Research on the Impact of the Development of Artificial Intelligence on the Share of Labor Income

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Abstract—Based on the data from China Statistical Yearbook and the official website of the National Bureau of statistics, this paper uses the Panel data regression and quantile regression method to research the influence of the advancement degree of artificial intelligence on the share of labor income from 2005 to 2017. The results indicate that the negative effect of artificial intelligence advancement degree on labor income share is not significant, but there are differences in the impact of artificial intelligence development level on labor income share at different labor income share levels. Considering the regional heterogeneity, subsamples of Beijing Tianjin Hebei, Yangtze River Delta, and Pan-Pearl River Delta with different levels of artificial intelligence development are selected to study the impact of artificial intelligence on labor income share. The test results show that there are significant differences in the influence of the advancement degree of artificial intelligence on the share of labor income in different regions.

Keywords- Artificial Intelligence; Share of labor income; Panel data regression; Quantile regression

1 INTRODUCTION

In the process of the development of the world economy and the economies of various countries, technological progress goes hand in hand, explodes intensively in a revolutionary way, and has a significant effect in promoting economic growth. Artificial intelligence technology is a strategic technology that can lead a new round of scientific and technological revolution and industry innovation. Accelerating the improvement of a new generation of artificial intelligence technology is one of the most important things for China. The state attaches great importance to the improvement of artificial intelligence technology, issues a number of artificial intelligence policies and plans, seizes the significant strategic opportunities, and constructs the first-mover advantage of the improvement of artificial intelligence technology in China. In 2016, the NDRC, the Ministry of science and technology, the Ministry of industry and information, and the central network office jointly issued the "Internet plus" three-year action plan for artificial intelligence, which focused on promoting the core technology of artificial intelligence. In 2017, China issued the development plan for a new generation of artificial intelligence, which raised artificial intelligence to a national strategic level. The release of the three-year action plan for improving the advancement of a new generation of artificial intelligence industry (2018-2020) makes a clear

plan for the important development objectives and directions of artificial intelligence. At present, the industry of artificial intelligence in China has developed rapidly, and the scale of the core industry has reached 325.1 billion yuan [1]. Since 2014, the financing scale of the artificial intelligence industry has been expanding, from 10.6 billion yuan in 2014 to 140.2 billion yuan in 2020[2], attracting a large amount of capital. Artificial intelligence technology is rapidly integrating with all walks of life, contributing to the transformation and upgrading of traditional industries, improving quality and efficiency, and providing new momentum for China's high-quality economic development. However, the last round of revolution in scientific and technological resulted in a general decline in the share of global labor income and a significant increase in income inequality in major economies. As a strategic technology of the new round of scientific and technological revolution, will the mushroom growth of artificial intelligence aggravate the reduction of labor income share? Based on the policy and practical background of the prompt advancement of artificial intelligence, this paper uses the data of China Statistical Yearbook and the National Bureau of statistics to study the impact of the advancement degree of artificial intelligence on the share of labor income, on the premise of exploring the path to achieving higher quality employment under the background of the advancement of artificial intelligence and accelerating the upgrading of industrial intelligence, it has important practical significance in adjusting income distribution and promoting shared development.
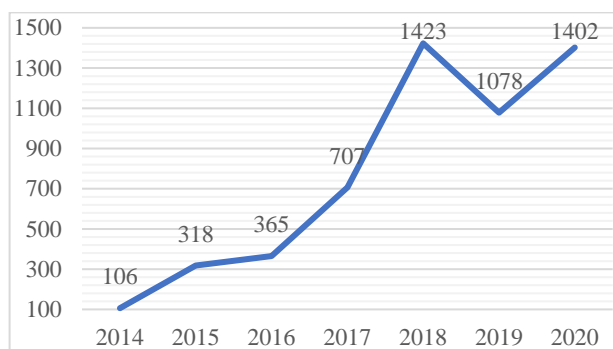
Figure 1. Financing scale of China's artificial intelligence industry from 2014 to 2020 (unit: 100 million yuan)

Data source: AI media data center

2 LITERATURE REVIEW

The existing research on the influence of the advancement degree of artificial intelligence on labor income share mainly uses enterprise-level data and interprovincial panel data as samples. When measuring the advancement degree of artificial intelligence, the total investment in fixed assets in some industries which includes information transmission, computer services, and software industry are mostly selected (MA Guowang and Li Baoyao, 2021; CAI Xiao and Huang

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[1] Shenzhen Artificial Intelligence Industry Association: 2021 white paper on artificial intelligence development.
[2] AI media data center: Analysis on the development status, industrial scale and future development trend of artificial intelligence in China in 2020.

