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Research Article

Design of Logistics Economic Management Measures System in the Era of Internet of Things

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In order to test whether the intelligent logistics system based on the Internet of things is an important guarantee for an enterprise to have supply chain competitiveness and save a lot of costs in production and sales, this paper puts forward the innovative architecture and application of the new technology of intelligent logistics system based on the Internet of things, constructs the PLS path model and coordination degree measurement model, and measures and analyzes the coordinated development level of the "logistics regional economy" composite system and the coordinated development level of each subsystem, the coordination degree of the "logistics regional economy" composite system, and the coordination degree of each subsystem. It has effectively solved the problems of low operation efficiency and high labor cost in the procurement and inventory link; moreover, the direct effects of the development of logistics industry on the rationalization and upgrading of industrial economic structure are −0.2269 and 0.0289 respectively, which are significant at the level of 1%. The overall cointegration test shows that China's logistics industry and economic growth maintain a long-term and stable equilibrium relationship.

1. Introduction

Internet of things is the effective integration of modern computer technology, artificial intelligence technology, and perception technology to form a systematic, aggregated, and controlled information management technology. It belongs to the third revolutionary innovation of information technology, as shown in Figure 1 [1]. In the logistics industry, the use of modern Internet of things technology can have a strong impact on the traditional logistics economic management, reestablish the recognition of logistics enterprises for science, technology, and information, improve the intelligent monitoring and management of logistics enterprises, and promote the sharing of information resources among logistics enterprises [2, 3]. Finally, to achieve the goal of win-win, the Internet of things is an important part of information technology in the new era. In the technical system of the Internet of things, its core is still the Internet, and the Internet of things is the extension and expansion of the Internet. The Internet of things integrates intelligent perception and recognition technology with the network. In the application layer, it is mainly to share information across regions, analyze information, and realize intelligent management services under the Internet of things technology [4]. The concept of Internet of things needs to be realized through infrared sensors, GPS positioning, laser scanning, and sensing devices so as to provide channels for information exchange between different items and realize intelligent identification, tracking, and monitoring of items.

2. Literature Review

In a new economic normal, Yang and Kim actively change management ideas and innovate management methods to ensure that the traditional logistics industry can survive and develop in the fierce market competition. As a new product of an era, the Internet of things has brought hope to the logistics industry [5]. Bouras et al. found that the Internet of things technology has brought rare development opportunities to the logistics industry and effectively promoted the development of the traditional logistics industry towards a modern, mainstream, and forward-looking trend [6].

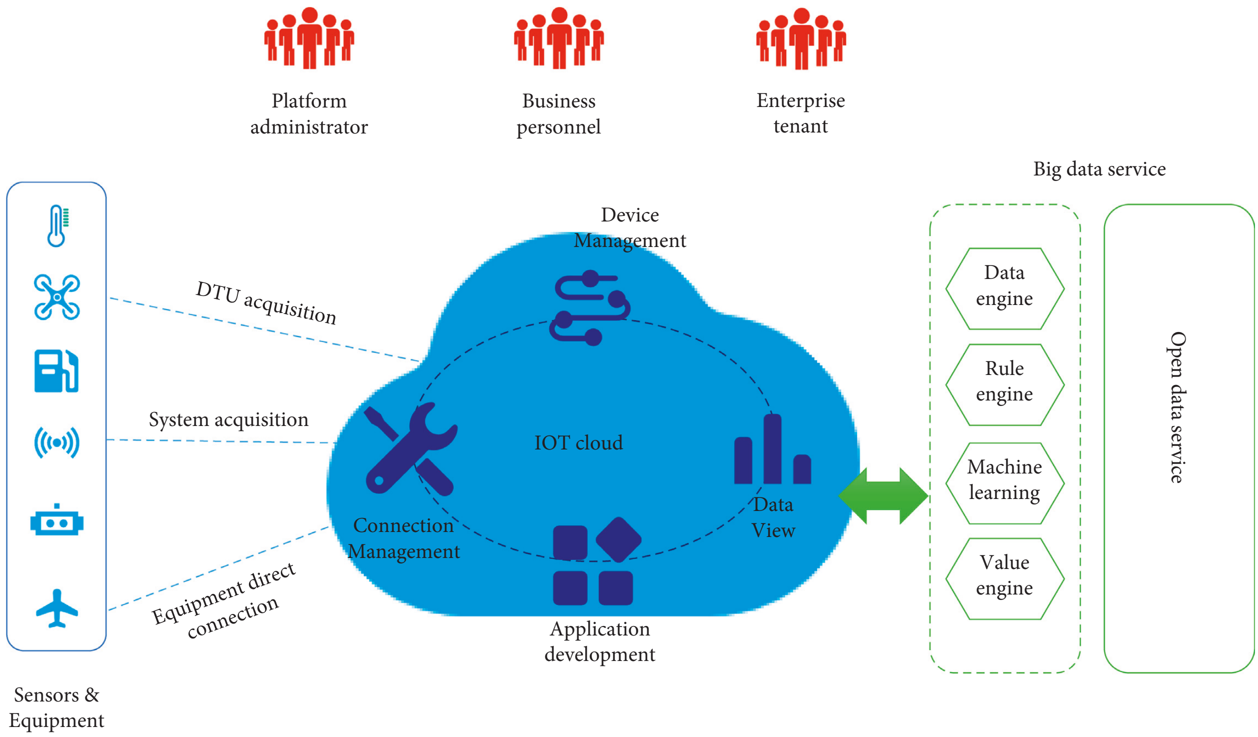

Figure 1: Flowchart of the Internet of things.

