research and development
48	M73	Advertising and market research
49	M74-75	Other professional, scientific and technical activities; veterinary activities
50	N	Administrative and support service activities
51	O84	Public administration and defense; compulsory social security
52	P85	Education
53	Q	Human health and social work activities
54	R-S	Other service activities
55	T	Activities of households as employers; undifferentiated goods and services producing activities of households for own use
56	U	Activities of extraterritorial organizations and bodies