Xumei, 2019; Shen Shang, 2020; Yu Boyang, 2020) [1] - [4], and the number of authorized artificial intelligence invention patents (Chao Xiaojing and Zhou Wenhui, 2021; Peng Daiyan et al., 2021; Deng Xiang and Huang Zhi, 2019) [5] - [7], Industrial robot density (Yu Lingzheng et al., 2019) [8] and regional equipment capital price index (Fu Wenyu et al., 2020) [9]. Some pieces of literature also select indicators such as the application of industrial robots, the proportion of long-distance optical cable lines, the proportion of smartphone users, and the proportion of Internet users to comprehensively measure the development level of artificial intelligence [10]. Existing studies mostly measure the share of labor income by using the proportion of labor remuneration in GDP (Wu Yang, 2019; Xue Ying, 2021) [11], [12], and the factor method is also used to measure the share of labor income (Lu Tingting and Zhu Zhiyong, 2021) [13].

In terms of methods, many studies have set up basic panel regression models for analysis (Yu Lingzheng et al., 2019; Lu Tingting and Zhu Zhiyong, 2021) [8], [13], and some pieces of literature choose the PSM-DID model, PVAR model, and spatial econometric model to analyze the influence of the application of artificial intelligence on labor income share (Wu Yang, 2019; Ma Guowang and Li Baoyao, 2021; Xue Ying, 2021) [11], [1], [13]. It is found that the application of artificial intelligence significantly reduces the share of labor income (MA Guowang and Li Baoyao, 2021; Chao Xiaojing and Zhou Wenhui, 2021; Lu Tingting and Zhu Zhiyong, 2021; Chen Lifeng and Zhong Yuting, 2020) [1], [5], [13], [14]. Other studies have shown that the share of enterprises' labor income can be significantly promoted by the application of artificial intelligence (Wu Yang, 2019) [11]. Heterogeneity analysis indicates that the development of artificial intelligence has a more significant effect on the share of labor income in the western region (Chao Xiaojing, Zhou Wenhui, 2021; Lu Tingting and Zhu Zhiyong, 2021; Xue Ying, 2021) [5], [13], [12], and has a greater inhibitory effect on non-technology intensive areas (Chao Xiaojing, Zhou Wenhui, 2021) [5].

3 RESEARCH DESIGN

3.1 Variables

The explained variable is the share of labor income (LS). According to the existing literature, it is measured by the proportion of labor remuneration in regional GDP [12].

The explanatory variable is the development level of artificial intelligence (AI). According to the existing literature, it is expressed by the proportion of the total investment in fixed assets in some industries, including information transmission, computer services, and software industry in the regional GDP [1].

According to the relevant research on the factors which influence the share of labor income, this paper selects economic development level (PGDP), the degree of government intervention (GOV), industrial structure (INS) [15], and tax burden level (TAX) [13] as the control variables. The fiscal expenditure accounts for the proportion in regional GDP that can be used to measure the degree of government intervention, GDP per head can be the tool to measure the level of economic development, the added value of the secondary industry accounts for the proportion in regional GDP can describe the industrial structure [15], and the proportion of government tax revenue in regional GDP can describe the tax burden level [13].

3.2 Model Establishment

This paper sets the following basic panel regression model for estimation:

$$LS_{i,t}=\alpha_0+ \alpha_1 AI_{i,t}+ \Sigma\beta*Control_{i,t}+ \gamma_i+ \varepsilon_{i,t}$$

$LS_{i,t}$ represents the labor income share of region i in period t, $AI_{i,t}$ represents the development level of artificial intelligence in region i in period t, $Control_{i,t}$ represents the collection of all control variables, γ_i is an individual fixed effect, and $\varepsilon_{i,t}$ is a random disturbance term. The estimated coefficient α_1 of the advancement level of artificial intelligence $AI_{i,t}$ is attached to great importance in this paper.