Sullivan proposed that in the new era, the Internet of things is a unique information technology, which indicates the arrival of a new information age [7]. Chen et al. found that the Internet of things technology can effectively connect things with things. The Internet is a key technology, which promotes its effective expansion and extension. It extends information exchange to the exchange of things. The emergence of the Internet of things technology is regarded as the third wave of information technology and truly integrates Internet technology into real life [8]. The fundamental starting point for NG and Wakenshaw to establish a network system is to monitor and control goods and improve management efficiency and quality [9]. Mahalle et al. proposed that, in general, the construction of the Internet of things needs to be based on communication equipment, mainly infrared sensors, GPS sensing devices, and so on, and connected with the network to conduct information smoothly [10]. Fenza found that for the management of goods, the Internet of things system needs to carry out the following three steps: first, identify goods and store them by category; second, with the help of intelligent identification equipment, the article attributes are read and the obtained information is converted; third, truthfully transmit the item information to the network, transfer the information to the control center with the help of the Internet, and centrally manage the items [11]. By using intelligent identification technology, scanning, sorting and uploading item information, and storing the information in the information management system, objects and objects can know each other's needs and respond positively. For example, the clothing information includes the requirements for water temperature. Arch et al. found that due to its wide application range, the Internet of things needs to be supported by cloud computing. Cloud computing is to integrate all information and resources into the network with the help of the network so that users can obtain them anytime and anywhere [12]. Edwards proposed that the Internet of things itself does not have an independent computing carrier, so the calculation of all information is allocated to the corresponding computing system, and cloud computing can effectively solve this situation [13]. Aachen and others found that the Internet of things calculates and processes huge data information through cloud computing platform and pattern recognition M2M and other computing cardinality, which is also a test of cloud computing technology [14]. In the traditional logistics system, due to the influence of objective factors such as road conditions and geographical location, the delivery time is long, and the logistics information management is difficult [15]. Logistics management software has the functions of predicting logistics delivery time and goods query, which can effectively avoid the delay of logistics due to information errors. At the same time, with the help of supply chain-related facilities, effectively reduce the material waste in the logistics process, reasonably allocate resources, reduce the logistics cost investment to a certain extent, and maximize economic benefits. In addition, customers can query the express information through the mobile terminal. The visual management mode increases the openness and transparency of logistics, further refines the logistics process, promotes the increasingly standardized logistics links, and can quickly find the responsible person in case of an accident.

3. Method

By the end of 2011, the operating mileage of China's railways (including local and cooperative railways) had reached 93200 kilometers, about 1.8 times that of 1978. The railway business quality has been improved rapidly, in which the mileage of double track has increased from 7360 km in 1978 to 29884 km in 2011, and the proportion of double track mileage in the total length of business line has increased from 15.7% in 1978 to 45.24%. The electrified railway increased from 100000 km in 1978 to more than 34300 km in 2011, and the proportion also increased from 1.9% to 51.98% of the total length of business lines. The automatic block mileage increased from 5981 km in 1978 to 37500 km in 2011, and the proportion increased from 12.3% in 1978 to 56.61%. Although railway construction has made some achievements, at present, China's transportation network density is far lower than that of developed countries. The railway network density is only 38% of that of the United States, 8% of that of Japan, and 17% of that of Germany. The railway double track rate and electrification rate are less than 50%. Figure 2 shows the railway development process [16].

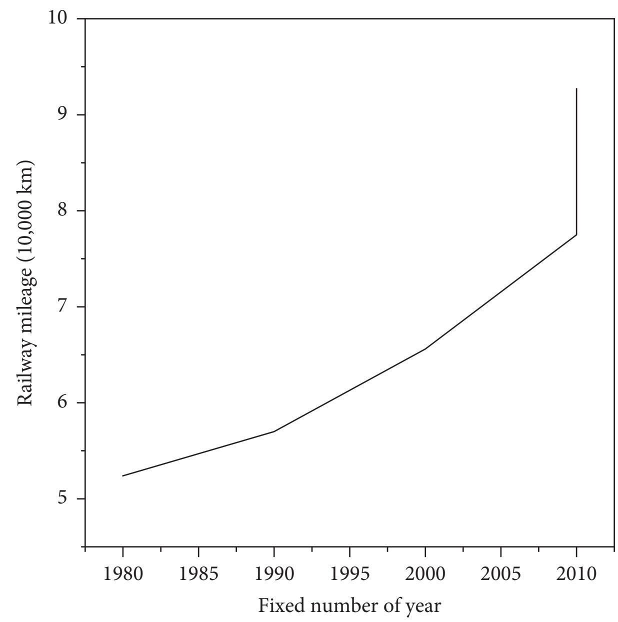

Figure 2: Railway development history.

After the reform and opening up, China's civil aviation construction has developed rapidly. In 1978, the mileage of civil aviation was only 148900 kilometers. By the end of 2011, it had reached 3490600 kilometers. The average is increasing every year 101200 kilometers. The performance of civil aviation construction is not only reflected in the increase of navigation mileage, but also greatly improved aviation operation efficiency. In 2010, the average daily utilization rate of registered transport aircraft in the whole industry was 9.35 hours, including 9.76 hours for large- and medium-sized aircraft and 5.15 hours for small aircraft. In 2010, the average seating rate of regular flights was 80.2%, and the average carrying rate of regular flights was 71.6%. Figure 3 shows the development process of civil aviation [17].

