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Research on the Impact of Artificial Intelligence on the High-quality Development of the Logistics Industry
—*Based on the Perspective of Total Factor Productivity*

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ABSTRACT
At present, artificial intelligence technology has become a critical weapon to promote the transformation and upgrading of the logistics industry. This article first describes the mechanism of artificial intelligence affecting the total factor productivity of the logistics industry, and then based on my country's provincial panel data from 2005 to 2017, using the Malmquist index. The method is used to measure the total factor productivity index of my country's logistics industry and its decomposed technical efficiency and technological progress index to empirically test the impact of the development level of artificial intelligence on the total factor productivity of the logistics industry. Among them, artificial intelligence mainly affects the total factor productivity of the logistics industry by intelligently upgrading logistics production tools, intelligently configuring logistics resources, and intelligently optimizing logistics links. The empirical results show that artificial intelligence technology has a significant role in promoting the total factor productivity of the logistics industry, and this effect is mainly achieved by promoting the technological progress of the logistics industry.

Keywords: *Artificial intelligence, Logistics industry, Total factor productivity, Technological progress.*

1. INTRODUCTION

As the basic and leading industry of my country's national economy, the logistics industry is an important field to promote the construction of a country with a strong quality, but it is also one of the prominent shortcomings in my country's economic and social development. In the context of supply-side structural reforms, the traditional logistics industry's development methods are unsustainable. Smart logistics represented by artificial intelligence is gradually becoming an important source for the transformation and upgrading of the logistics industry. It is the development direction and the only way for modern logistics. Artificial intelligence can increase the degree of automation of the production process, replace labor with intelligent systems and equipment, thereby reducing the demand for labor (Chen Yanbin et al., 2019), and improving total factor productivity.

An indispensable condition for the logistics industry to achieve high-quality development is the improvement of total factor productivity. Improving total factor productivity is the only way for sustainable economic development (Tang Jianrong et al., 2016).The efficiency index, total factor productivity reflects the economic growth quality of the logistics industry in a narrow sense. The growth of total factor productivity (TFP) is also considered by the neoclassical economic growth theory to be an important source of sustained economic growth (Guo Jiatang and Luo Pinliang, 2016).

2. MECHANISM OF ACTION AND RESEARCH HYPOTHESIS

Figure 1 shows how artificial intelligence affects the total factor productivity of my country's logistics industry. In general, artificial intelligence affects the total factor productivity of the logistics industry through intelligent upgrading of logistics production tools, intelligent allocation of logistics resources, and intelligent optimization of logistics links.

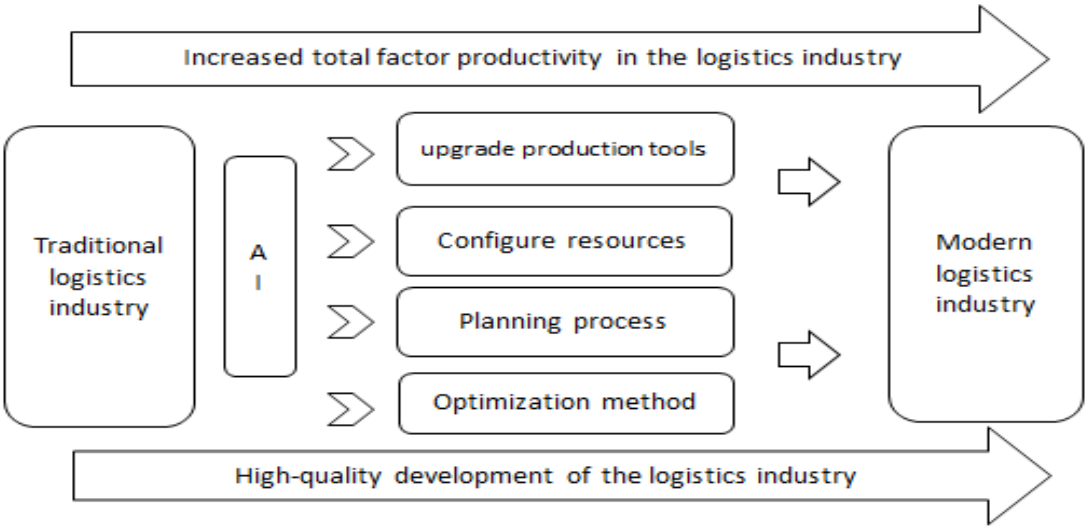

Figure 1 The path of AI affecting the total factor productivity of the logistics industry

