

Article

Transportation Infrastructure or Economic Power? Development of the Automobile Industry in the United States

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Abstract: The motive for the Korean automobile industry's US investment is the easing of trade regulations and managing a stable supply chain by establishing local production. The Korean automobile industry has undergone major changes due to strong trade regulations since the beginning of the Trump administration and the COVID-19 pandemic. This has affected parts production, procurement, and automobile manufacturing and shaken the foundation of the automobile industry supply chain. The purpose of this study is to provide implications for additional investment decisions by analyzing the impact of the US industry and economy on the success of the automobile industry if Korean automobile companies advance into the US. This study conducted panel analysis by collecting 10 years of data to investigate the impact of economic, industrial, and infrastructure factors in each state on the success of the automobile industry. This study reflected the characteristics and investment motivation of the automobile industry. The study findings revealed that an export-oriented industrial area is suitable for strategic investment rather than a region where the economy is simply large or where all industries are developed. In addition, when making investment decisions, it is important to prioritize the internal capabilities of the company rather than external factors.

Keywords: automotive industry; FDI; panel analysis; supply chain management; trade policy



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1. Introduction

Car manufacturing company supply chain is, to varying degrees, complex with the involvement of various stages of suppliers. In addition, car manufacturing operations require huge investments into facilities, equipment, employment, and more. Therefore, the car manufacturing industry is considered a driver of economic development for countries and regions [1,2]. Countries or regions that intend to achieve economic growth through developing large-scale industrial complexes offer various incentives to attract investment of global firms including car manufacturing companies. In addition, trade regulations and pressure are occasionally adopted to urge relocation of supply chains into various countries and regions.

Foreign direct investment (FDI) in the automobile industry traditionally has sought out local market expansion and reduction of production costs. However, in recent years, FDI has increased in developed countries such as the EU and the US for strategic purposes: to overcome trade regulations and trade pressures, to maintain the local market, and to reduce disputes between countries [3,4]. Due to the impact of COVID-19, the focus of supply chain management (SCM) of car manufacturing companies is seemingly shifting from efficiency to resilience.

Under the new trade environment and the impact of COVID-19, a solution that can be considered by car manufacturers would be to establish manufacturing facilities in such countries as the US. Location and site selection for the facilities is still important since it directly influences cost and customer services. Therefore, it is necessary for car manufacturers to understand the factors that affect the automobile industry to ensure

effective decision-making regarding location. It is also important for policy makers to prioritize factors that have more impact on the development of the automobile industry.

Many studies related to the automotive industry have been conducted, including automotive SCM, logistics, and FDI case studies, but most were fragmentary studies on specific situations or topics. This study intends to present strategies and implications by analyzing success factors from the perspective of the entire industry based on automotive SCM. Therefore, the purpose of this study is to examine the factors that contribute to the growth and concentration of the automobile industry in the US. Panel models are developed to explain export growth and concentration of automobile industry using economic variables and variables related to transport and logistics infrastructure. Data are collected from various sources from 2011 to 2020 (Table 1).

Table 1. FDI status Korea to US and EU (million \$).

Classification	Total FDI to US	Automotive FDI	Total FDI to EU	Automotive FDI
2011	7442	147	2451	116
2012	5925	89	3462	289
2013	5869	101	3165	369
2014	5961	199	3110	109
2015	7050	160	2134	106
2016	13,670	126	2647	160
2017	15,318	323	4403	306
2018	11,219	210	7515	1801
2019	15,370	216	9274	974
2020	14,730	144	7800	569

Source: The Export-Import Bank of Korea.

The remaining part of this study is constructed as follows. Section 2 examines the trend of related research through the theoretical background and previous studies and verifies the validity of this study and the objectivity of variable selection. Section 3 presents research methods and data collected for this study. Section 4 consists of analysis to verify this study. Factors derived from previous studies and in-depth interviews with experts were mentioned in detail, and panel regression analysis was conducted based on this data. Section 5 summarizes the final analysis results, presents conclusions and implications, and mentions the limitations of the study.