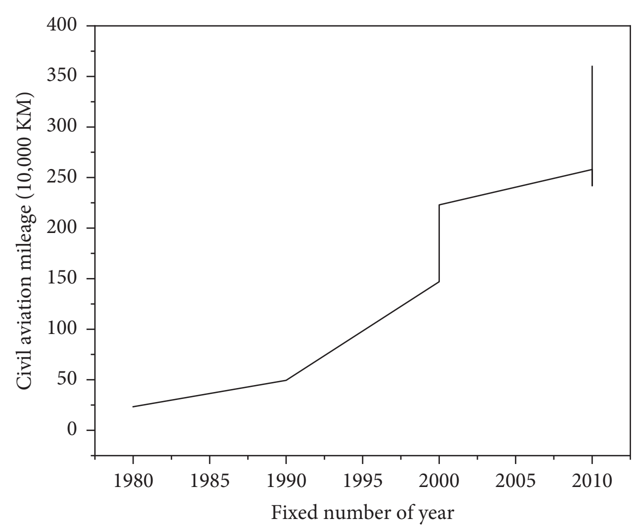

Figure 3: Development history of civil aviation.

Pipeline transportation is developed with the growth of oil and natural gas. It has the advantages of large transportation volume, less land occupation, low energy consumption, low cost, and high reliability. The construction of China's pipeline network began in the late 1950s. Before 1970, most of China's pipelines were distributed in the western region. With the successive development of Daqing oil, Shengli, North China, Liaohe, and other large- and medium-sized oilfields, pipeline transportation in the eastern region has developed greatly. In 1978, the total length of pipeline transportation lines in China was 8400 km, and by the end of 2007, it had reached 54600 km (Figure 3–6). Chinahas gradually formed a cross-regional oil and gas pipeline network industrial pattern [18, 19]. The national oil and gas pipeline network was gradually improved, and a product oil pipeline to send oil from the west to the East and oil from the north to the south was built.

Logistics demand is composed of the needs with payment capacity generated by social and economic activities in various links of logistics. It is reflected by various logistics demand quantities such as transportation, warehousing, distribution, and circulation processing. Freight volume and freight turnover reflect the operation of the national economy and are relatively comprehensive indicators representing the general situation of logistics demand [20]. As can be seen from Figure 5, after 1978, the freight volume and freight turnover increased steadily. Particularly after 2006, affected by the national macroeconomic regulation and control policies, all localities accelerated investment in the development of modern logistics industry, and the freight volume and freight turnover increased rapidly. By the end of 2011, the freight volume was 36969.61 million tons and the freight turnover was 15932.4 billion ton kilometers, 14.86 and 17.21 times that of 1978, respectively.

Judging from the freight volume completed by various modes of transportation, with the attention of the central and local governments to highway construction, highway

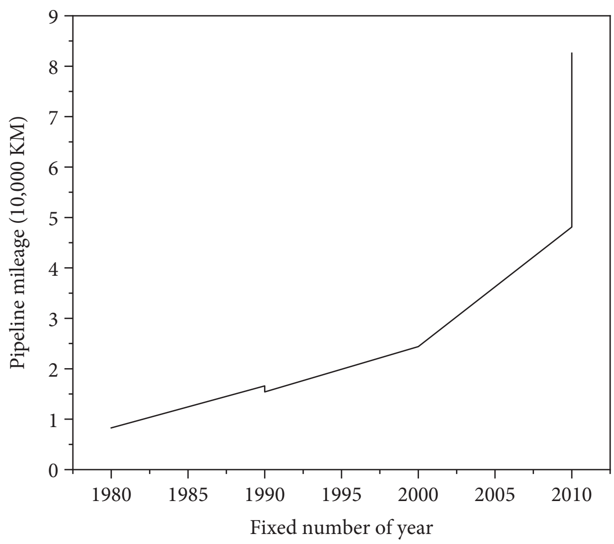

Figure 4: Development history of pipeline in China.

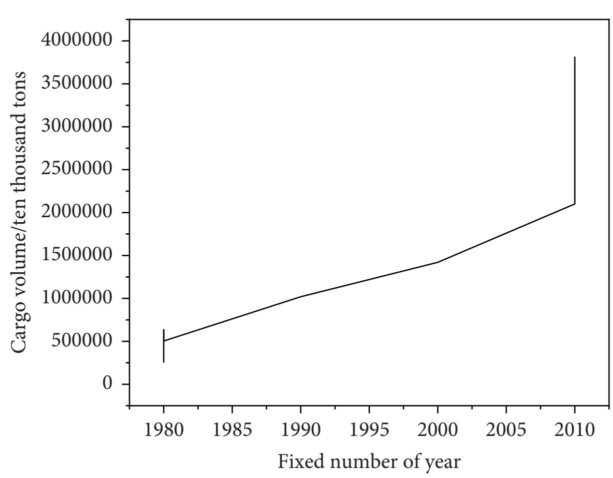

Figure 5: Development history of freight volume in China.

transportation has become the leading mode of transportation since the 1980s. In 1978, the proportion of highway freight volume in the total freight volume was only 34.21%, up to 75.4% in 1984, and has remained above 70% since then. This shows the importance of road transportation for the logistics industry. After 1978, the railway freight volume has maintained an increasing trend, but the ratio of railway freight volume to the total freight volume has been in a downward trend. In 1978, the proportion was 44.28%; in 1986, it was 15.79%; and in 2011, it was only 10.63%. The proportion of waterway transportation in the total freight volume has been increasing slowly since 1979, accounting for 11.59% of the total freight volume in 2011. Although the cargo volume of air and pipeline transportation has maintained an upward trend since 1978, the proportion of these two transportation modes in the cargo volume has been low, almost less than 2%. It can be seen from the above analysis that at present, the main modes of transportation are highway, railway, and water transportation.