In order to describe the change of marginal effect of artificial intelligence in the change of labor income share, this paper uses a panel quantile model for parameter estimation. The panel quantile regression model regards the explained variable as a function distribution and estimates the influence of the explained variable at different quantiles of the explained variable according to the summation of the absolute value of the minimized weighted residual. In this paper, the panel quantile model is used for estimation, and the specific form is as follows:

$$LS_{it\,|\,\tau}=\alpha_{0\tau}+ \alpha_{1\tau}AI_{it\,|\,\tau}+ \Sigma\beta^{\tau}*Control_{it\,|\,\tau}+ \gamma_{i\,|\,\tau}+ \varepsilon_{it\,|\,\tau}$$

The subscript ｜τ indicates the quantile, $\tau\in$ (0.25, 0.50, 0.75, 0.90).

3.3 Data

The panel data studied in this paper includes 31 provinces, cities, and autonomous regions, with a period of 2005-2017. The data is from China Statistical Yearbook and the official website of the National Bureau of statistics. Due to the lack of workers' compensation data in 2008 and 2013 in China Statistical Yearbook, this paper uses the average of previous and subsequent years to fill in. Descriptive statistical results are shown in Table 1.

Table 1 Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
LS	403	0.489	0.057	0.343	0.635
AI	403	0.009	0.006	0.000	0.051
GOV	403	0.246	0.188	0.080	1.379
TAX	403	0.076	0.030	0.030	0.200
PGDP	403	4.498	0.277	3.703	5.111
INS	403	0.434	0.085	0.054	0.620

4 EMPIRICAL ANALYSIS

4.1 Benchmark Regression Results

This paper studies the impact of the advancement degree level of artificial intelligence on labor income share by regression of panel data. Table 2 indicates the benchmark regression results.

The estimated coefficient of artificial intelligence which influences the share of labor income is -0.068, which shows that the advancement of artificial intelligence technology will be responsible for the decline of labor income share to some extent; R^2 is 0.266, and the F value of the model is 26.659, which is significant at the level of 1%. In the sample interval, the improvement of artificial intelligence technology has an inhibitory effect on the share of labor income. As the advancement of artificial intelligence is a gradual process, the initial stage of development is mainly manifested in the intensification of capital deepening, the substitution effect and squeeze effect on the labor force are dominant, showing the result of "machine replacement", which brings about the decline of the labor income share. Among the control variables, the degree of government intervention, the level of the tax burden, and industrial structure have a negative effect on the labor share, but they are not significant, indicating that the increase of government expenditure, tax, and the added value of the secondary industry has an inhibitory effect on the share of labor income, resulting in the decline of the share of labor income; the estimated coefficient of economic development is significantly positive, which indicates that the promotion of economic development level can elevate the increase of the labor share.

Table 2 Benchmark Regression Results

Variable	Coef
AI	-0.068
	(0.257)
GOV	-0.003
	(0.031)
TAX	-0.042
	(0.142)
PGDP	0.033***
	(0.009)
INS	-0.247***
	(0.030)
Constant	0.452***
	(0.040)
Obs	403
R^2	0.266
F-Test	26.659

Note: standard errors are in brackets, ***, **, * respectively mean significant at the level of 1%, 5%, and 10%, the same below.

4.2 Quantile Regression Results

Table 3 reports the impact of artificial intelligence development level on labor income share at different labor income share levels. The results indicate that there are significant differences in the marginal effect of the advancement degree of artificial intelligence on the share of labor income at different levels. In each quantile, the estimated coefficients of the advancement degree of artificial intelligence which influence the share of labor income are negative, indicating that the advancement degree of artificial intelligence technology has an inhibitory effect on the share of labor income, and the absolute value of the coefficient shows a decreasing trend on the whole. With the increase of the quantile, the significance level gradually declines, and the higher the share of labor income, the weaker the marginal inhibitory effect of the advancement degree of

artificial intelligence on the share of labor income. Firstly, in each quantile, the regression coefficients of artificial intelligence on labor income share are negative, the estimation coefficients of 0.25 and 0.50 quantiles are significant at the level of 5%, and the estimation coefficients of 0.75 and 0.90 quantiles are not significant, which further shows that artificial intelligence has an inhibitory effect on labor income share. Secondly, the higher the quantile, the smaller the absolute value of the artificial intelligence estimation coefficient. The estimation coefficient of artificial intelligence decreased from -1.485 in the 0.25 quantile to -0.391 in the 0.90 quantiles. The main reason is that with the increase of the share of labor income, the employment creation effect of artificial intelligence is gradually released, the substitution effect and squeeze effect on the labor force are gradually weakened, and its negative impact on labor income share is continuously weakened.