2. Literature Review

2.1. Theoretical Background

2.1.1. SCM and Characteristic of Automotive SCM

The concept of the supply chain was first introduced in the 1980s and has been studied and used in practice by many researchers and companies. The supply chain in the 1980s was managed with logistics, inventory, and production management, and as the cost structure for each area constituting the supply chain was subdivided, its functions and areas became specialized. In the 1990s, the enterprise resource planning function was added, and the concepts of demand forecasting, inventory management, production planning, and payment were also defined as areas of the supply chain.

There are various definitions of ‘supply chain’, but in general, ‘supply chain’ refers to the process of obtaining raw materials for a company, making products, and delivering them to customers. The management method for optimizing the entire process from product planning, raw material purchase, logistics, distribution, and sales is called SCM [5–7].

SCM has developed into an important management strategy as a company pursues efficiency in each stage with the goal of reducing logistics costs. In particular, the automobile industry developed another management technique called ‘just-in-time’ (JIT) by developing SCM as a business strategy. JIT is a cost-saving inventory management method that operates with minimal inventory based on thorough logistics punctuality and stability. It is also a production management technique that can reduce costs and a logistics management technique that pursues logistics punctuality [8–11]. However, recent automobile

manufacturers have experienced production line disruption due to uncertainty in parts procurement due to trade regulations, frequent natural disasters, and COVID-19.

Since automobiles are comprised of about 30,000 parts, and even a single shortage causes the entire production line to stop and leads to huge losses, it is an industry that, more than any other, emphasizes the importance of procurement and logistics. In addition, since those 30,000 parts are procured from several countries, the automobile industry must carefully manage everything that happens in the entire supply chain, including procurement of raw materials; parts production; logistics; customs clearance; establishing a production plan; and adjusting the order quantity, logistics route, and procurement methods according to each changing situation.

Despite these characteristics of the automobile industry, supply chain participants who experienced difficulties in production due to external factors prefer supply chain changes such as active localization rather than JIT [7,12,13].

2.1.2. Motivation of FDI and Automotive Industry

The motivations of FDI are market development, resource acquisition, and methods to reduce costs and risks. For this reason, many companies are making FDI in various forms such as new investment, mergers and acquisitions, and consignment production.

From the point of view of the automobile industry, the main purpose of FDI in Central and Eastern Europe is to construct low-cost production bases for the whole of Europe, so the cost study by region has become the main focus. However, in Southeast Asia, thorough market research will be required for the purpose of increasing sales in the region and developing new markets. Since the main purpose of US investment is to evade trade regulations, the investment decision is made according to the current status of trade and US trade policy.

When the Trump presidency began, harsh trade policies were implemented against an unspecified majority, which expanded into a diplomatic task; these trade restrictions have been narrowed down to automobiles and auto parts, which are the US's largest deficit items [14,15] (Table 2).

Table 2. US trade top 10 imported products (million\$).

	Product	Amount
1	Motor cars and other motor vehicles principally designed for the transport of persons including station wagons and racing cars	176,853
2	Automatic data-processing machines and units thereof	126,895
3	Telephone sets, including telephones for cellular networks	100,266
4	Medicaments consisting of mixed or unmixed products for therapeutic or prophylactic uses, put up in measured doses	90,157
5	Articles exported and returned	86,403
6	Petroleum oils and oils obtained from bituminous minerals, crude	78,418
7	Parts and accessories of the motor vehicles of headings	68,015
8	Human blood; animal blood prepared for therapeutic, prophylactic, or diagnostic uses	59,745
9	Gold (including gold plated with platinum), unwrought or in semi-manufactured forms, or in powder form	45,814
10	Petroleum oils and oils obtained from bituminous minerals	32,965

Source: Korea International Trade Association (2020).