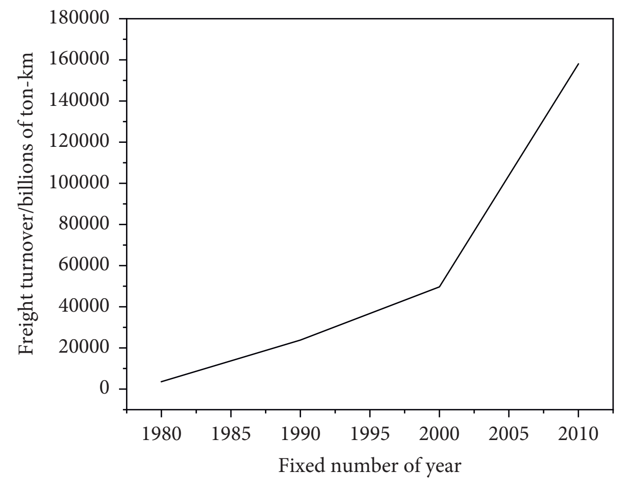

Figure 6: Development history of freight turnover in China.

Procurement is also particularly important for logistics. Although procurement is the first step in the production process, in order to save costs, the company adopts the form of logistics outsourcing for transportation and the first step of goods delivery; that is, the supplier of Party B shall supervise the transportation and quality of goods. However, there are unwritten regulations in the industry: due to the particularity of crude oil and ester lipid materials, suppliers will use transportation devices far higher than national standards in undertaking transportation so as to ensure the quality of product delivery. This measure does realize the service differentiation of supply chain management in suppliers and ensure the lowest cost of the whole supply chain, but it undoubtedly increases the production cost for a large number of small- and medium-sized science and technology production enterprises represented by economic scale. Therefore, after weighing multiple variable factors such as transportation route, plant site distance, and temperature deviation, we choose to reach an agreement on self-regulation in transportation with suppliers in the procurement agreement so that the responsibilities of freight drivers in the delivery link are greatly reduced, and higher standards are put forward for goods acceptance and warehousing.

After the crude oil ester and lipid products enter the inventory state, due to the complexity required by the project, they will be classified and placed according to different requirements and numbers, summarized and recorded by the special management personnel of the warehouse, and fed back to the production office. The production office shall uniformly feed back to the human resources department of the functional department for unified performance statistics. The personnel, working hours, and important matters involved in the whole process of goods delivery are as follows: (due to the confidentiality of the customer's business, the names of the materials involved are all substitute names and only represent some materials) as shown in Figure 7 [21, 22].

Therefore, the company's inventory management model can be used: allow shortage—noninstantaneous delivery model. According to the model assumptions and storage

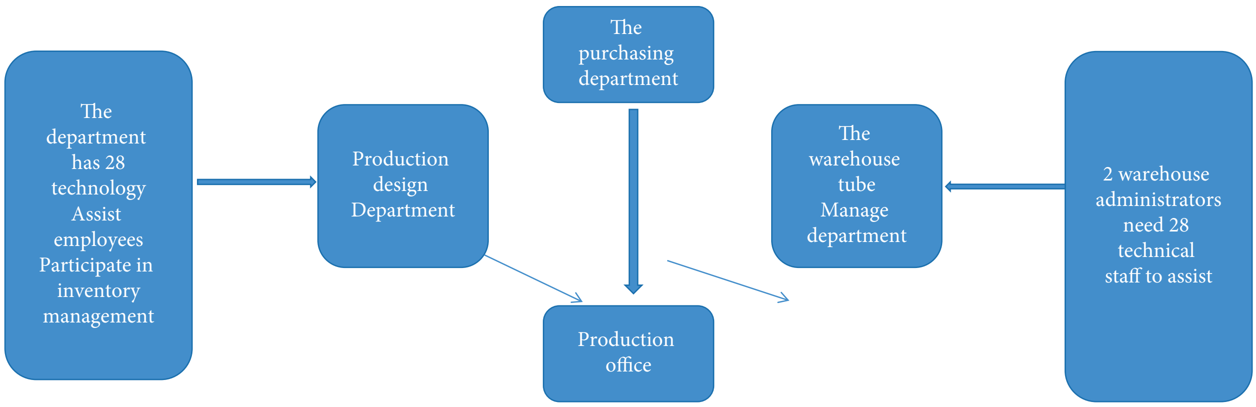

Figure 7: Organization chart of production department.