2.1. Intelligently upgrade production tools

The development of artificial intelligence technology has given birth to a series of intelligent equipment, such as picking robots, palletizing robots, automatic guided transport vehicles, unmanned vehicles, unmanned aerial vehicles, etc., through autonomous control technology, these devices can carry out intelligent grasping, Stacking, handling, and autonomous navigation make the entire logistics operation system highly flexible and expandable (He Liming, 2017). In smart warehouses, smart robots supplement and replace a large amount of labor and perform complicated and mechanical tasks. This not only reduces labor costs for logistics companies, but also promotes the innovation of production tools, basic equipment and labor in the logistics industry.

2.2. Intelligent allocation of logistics resources

Inventory management and warehouse location are two important resource allocation links in the logistics industry. Scientific inventory management and warehouse location can greatly reduce the waste of resources of the enterprise. One of the earliest applications of artificial intelligence technology in the logistics industry is inventory management. Through the analysis of historical sales data, companies can dynamically adjust inventory levels in a timely manner, so that corporate inventory can circulate in an orderly manner. In terms of warehouse site selection, according to the different constraints of the real environment, artificial intelligence can integrate factors such as the geographical location of customers, suppliers, and manufacturers, scientifically select sites, and provide enterprises with optimized solutions to avoid human interference. Minimize business costs.

2.3. Intelligent optimization of logistics links

Through the operation of the intelligent logistics system, the logistics industry's front-end warehouse site selection, mid-end logistics cloud platform and other technical management, as well as the operation of smart equipment, terminal information and data analysis and market forecasting will be scientifically planned. Artificial intelligence enables intelligent planning, intelligent analysis and forecasting, intelligent warehousing, intelligent packaging, intelligent transportation, and intelligent loading and unloading by empowering all links and fields of logistics. Based on this, this paper proposes the following research hypotheses.

Hypothesis H1a: Artificial intelligence has a significant positive effect on the total factor productivity of the logistics industry.

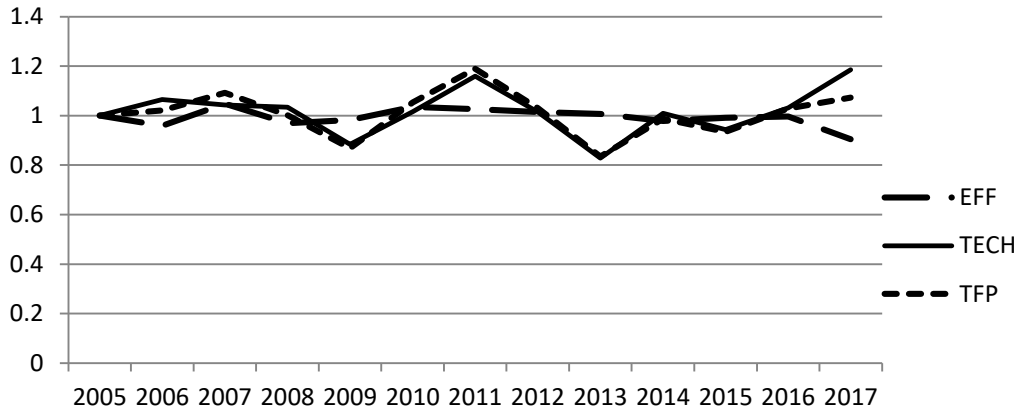

Figure 2 The growth trend of the total factor productivity index of the logistics industry

In order to judge the internal power of artificial intelligence on the total factor productivity of the logistics industry, we need to analyze whether the total factor productivity of my country's logistics industry is dominated by technological progress or technological efficiency. This paper uses the input-output data of China's 30 provinces' logistics industry from 2005 to 2017, and uses the DEAP2.1 software to calculate the Malmquist productivity index for each province from 2005 to 2017. As can be seen from the figure 2, the total factor productivity index (TFP) broken line and technology the change trend of the Progressive Change Index (TECH) is basically consistent. It is initially available that the total factor productivity growth of China's logistics industry during the period 2005-2017 was mainly driven by technological progress. Based on this, this paper proposes the following research hypotheses.