Due to these trade restrictions, the Korean automobile industry is entering the United States. Korea's first FDI in the US automobile industry began in 1985. However, local US production began in earnest in 2005 after the US Office of the United States Trade Representative restricted imports by imposing anti-dumping and countervailing duties on Korean automobile imports. Accordingly, the Hyundai Motor Group established a Hyundai Motors plant in 2005 and a Kia Motors plant in 2009.

Although there has been no additional investment since the establishment of the production plant, the Korean auto industry's FDI is expected to increase in the future given

the anticipated continuation of the supply chain crisis due to US trade restrictions and COVID-19 [7]. Presently, however, competition is fiercer, and investment motives and success factors are different. Therefore, it is necessary to conduct a thorough analysis before making an investment decision [16,17].

2.2. Previous Empirical Literature

In this chapter, papers on panel analysis with economic growth, infrastructure investment, and industrial development as major variables are analyzed.

Cantos, Gumbau-Albert, and Maudos [18] analyzed the effects of roads and railways in Spain on the agricultural, electronics, and construction industries. As a result of the analysis, it was argued that the logistics infrastructure has a distinct positive effect on the growth of each industry. Lee and Ning [19] analyzed the effects of road, rail, and inland waterways data on China's economic growth in 31 administrative regions in China. The analysis revealed that roads had a positive effect on economic growth and that railroads and inland waterways had no significance. Therefore, in areas where economic growth is the target, road network expansion should be prioritized over other investments.

Conversely, there are studies analyzing the impact of infrastructure on economic growth and regional productivity. Dalenberg and Patridge [20] argued that infrastructure investment had a positive effect on local productivity by shortening commuting time and thus expanding the supply and demand of labor. Bae [21] analyzed the impact of US economic development on infrastructure spending. The analysis revealed that economic growth leads to infrastructure investment, and infrastructure investment leads to the development of local industries. In other previous studies, it was demonstrated that economic growth, infrastructure investment, and industrial development were all related as complementary relationships [22–24]. However, the studies did not focus on specific industries. If a specific industry is set as a dependent variable and reanalyzed, another result that can reflect the characteristics of the industry may be derived.

3. Research Model and Data Collection

This study used panel regression analysis to determine the effect of each factor on location selection. Variables of the models are as follows (Tables 3 and 4).

Table 3. Description of analysis data.

Variables	Variable Description	Description Source
Independent Variable (Each State)	ln(GDP)	GDP (State GDP) US Department of Commerce
	ln(GE)	Global Export (Total Export \$ to Global) US Department of Commerce
	ln(NAE)	North America Export (Total Export \$ to N.A.) US Department of Commerce
	ln(LOP)	Logistics Payroll US Department of Transportation
	ln(LL)	Logistics LQ US Bureau of Labor Statistics
	ln(MW)	Minimum Wage US Bureau of Labor Statistics
	ln(RL)	Road Length US Department of Transportation
	ln(POP)	Population US Census Bureau
	LAP	Land Price Lincoln Institute of Land Policy
	Port	Port US Department of Transportation
	CT	Corporate Tax Tax Foundation
Dependent variable	ln(GCX)	Global Car Export US Department of Commerce
	ln(CEL)	Car Export LQ US Department of Commerce

Table 4. Descriptive statistics.

Variables		Mean	Standard Deviation	Min	Max
ln(GDP)	\$	26.70252	0.6605832	25.73083	28.65778
ln(GE)	\$	24.14871	0.8214343	22.34192	26.51891
ln(NAE)	\$	22.17761	1.167884	19.57664	24.71559
ln(LOP)	\$	15.53687	1.444965	14.14999	17.68749
ln(LL)	Coefficient	1.030822	0.1723074	0.6777119	1.468401
ln(MW)	\$	7.920367	1.124968	5.15	12
ln(RL)	Mile	11.42141	0.53088	9.970713	12.66174
ln(POP)	Persons	15.85952	0.5996251	14.9309	17.49325
LAP	Coefficient	3.26667	1.366913	1	5
Port	EA	4	3.536716	0	12
CT	\$	6.60824	2.767285	0	12