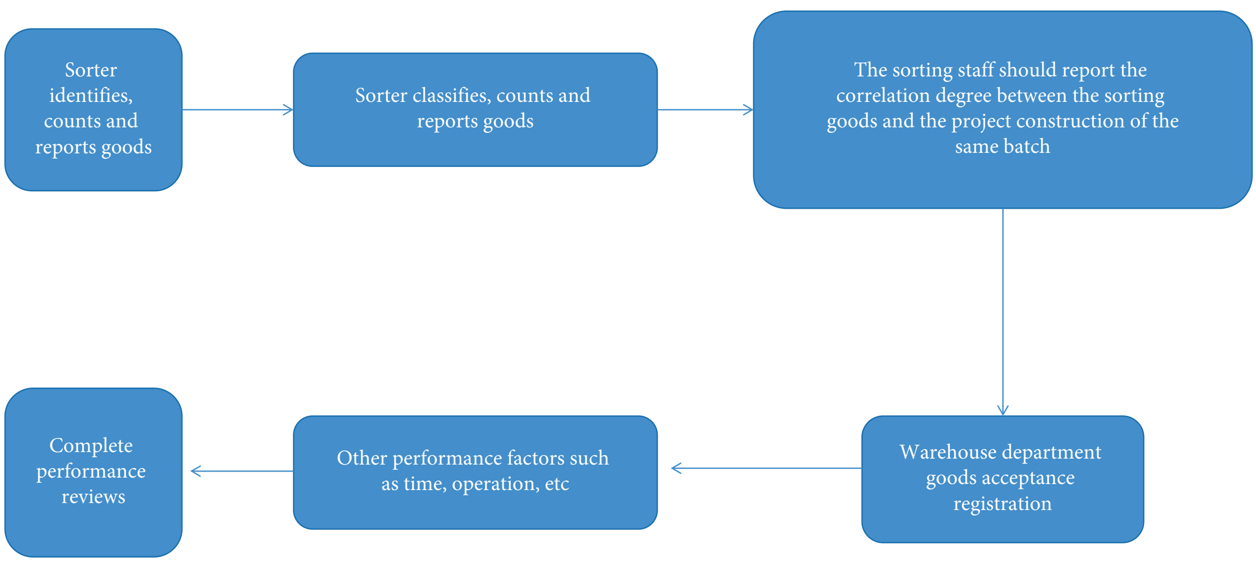

Figure 8: Workflow chart of performance appraisal.

state diagram, the average total cost (i.e., cost function) in [0, t] time is derived, and then the optimal inventory strategy is determined.

From the perspective of $[0, t_1]$, the maximum out of stock quantity $B = D \cdot t_1$.

From the perspective of $[0, t_1]$, the maximum stock-out $B = (P - D)(t_2 - t_1)$.

So, $Dt_1 = (P - D)(^2_t - t_1)$; from this solution,

$$t_1 = \frac{(P - D)}{p} t_2. \tag{1}$$

From the perspective of $[t_2, t_3]$, the maximum out of stock quantity $A = (P - D) \cdot (t_3 - t_2)$, and the maximum inventory $A = D(t - t_3)$. So, $(P - D)(t_3 - t_2) = D(t - t_3)$; from this solution,

$$t_3 - t_2 = \frac{D}{P}(t - t_2). \tag{2}$$

In $[0, t]$ time, the storage fee is $(A/2)C_1(t - t2 = (1/2)C_1(P - D))(t_3 - t2(t - t_2))$.

The shortage fee is $(1/2)C_2 D t_1 t_2$; substituting into (1) and (2), after finishing, the following is obtained:

$$C(t_1, t_2) = \frac{(P - D)D}{2P}\left[C_1 t - 2C_1 t_2^2 + (C_1 + C_2)\frac{t_2^2}{t} + \frac{C_3}{t}\right]. \tag{3}$$

$$\text{Solving equations} \begin{cases} (\partial C(t, t_2)/\partial t) = 0 \\ (\partial C(t, t_2)/\partial t_2) = 0 \end{cases},$$

$$\text{Get: } t^* = \sqrt{\frac{2C_3}{C_1 D}} \cdot \sqrt{\frac{C_1 + C_2}{C_2}} \cdot \sqrt{\frac{P}{p - D}},$$
$$t_2^* = \left(\frac{C_1}{C_1 + C_2}\right) t^*. \tag{4}$$

It is easy to prove that the cost $C(t^*, t_2^*)$ at this time is the minimum value of the cost function $C(t, t^2)$. Therefore, the reference values of the optimal inventory strategy of the model are as follows:

Optimal inventory cycle:

$$t^* = \sqrt{\frac{2C_3}{C_1 D}} \cdot \sqrt{\frac{C_1 + C_2}{C_2}} \cdot \sqrt{\frac{P}{P - D}}. \quad (5)$$

Economic order quantity:

$$\begin{aligned} Q^* &= Dt^* \\ &= \sqrt{\frac{2\ DC_3}{C_1 D}} \cdot \sqrt{\frac{C_1 + C_2}{C_2}} \cdot \sqrt{\frac{P}{P - D}}. \end{aligned} \quad (6)$$

Shortage replenishment time:

$$\begin{aligned} t_2^* &= \left(\frac{C_1}{C_1 + C_2}\right) t^* \\ &= \sqrt{\frac{2C_3}{C_1 D}} \cdot \sqrt{\frac{C_1}{C_1 + C_2}} \cdot \sqrt{\frac{P}{P - D}}. \end{aligned} \quad (7)$$

Start supply time:

$$\begin{aligned} t_1^* &= \frac{(P - D)}{P} t_2^* \\ &= \sqrt{\frac{2C_3}{C_1 D}} \cdot \sqrt{\frac{C_1}{C_1 + C_2}} \cdot \sqrt{\frac{P - D}{P}}. \end{aligned} \quad (8)$$

End of supply:

$$t_3^* = \frac{D}{p} t * + \frac{(p - D)}{p} t_2^*. \quad (9)$$

Maximum stock:

$$A^* = D\left(t^* - t_3^*\right). \quad (10)$$

Maximum stock-out:

$$B^* = Dt_1^*. \quad (11)$$

Average total cost:

$$C^* = \frac{1}{t}\left[\frac{1}{2} C_1 (P - D)\left(t_3 - t2\right)\left(t - t2 + \frac{1}{2} C_2 D t_1 t_2 + C_3\right)\right] = \frac{2C_3}{t^*}. \quad (12)$$

Table 1 above fully shows that in the actual procurement of the company, the control and management of the procurement process is a key step to solve the cost problem, and optimizing the logistics system is an important way to control the cost. Ordinary transport vehicles cannot carry out real-time accurate positioning in the vehicle positioning link; that is, they cannot comprehensively analyze the transportation conditions in combination with the information of the carriage adjustment system and the position of the vehicle [23]. At present, the methods to solve such problems are as follows: first, the cockpit or driver carries out business positioning and communication feedback through the mobile terminal app. This method has the disadvantages of cumbersome and inconvenient operation and management, which increases the risk of transportation outsourcing of the company. Second, the disadvantage of this method is that the cost is too high. For the installation of the finished product positioning system and communication tools, it is first necessary to ensure smooth use. Second, the company's independent information system needs real-time data monitoring [24]. To sum up, the company has two main problems in the logistics and transportation link. First, the physical factors of the environment in which the raw materials are located need to be monitored, controlled, and adjusted in real time. Second, the transportation positioning system needs to be convenient and cannot be independent of the middle platform. The specific performance of these two problems and the disadvantages of the solution are shown in Table 2 below.