Hypothesis H2a: The growth of total factor productivity in China's logistics industry is driven by technological progress, and artificial intelligence can significantly positively promote technological progress in the logistics industry.

3. EMPIRICAL RESEARCH

3.1. Model setting

This article refers to the mathematical model above and the practice of Guo Jiatang and Luo Pinliang (2016) to construct the following regression model to examine the impact of the development level of artificial intelligence on the total factor productivity and technological progress of the logistics industry. The model is as follows:

$$Y = \beta_0 + \beta_1 AI_{i,t} + \beta_c CV_{i,t} + f_i + \varepsilon_{i,t} \quad (1)$$

3.2. Variable setting

3.2.1. The explained variable

At present, my country's definition of the logistics industry is not clear. Given that the added value of my country's transportation, warehousing and postal industry accounts for more than 80% of the total value added of the logistics industry, this industry is highly representative. Warehousing and postal industry data instead of logistics industry data for analysis. The explained variable in this article is the total factor productivity of the logistics industry, which is calculated by the Malmquist-DEA index method.

3.2.2. Core explanatory variables

This article refers to the practice of Cai Xiao and Huang Xumei (2019), and selects the reciprocal of the digital equipment capital price index of each province in each year to reflect technological progress, that is, the development level of artificial intelligence.

3.3. Analysis of empirical results

The use of ordinary standard deviation in the calculation will cause the significance of the result to be overestimated. In order to improve the accuracy of the analysis, this paper uses the clustering robust standard deviation. The models (1)-(3) in Table 1 are the results of using Stata14 software to estimate the sample data based on the measurement model constructed by the formula (1). Model 1 uses the total factor productivity index as the explained variable, only adding the artificial intelligence level variable, it can be found that the regression coefficient of AI is 1.389, and it is

significant at the 1% significance level, indicating that the improvement of artificial intelligence technology is beneficial to the logistics industry The increase in total factor productivity, columns (2) and (3) are fixed-effects and random-effects models respectively. Model (4) and Model (5) use the logistics industry's technical efficiency index and technological progress index as the explained variables to test the ways in which artificial intelligence affects them. The regression results show that the effect of artificial intelligence on the technical efficiency of the logistics industry is not significant, but it has a significant promotion effect on technological progress. The coefficient is 2.403, and it is significant at the level of 1%. And the substitution of brainpower has significantly promoted the technological progress of the logistics industry.

Table 1. Benchmark regression results

	Dependent variable				
	TFP			EFF	TECH
Independent variable	(1)	(2)	(3)	(4)	(5)
L2.AI	1.389***	2.114***	1.929***	-0.297	2.403***
	(3.53)	(4.81)	(4.19)	(-0.92)	(9.09)
N	330	330	330	330	330
R2	0.0514	0.1835	0.1753	0.0548	0.3419

Note: *, **, *** indicate that the significance test at the 10%, 5%, and 1% levels has been passed, and the values in parentheses are their corresponding t-values

4. CONCLUSIONS

Artificial intelligence has a significant positive impact on the total factor productivity of my country's logistics industry, that is, the development of artificial intelligence can promote the development of the logistics industry, and this promotion shows obvious lagging characteristics; at the same time, the total factor productivity is decomposed to obtain technology the efficiency index and the technological progress index are respectively and it is found that artificial intelligence has a significant positive impact on the technological progress of the logistics industry, while the development of artificial intelligence promotes the technological progress of the logistics industry, and artificial intelligence has no significant impact on the technical efficiency of the logistics industry. Based on this, we can come to the conclusion that artificial intelligence promotes the overall total factor productivity of the logistics industry by promoting technological progress in the logistics industry.

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