There are three independent variables. Gross domestic production, total export, and state population are used to represent state economies. Underwood [25] analyzed cases of investment motivation and location factors for 9 companies that established 17 automotive factories in the United States between 1982 and 2011 and summarized the impact on businesses, states, and consumers. Sturgeon et al. [26] and Colovic and Mayrhofer [27] emphasize the importance of consumer market proximity. Sturgeon et al. [26] analyzed the US investment and success factors of global automakers and argued that consumer market proximity and industrial agglomeration effect were important factors. Colovic and Mayrhofer [27] took the top 20 global automobile manufacturers as an example and argued that location is the most important factor in overseas investment in the automobile industry, and both the consumption market and the value chain should be considered simultaneously.

For expenses and cost, minimum wage, value of land, and corporate tax were included. These variables were collected by the US Bureau of Labor Statistics and the Lincoln Institute of Land Policy. Logistics and transport infrastructure—such as ports, total road length, and logistics location quotient (LQ)—were also important factors. LQ was devised by Isard (1960) and mainly used in economic geography to analyze the degree of regional specialization of an industry. If the LQ coefficient is greater than 1, the industry can be considered specialized. This research was conducted using various types of LQ based on employment, import/export, production scale, etc. depending on the researcher [28,29].

Logistics-related employment LQ by state is as shown in the equation below.

$$LQ_{\text{Empl}_{i,jl}} = \frac{\text{Empl}_{i,jl} / \text{Empl}_{i,Al}}{\text{Empl}_{Al,jl} / \text{Empl}_{Al,Al}}$$

$\text{Empl}_{i,jl}$: Logistics employment for each state

$\text{Empl}_{i,Al}$: Total employment for each state

$\text{Empl}_{Al,jl}$: Logistics employment for US

$\text{Empl}_{Al,Al}$: Total employment for US

The dependent variable is the regional export performance and automobile export LQ. Underwood [25] noted that increased production, sales, and exports can be an outcome for FDI company and state governments. In addition, the LQ, which indicates the degree of industrial specialization and economic outcome, can be the achievement of the industry [30].

In general, business outcome has been evaluated in terms of financial performance such as sales and acquisition profit or corporate assets. However, the recent manufacturing business is showing results that have nothing to do with sales performance due to rising material costs, logistics costs, and labor costs. In addition, automobile-related companies in the United States are often foreign components of multinational corporations rather than corporations headquartered in the United States. In this case, it was difficult to set

corporate assets or financial performance as a dependent variable because individual sales were not disclosed.

The LQ in terms of automobile export performance by state is shown in the equation below.

$$LQ_{Ex_{i,jl}} = \frac{Empl_{i,jl}/Empl_{i,AI}}{Empl_{AI,jl}/Empl_{AI,AI}}$$

$Empl_{i,jl}$: Automotive export performance for each state

$Empl_{i,AI}$: Total export for each state

$Empl_{AI,jl}$: Automotive export performance for US

$Empl_{AI,AI}$: Total export for US

Panel regression analysis is performed using the selected independent and dependent variables. Based on the analysis results, it will be possible to derive the success factors of the US automobile industry and the US investment strategy for Korean automobile companies.

The baseline estimation equation is

$$\begin{aligned} \log(GCX)_{it} = & \beta_0 + \beta_1 \log(GDP) + \beta_2 \log(GE) + \beta_3 \log(NAE) + \beta_4 \log(LOP) \\ & + \beta_5 \log(LL) + \beta_6 \log(MW) + \beta_7 \log(RL) + \beta_8 \log(POP) \\ & + \beta_9 (LAP) + \beta_{10} (Port) + \beta_{11} (CT) + \mu_{it} \end{aligned} \quad (1)$$

$$\begin{aligned} \log(CEL)_{it} = & \beta_0 + \beta_1 \log(GDP) + \beta_2 \log(GE) + \beta_3 \log(NAE) + \beta_4 \log(LOP) \\ & + \beta_5 \log(LL) + \beta_6 \log(MW) + \beta_7 \log(RL) + \beta_8 \log(POP) \\ & + \beta_9 (LAP) + \beta_{10} (Port) + \beta_{11} (CT) + \mu_{it} \end{aligned} \quad (2)$$

where i = region 1, ..., 30, t = 2011, ..., 2020, and log means the natural logarithm.