The batch crude oil, raw ester, and raw grease sorted and identified by the "sorting team" shall be classified and placed according to different requirements according to storage requirements. If 1# crude oil needs to be partially stored and partially used, it shall be placed in area a for long-term use after identification; 2# crude oil shall be taken from all inventories in batches and shall be placed in non-long-term use area B after identification; 1# raw ester shall be protected from light and high temperature ⟶ after identification, it shall be placed in non-sunlight and non-high-temperature area C; 2# raw ester shall be protected from light and liquid ⟶ after identification, it shall be placed in non-sunlight and non-wet area D; 1# raw fat needs to be close to water source; no fire ⟶ after identification, it shall be placed in non-fire source wet area E; 2# raw grease shall be kept away from the fire at the tuyere. After identification, it shall be placed in the non-tuyere wet area F, and so on, but the traditional goods homing operation of the company adopts nonintelligent homing operations such as manual vehicle + manual handling (this method may be applicable to enterprise sorting under other different needs), which prolongs the working hours, increases the workload and has low efficiency, seriously affects the production efficiency of the whole production link, and improves the labor cost. Therefore, the problem in the homing storage stage is that under the current production situation of the company, manual homing operation is not conducive to project requirements and sorting homing, as shown in Table 3.

After manual recording, the company's traditional sorting and sorting work will register the information of identification personnel and sorting work, and the warehouse administrator will summarize and feed back the situation of the production office within a certain period so as to realize performance statistics. With the increase of the quantity of goods and the complexity of manual operation, when the identity information cannot be effectively and timely identified, the problems in inventory management are as follows: first, it will increase procurement costs and management costs; second, it is difficult to identify the "sorting team" information efficiently and quickly and feed it back in time; and third, the connection between safety period and production cycle is chaotic. To sum up, the company has three main problems in the logistics and warehousing link: first, the warehousing and sorting cannot realize intelligent and efficient identification and classification; second, automatic placement cannot be realized after

Table 1: Purchase of certain crude oil—cost correspondence.

Optimal inventory cycle	Economic order quantity	Shortage replenishment time	Start supply time	End supply time	Maximum inventory	Maximum backorder	Average total cost
26.45 days (26 days)	21165 pieces/ time	7.55 days (8 days)	1.52 days (2 days)	22.67 days (23 days)	3023 pieces	1207 pieces	604.68 yuan/ day

Table 2: Transportation problems and shortcomings of traditional solutions.

Problems encountered in transportation	Specific performance of traditional solutions	Disadvantages of traditional solutions	Effect to be achieved	Problems encountered in transportation
Transportation cannot realize real-time monitoring and quality control	Temperature, humidity, pH	Special device	Expensive and impractical	Low cost and timeliness
The transportation positioning system is not convenient and independent	Real-time positioning and data feedback	App, finished GPS	Cumbersome operation and increasing control cost	Convenient and complete with company a

Table 3: Storage of different crude oil esters and esters.

Project materials	Personnel	Region	Important matters	Other
1# crude oil	3 (2 technicians + 1 warehouse keeper)	A	Partial storage and partial ready to use	Reference 1# document
2# crude oil	2 (1 technician + 1 warehouse keeper)	B	Full inventory; batch withdrawal	Reference 2# document
1# orthoester	4 (3 technicians + 1 warehouse keeper)	C	Full inventory; batch withdrawal	Reference 3# document
2# orthoester	3 (2 technicians + 1 warehouse keeper)	D	Avoid light; avoid liquid	Reference 4# document
1# crude fat	2 (1 technician + 1 warehouse keeper)	E	Near water source; prohibit cooking	Reference 5# document
2# crude fat	3 (2 technicians + 1 warehouse keeper)	F	Shelter; prohibit cooking	Reference 6# document

Table 4: Storage problems and shortcomings of traditional solutions.

Problems encountered in warehousing	Specific performance	Traditional method	Disadvantages of traditional methods	Effect to be achieved
The warehouse cannot realize intelligent sorting and cargo identification	Weight measurement and manual experience identification	Manual operation device identification	The operation is complex, time-consuming, and laborious	Reduce ineffective work
The warehouse cannot realize intelligent classified placement	Manual trolley and manual placement	Manual experience classification	Time-consuming, repetitive processes, inefficient	Save time and project cost
The warehouse cannot be effectively identified	Files recording	Form management	Increase management workload, not intuitive	Concise, clear, and intelligent

warehouse sorting; and third, the statistical work cannot be effectively identified after warehousing and sorting. The specific performance of these three problems and the disadvantages of other solutions are shown in Table 4.

According to the above problems, the performance process assessment scheme is established. The company has set up a performance assessment workflow in the production department to conduct the above performance assessment at different process stages. The workflow is shown in Figure 8.

According to the special operability of the company's production and supply links, the technical assessment is focused on the operation methods of crude oil, raw ester, and raw fat. The correctness of operation is an important guarantee for production design and sales links. However, the company currently adopts the methods of manual form registration and experience sharing to assess the technical performance of this operation. The assessment method is single and cannot accurately assess the technical operation. Under this system, the company tries to improve the performance system and assessment method and optimize the system through a certain performance incentive system. However, this method has fundamental limitations. For the links of manual operation, it can only be assessed in terms of quantity, man-hour, and completion degree, which cannot achieve the key role of controlling quality [25].