From the estimation results of control variables, in all quantiles, the estimated coefficients of the degree of government intervention have a significant positive effect at the level of 1%, which indicates that the increase of the degree of government intervention can bring about the improvement of labor share; the estimated coefficients of tax burden level and industrial structure are negative, which are significant at the level of 1%. The improvement of tax level and the increase of the added value of the secondary industry have a significant inhibitory effect on the share of labor income.

Table 3 Quantile Regression Results

	0.25	0.50	0.75	0.90
AI	-1.485**	-1.009**	-0.293	-0.391
	(0.622)	(0.483)	(0.500)	(0.639)
GOV	0.119***	0.099***	0.091***	0.067***
	(0.020)	(0.016)	(0.016)	(0.021)
TAX	-0.502***	-0.763***	-0.805***	-0.757***
	(0.156)	(0.121)	(0.125)	(0.160)
PGDP	-0.031**	-0.015	0.006	-0.008
	(0.015)	(0.012)	(0.012)	(0.015)
INS	-0.363***	-0.370***	-0.279***	-0.346***
	(0.051)	(0.039)	(0.041)	(0.052)
Constant	0.782***	0.757***	0.654***	0.769***
	(0.067)	(0.052)	(0.054)	(0.069)
Mean dependent var	0.489		SD dependent var	0.057

4.3 Subregional Regression Results

From the regional heterogeneity regression results shown in Table 4, there are significant regional differences in the impact of artificial intelligence on labor income share. Artificial intelligence technology has a negative effect on the labor income share of Beijing, Tianjin and Hebei (BTH) and the Yangtze River Delta[3], which is significant at the level of 1%, and has a weak positive impact on the share of labor income in the Pan-Pearl River Delta[4]; Artificial intelligence has the

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3 The Yangtze River Delta region includes Shanghai, Zhejiang Province, Jiangsu Province and Anhui Province
4 The Pan Pearl River Delta region includes Fujian Province, Guangdong Province, Guangxi Zhuang Autonomous Region, Hainan Province, Guizhou Province, Hunan Province, Jiangxi Province, Sichuan Province and Yunnan Province

greatest negative impact on the share of labor income in Beijing, Tianjin and Hebei, followed by the Yangtze River Delta. The main reason for this difference is that the advancement degree of artificial intelligence is uneven in different regions. The economy of Beijing Tianjin Hebei and the Yangtze River Delta has developed rapidly, and the development level of artificial intelligence is relatively high. The era of rapid development of artificial intelligence has come, and intelligent equipment has replaced a large number of labor forces. However, artificial intelligence in some provinces of the Pan-Pearl River Delta is still in the stage of steady development or even earlier, so the inhibitory effect of artificial intelligence on the share of labor income in the Pan-Pearl River Delta is not significant.

Table 4 Heterogeneity Test

	BTH	the Yangtze River Delta	the Pan-Pearl River Delta
AI	-5.109***	-3.566***	0.273
	(1.413)	(0.963)	(0.713)
GOV	1.405***	0.524***	0.113
	(0.219)	(0.061)	(0.094)
TAX	-0.512*	-1.778***	-0.279
	(0.295)	(0.097)	(0.189)
PGDP	-0.140***	0.063***	0.022
	(0.038)	(0.011)	(0.016)
INS	-0.346***	-0.560***	-0.190**
	(0.113)	(0.052)	(0.092)
Constant	1.098***	0.524***	0.483***
	(0.103)	(0.055)	(0.076)
R-squared within	0.643	0.782	0.122

5 CONCLUSION

Using the data of China Statistical Yearbook from 2005 to 2017 and the interprovincial panel data on the official website of the National Bureau of statistics, this paper measures the impact of the advancement degree of artificial intelligence on the share of labor income. The results show that: (1) artificial intelligence has a negative impact on labor income share, but it is not significant; (2) The influence of artificial intelligence development level on labor income share is different at different labor income share levels. Artificial intelligence has a significant inhibitory effect on labor income share, and with the increase of labor income share, the marginal inhibitory effect of artificial intelligence application on labor income share is weaker; (3) There are significant regional differences in the influence of artificial intelligence technology on labor income share. The advancement and application degree of artificial intelligence has a significant inhibitory effect on the share of labor income in Beijing, Tianjin and Hebei, and the Yangtze River Delta, and has the greatest negative impact on the share of labor income in Beijing, Tianjin, and Hebei, followed by the Yangtze River Delta.

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