4. Analysis and Results

4.1. Diagnostic Analysis

First, the fit was checked through the Hausman test as shown below, and a fixed effect model and a random effect model were selected (Table 5).

Table 5. Model fit test.

Model	<i>f</i> -Test		Hausman Test	
	<i>f</i> -Value	<i>p</i> -Value	Chi2	<i>p</i> -Value
Global Car Export	25.60 ***	<0.001	41.29 ***	<0.001
Car Export LQ	3.57 ***	<0.001	89.1 ***	<0.001

Notes: 1. *** $p < 0.001$.

In the analysis of model 1 with the amount of automobile export as a dependent variable, the f -value was 25.60, indicating that the null hypothesis was rejected at the 1% significance level. This means that the fixed effect model is relatively suitable.

The result of the Hausman test is as follows. Chi2 was 41.29, and p -value was <0.001. Again, it was confirmed that the fixed effect model, which is an alternative hypothesis, is more suitable than the random effect model. In the analysis of model 2 using automobile LQ as a dependent variable, the f -value was 3.57, indicating that the null hypothesis was rejected at the 1% significance level. The result of the Hausman test is as follows. Chi2 was 89.10, and p -value was <0.001. Again, it was confirmed that the fixed effect model, which is an alternative hypothesis, is more suitable than the random effect model.

Prior to panel regression analysis, correlation analysis and multicollinearity analysis were performed in this chapter. As for the correlation, a high correlation was derived from economic, industrial, and population factors. However, all variance inflation factor (VIF) values were derived below 10, so we proceeded with panel regression analysis using this variable (see in the Appendix A).

4.2. Panel Regression

The panel regression analysis revealed Table 6 that the North America export ($\beta = 1.027$, $p < 0.001$) had a positive effect on global automobile exports, and logistics payroll ($\beta = -0.127$, $p < 0.036$), minimum wage ($\beta = -0.049$, $p < 0.035$), land price ($\beta = -0.116$, $p < 0.015$), number of ports ($\beta = -0.052$, $p < 0.015$), and road length ($\beta = -3.985$, $p < 0.004$) had a negative effect. The negative influence of road length and number of ports indicates the characteristics of automobile logistics.

Table 6. Panel regression model analysis result (Model 1: global car export).

Variable	B	95% Wald Confidence Interval		Wald Chi Square	Hypothesis Test	
		Min	Max		Degrees of FREEDOM	Significance Probability
GDP	−0.247	−0.692	0.197	1.191	1	0.275
Global Export	0.134	−0.086	0.355	1.426	1	0.232
North America Export	1.027	0.881	1.172	191.749	1	0.001
Logistics Payroll	−0.127	−0.246	−0.008	4.376	1	0.036
Logistics LQ	0.505	−0.248	1.258	1.730	1	0.188
Minimum Wage	−0.049	−0.095	−0.004	4.454	1	0.035
Road Length	−3.985	−6.733	−1.236	8.078	1	0.004
Population	−0.643	−1.317	0.032	3.488	1	0.062
Land Price	−0.116	−0.210	−0.022	5.870	1	0.015
Port	−0.052	−0.094	−0.010	5.974	1	0.015
Corporate Tax	−0.055	−0.137	0.028	1.664	1	0.197

The rationale for this can be found in the case study of Hyundai motors in Alabama [3]. At the time of Hyundai Motor's entry into the United States, the Alabama state government carried out a four-lane road extension project connecting the port and factory and major bases and factories. That is, there is a road that received heavy use regardless of its total length. A large factory site is preferred over a site with a well-maintained road network. It is analyzed that road length has a negative effect on the performance of the automobile industry.