Based on the assessment of the original technical data, the company assesses the technical results in terms of goods sorting volume, identification volume, warehouse transportation volume, and project matching-related volume. However, for the company's project construction and sorter department span, some sorters have the problems of lag and delay in implementation, which will also affect the performance statistical feedback of warehouse management, so as to lag and interfere with the performance evaluation of the

Table 5: Performance problems and shortcomings of traditional solutions.

Problems encountered in performance	Specific performance	Traditional method	Disadvantages of traditional methods	Effect to be achieved
The accurate assessment of technical operation process cannot be realized	Fuzzy operation assessment and incomplete technical indicators	Form registration experience sharing	The operation is complex and easy to cause production lag	Assessment and specification of precision technology operation
There are delays and errors in the statistics of technical results	Implementation delay and strong subjectivity of judgment	Form registration, experience sharing	Waste of resources and failure to comply with relevant systems	Accurately count the quantity and objectively complete the sorting

Table 6: Test results.

Inspection name	TL		TS	
	Inspection value	*P* value	Inspection value	*P* value
Spatial fixed effect LR test	662.8552	0.0000	1100.2595	0.0000
Time fixed effect LR test	180.6226	0.0000	148.8757	0.0000

whole department of the production department. In addition, in the data statistics, the main sorters from the production design department are subjective in judging the accuracy of goods, and there are a certain amount of mistakes in the sorting and placement process, resulting in the waste of "leftover materials" for the company. Therefore, it is of practical significance to optimize the performance appraisal system of the company, as shown in Table 5 [25].

4. Results and Analysis

The spatial autocorrelation test shows that there is an obvious spatial dependence in the rationalization and upgrading of China's industrial economic structure. Since different fixed effects will affect the estimation results of the model, it is necessary to determine whether there are significant fixed effects in time and space according to the likelihood ratio test (LR). It can be seen from Table 6 that LR test shows that there are significant spatial individual fixed effect and time fixed effect. It is necessary to establish a time-space double fixed effect model to analyze the impact of logistics industry development on industrial economic structure optimization.

Table 5 gives the estimation results of the model in the form of two spatial weight matrices. It can be seen from Table 6 that the values of Wald test and LR test are significant at the level of 1% regardless of the form of spatial weight matrix, which shows that it is reasonable to adopt the spatial panel Dobbin model with dependent variable lag term and independent variable lag term. In addition, from the model estimation results, the log likelihood value, goodness of fit, and other statistics of the two forms of spatial weight matrix models have good goodness of fit. In comparison, the estimation result of economic distance weight matrix model is better than that of spatial adjacency weight matrix model. Therefore, the estimation result of economic distance weight matrix as spatial weight matrix is selected for analysis. In the spatial effect model, due to the spatial correlation, the traditional independent variable coefficient and significance level can no longer be used as the basis to measure the influence and significance of variables. The application of point estimation (IV/GMM) method and test results of one or more spatial regression models may lead to wrong conclusions. Using partial differential method to explain the influence of independent variables on dependent variables may also lead to the bias of results. In view of the above problems, it is believed that using the direct and indirect effects of independent variables can better explain the spatial panel data model. The direct effect is the change of the dependent variable caused by the change of the independent variable of a spatial unit, which includes the feedback effect after the independent variable affects the dependent variable of adjacent spatial units. The indirect effect is that the change of independent variable of a spatial unit leads to the change of dependent variable of adjacent spatial units. The upper part of Table 7 shows the coefficient estimation results of independent variables, and the lower part shows the direct and indirect effects of independent variables.

From the model estimation results in Table 6, the following conclusions can be drawn:

(1) The estimated values of $W * LN$ (TL) and $W * LN$ (TS) coefficients of the model are 0.2529 and 0.4569 respectively, which are significant at the level of 1%, indicating that there is a spatial positive correlation between the rationalization of industrial economic structure and the upgrading of industrial economic structure in China's provinces. Each province and region are not completely independent in the adjustment and optimization of industrial economic structure, and there is a significant positive spillover effect. This effect shows that the provinces and regions with high rationalization and upgrading index of industrial economic structure are close to each other. In terms of policy measures, there are demonstration effects and learning effects between adjacent provinces. The industrial economic structure adjustment policies and development direction of a region have a positive impact on its adjacent regions.

Table 7: Estimation results of spatial Doberman model.

Parameter	TL		TS	
	Economic distance matrix	Spatial adjacency matrix	Economic distance matrix	Spatial adjacency matrix
W ∗ LN (TL) or W ∗ LN (TS) LN (WL)	0.2529**(4.3992)	0.1789** (3.4721)– 0.1618*** (−8.2164)	0.4569** (10.1769) 0.02150** (3.6612)	0.3228** (5.9881) 0.0243** (3.5628)
LN (DK)	0.3296** (9.2061)	0.2423** (7.928)	0.2065** (6.4285)	0.2725** (7.9475)
LN (HR)	−0.4025*** (−6.8746)	−0.3428** (−6.1334)	0.3064** (5.9372)	0.3919*** (7.5336)
W ∗ LN (WL)	−0.3719** (−5.4256)	−0.3509*** (−8.6854)	0.0621** (2.6065)	0.0466** (2.5102)
W ∗ LN (DK)	−0.0652 (−0.6129)	0.0632 (0.8128)	−0.2075*** (−5.0146)	−0.2209*** (−5.5536)
Direct effect LN (DK)	0.3290 (8.9768)	0.2563 (7.5806)	0.1964 (6.3733)	0.2616 (7.9546)
Indirect effect LN (DK)	−0.0426 (−0.3739)	0.0760 (1.5636)	−0.1989 −(2.9596)	−0.1757 (−4.1284)
Direct effect LN (HR)	−0.3964 (−6.4888)	−0.3412 (−6.2413)	0.3850 (5.7224)	0.4227 (7.5636)
Indirect effect LN (HR)	0.3542 (−0.4893)	0.1707 (0.9632)	−0.2053 (−4.6931)	−0.2264 (−4.8366)

A province adopts measures to promote the adjustment and optimization of industrial economic structure, and its neighboring provinces also adopt similar measures, resulting in a positive spatial spillover effect.