Table 7 shows the results of analyzing the panel regression model using the car export LQ as a dependent variable. As a result of the analysis, North America export ($\beta = 0.595$, $p < 0.001$) was found to have a positive effect on the car export LQ for each state, and the minimum wage ($\beta = -0.045$, $p < 0.043$) was found to have a negative effect on the car export LQ.

Two panel analyses were performed using two dependent variables, and the results of comparative analysis between models are as follows.

First, North America export and the minimum wage were found to have a significant effect in common, indicating that they are very important factors. Additionally, it was found that the development of the logistics industry or logistics infrastructure had a negative effect on the performance of the automobile industry.

This is an example that clearly shows the characteristics of automobile logistics. The total wage, number of ports, and road length in the logistics industry were analyzed as negative. Automotive logistics pursues JIT and is being carried out by a specialized logistics company with a high understanding of automotive logistics. However, there are not many logistics companies specializing in automobiles, so most of them tend to focus on internal capabilities.

In addition, regardless of local logistics infrastructure, injection ports and roads are determined by state incentives. Therefore, it is analyzed that it is irrelevant to the performance of the automobile industry or has a negative effect.

Table 7. Panel regression model analysis result (Model 2: car export LQ).

Variable	B	95% Wald Confidence Interval		Wald Chi Square	Hypothesis Test	
		Min	Max		Degrees of Freedom	Significance Probability
GDP	−0.355	−0.917	0.207	1.530	1	0.216
Global Export	0.307	−0.027	0.641	3.248	1	0.071
North America Export	0.595	0.372	0.818	27.430	1	0.001
Logistics Payroll	0.000	−0.043	0.042	0.000	1	0.982
Logistics LQ	−0.489	−1.455	0.477	0.984	1	0.321
Minimum Wage	−0.045	−0.092	0.002	3.456	1	0.043
Road Length	6.422	−4.444	5.729	0.061	1	0.805
Population	−0.498	−3.201	2.205	0.130	1	0.718
Land Price	0.094	−0.061	0.250	1.407	1	0.236
Port	−0.023	−0.212	0.165	0.058	1	0.809
Corporate Tax	0.003	−0.010	0.017	0.212	1	0.645

5. Conclusions and Discussion

This study was conducted in accordance with the need to procure parts within the region through expansion of local investment and to expand the local market by examining the difficulties of stable parts procurement and local market development due to the trade regulations and COVID-19 restrictions that the Korean automobile industry is facing. Korea already produces about 600,000 vehicles through its automobile manufacturing plants located in Alabama and Georgia, but this is about 50% of market demand; the rest is dependent on imports. The automobile industry is the number one import industry in the United States. However, continuous imports and accumulated deficits were sanctioned through the Trump administration's trade regulations, and the COVID-19 outbreak that began in 2019 was a serious blow to the operation of local production plants that require the import of parts from their home countries.

Stable procurement logistics and production cost management are more essential in the automobile industry than in any other industry. Therefore, this study was conducted assuming that the Korean automobile industry's investment in the United States was the way to overcome the internal and external difficulties faced by the automobile industry by moving the supply chain to the local market. For this study, panel regression analysis was conducted to find out the success factors of the automobile industry in the US and to derive the optimal investment strategy.

This study has several conclusions. First, as a result of previous studies and expert interviews, it was found that the motives for overseas companies' investment in the US were market expansion and trade regulation evasion. Changing supply chains are expected to bring positive effects in the long run. Second, in all analysis, it was found that the total North America export amount, rather than the total global export amount, had a positive effect on the performance of the automobile industry. It could be estimated that the purpose of the automobile industry leaving its home country and entering the US is to expand its market share in North America based on the US market rather than global exports. In addition, it was found that regions where export-intensive industries are concentrated or areas with proportionate concentration are suitable for strategic investment rather than regions where the economy is simply large or where all industries are developed.

Third, in the cost analysis, large-scale cost factors—such as wages and land—were analyzed as important to the performance of the automobile industry. It was found that these factors are often provided as incentives by the state government, and the size of the incentives has a great influence on the initial investment decision. Finally, the analysis of this study reflected the characteristics of automobile logistics well. The automobile industry often uses internal resources for procurement, sales, and logistics due to the nature of the industry. Logistics LQ, number of ports, and road length had a negative effect on

the performance of the automobile industry. Therefore, it will be important to prioritize internal capabilities rather than local logistics and infrastructure factors when making investment decisions in the automotive industry in the future.

The study has several implications. This study mentioned the need for local investment by referring to various types of internal and external risks, including US trade regulations and COVID-19. This is recognized by individual companies and industries. However, there is limited research that comprehensively summarizes this and mentions implications and countermeasures. Therefore, the results and contents of this study will provide long-term comprehensive implications for internal and external risks to the automobile industry.

Second, the various types of risks surrounding the automobile industry, analysis of success factors of the automobile industry, and investment strategies mentioned above can be academic research tasks. Therefore, the current status of this study and the arrangement of countermeasures can suggest academic implications.

Also, it is worth noting that the analysis method of this study is not limited to the automobile industry and has scalability. For example, as a result of this study, it was confirmed that a large-scale agglomeration could not be a strategic location area. Therefore, the location determination method using this analysis can suggest implications for location-related studies of various industries and facilities other than the automobile industry. Finally, this study presents policy implications. US investment in the automobile industry and major key industries in Korea have always been the subject of political and diplomatic negotiations. If the government needs to make a decision on US investment in the automobile industry, this study can suggest implications for policy decision making.

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Appendix A

Table A1. Correlation analysis between variables.

Variable	GDP	Global Export	North America Export	Logistics Payroll	Logistics LQ
GDP	1				
Global Export	0.807 **	1			
North America Export	0.902 **	0.788 **	1		
Logistics payroll	0.863 **	0.817 **	0.856 **	1	
Logistics LQ	−0.062	−0.171 **	−0.235 **	−0.241 **	1
Minimum Wage	0.235 **	0.087	0.090 *	0.119	0.336 **
Land Price	0.417 **	0.234 **	0.277 **	0.281 **	0.358 **
Port	0.489 **	0.659 **	0.498 **	0.495 **	−0.172 **
Road Length	0.608 **	0.778 **	0.718 **	0.669 **	−0.273 **
Corporate Tax	−0.108 **	−0.385 **	−0.109 **	−0.197 **	−0.078
Population	0.977 **	0.817 **	0.928 **	0.861 **	−0.083 *

Table A1. Cont.

Variable	Minimum Wage	Land Price	Port	Road Length	Corporate Tax	Population
GDP						
Global Export						
North America Export						
Logistics payroll						
Logistics LQ						
Minimum Wage	1					
Land Price	0.471 **	1				
Port	0.077 **	0.014 **	1			
Road Length	−0.179 **	−0.192 **	0.478 **	1		
Corporate Tax	−0.069	0.026	−0.352 **	−0.317 **	1	
Population	0.146 *	0.354 **	0.541 **	0.665 **	−0.160 **	1

Notes: 1. * $p < 0.1$, ** $p < 0.05$.

Correlation analysis and multicollinearity analysis were performed using all variables. As for the correlation by factor, a high correlation was derived in relation to economic indicators. However, all VIF values were derived below 10, so panel regression analysis was performed using this variable.

Table A2. VIF analysis between variables.

Variable	VIF	1/VIF
GDP	7.976	0.125376
Global Export	6.766	0.147798
North America Export	2.577	0.388048
Logistics Payroll	5.005	0.199800
Logistics LQ	8.491	0.117772
Minimum Wage	1.873	0.533903
Land Price	4.548	0.219877
Port	2.954	0.338524
Road Length	3.503	0.285470
Corporate Tax	1.564	0.639386
Population	5.946	0.168180

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