(2) The direct effects of the development of logistics industry on the rationalization and upgrading of industrial economic structure are −0.2269 and 0.0289, respectively. The feedback effect can be obtained by calculating the difference between the direct effect of the independent variable and the coefficient of the independent variable. The feedback effect of the development of logistics industry on the rationalization and upgrading of industrial economic structure is −0.0053 and 0.0054, respectively, which is 1.8% and 29.7% of the direct effect. This shows that with the development of logistics industry, the rationalization and upgrading index of industrial economic structure in each province tends to rise; that is, the development of logistics industry can promote the rationalization and upgrading process of industrial economic structure in this region. The reasonable explanation of this phenomenon is that the logistics industry is a composite industry formed by the integration of traditional transportation, warehousing, postal industry, and emerging technology industries, with extensive industrial linkage. On the one hand, the development of logistics industry can produce large-scale resource agglomeration effect and market effect, improve the efficiency of resource flow, optimize the allocation of resources at the industrial level, avoid surplus and shortage, reduce the information search cost caused by industrial division of labor, and promote the process of rationalization of industrial economic structure. On the other one is the fact that the development of logistics industry can not only drive the development of transportation, post and telecommunications, and warehousing in the circulation sector, but also drive the development of finance, insurance, commerce, tourism, and other related tertiary industries through derivative demand. Moreover, it can also improve the operation efficiency of the secondary and tertiary industries, reduce the operation cost, guide the relevant industries in the primary and secondary industries to restructure the business process and organizational economic structure according to the concept of logistics industry, and realize the economic, reasonable, and efficient operation mode.

(3) The indirect effects of logistics development on the rationalization and upgrading of industrial economic structure are −0.4146 and 0.0613, respectively, which are significant at the level of 1% and 5%. The reasonable explanation of this phenomenon is that the transportation infrastructure is an important part of the logistics industry and has the network attribute. The production factors in the advantageous areas diffuse to the relatively backward surrounding areas through the network transportation infrastructure; it has promoted the development of various industries in surrounding areas.

(4) China's fixed asset investment promotes the upgrading of industrial economic structure and inhibits the rationalization of local industrial economic structure. This phenomenon may be caused by the fact that the current investment in fixed assets mainly tends to industrial industries, and the proportion of investment in the primary and tertiary industries is low, resulting in the unbalanced development of industrial economic structure. The indirect effect of China's fixed asset investment on the rationalization of industrial economic structure is negative and not significant, and the indirect effect on the upgrading of industrial economic structure is significantly negative, which shows that China's fixed asset investment has no obvious effect on the rationalization of industrial economic structure in adjacent areas and has an inhibitory effect on the upgrading of industrial economic structure. The direct effect of human capital on the rationalization of industrial economic structure is significantly negative, and the

direct effect on the upgrading of industrial economic structure is significantly positive, indicating that human capital can promote the optimization of local industrial economic structure.

5. Conclusion

Firstly, this paper analyzes the relationship between logistics industry and economic growth by using time series data, cointegration theory model, and Granger causality test. Then, using China's provincial panel data, this paper constructs a multidimensional factor panel data model including classical economic growth. Using the spatial lag model, this paper empirically analyzes the contribution of the development of logistics industry to regional economic growth, focuses on the current situation and problems of the company's manual logistics system, and analyzes and summarizes the defects and problems in the current company's supply chain. Secondly, after investigating the company's procurement and inventory process, it further puts forward the theoretical construction standards and technical requirements of intelligent logistics system based on the Internet of things. Finally, based on the provincial panel data from 1997 to 2011, the spatial panel Dobbin model is constructed by introducing the spatial lag term of dependent variable and the spatial lag term of independent variable, and the impact of the development of logistics industry on the optimization of industrial economic structure is analyzed from two aspects: the rationalization of industrial economic structure and the upgrading of industrial economic structure. The overall cointegration test shows that China's logistics industry and economic growth maintain a long-term and stable equilibrium relationship. Granger causality test shows that economic growth is not the reason for the growth of logistics network mileage and logistics effectiveness, and logistics industry is not the reason for economic growth. There is a significant positive spatial autocorrelation between logistics industry, and economic growth. Among the factors affecting regional economic growth, the development of logistics industry can promote regional economic growth, but the output elasticity coefficient is low. Among the neoclassical economic growth factors, capital and labor force have a greater contribution to economic growth. Among the factors of new economic growth, human capital has a significant positive impact on economic growth, while global trade and local government expenditure have a positive effect on economic growth, but not significant. Among the influencing factors of new economic geography, transportation infrastructure and market scale play a significant positive role in promoting economic growth. There is a significant positive spatial autocorrelation between the rationalization of industrial economic structure and the upgrading of industrial economic structure, and there are significant differences among the eastern, central, and western regions. The development of logistics industry not only promotes the optimization of industrial economic structure in this region, but also promotes the optimization of industrial economic structure in other regions, which shows that the development of logistics industry plays a positive role in promoting the optimization of China's industrial economic structure.

Data Availability

The data used to support this study are included within.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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