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Can Artificial Intelligence Boost Employment in Service Industries? Empirical Analysis Based on China

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ABSTRACT

Based on the provincial panel data of China during 2007–2020, this study examines the temporal and spatial dynamic characteristics of artificial intelligence (AI) development and service industry employment, using the fixed-effect model to analyze the influence mechanism of AI development on service industry employment. We analyzed the regional heterogeneity. The results revealed the following: (i) AI experts a direct and indirect impact on the service industry employment. The direct impact is manifested in the creation effect and substitution effect, while the indirect impact is manifested in the competition effect. These effects exert a positive and significant indigenous impact on the service industry employment: increasing the number of jobs, optimizing the employment structure, and increasing employment income; (ii) Subregional studies demonstrated that the impact of AI development on employment in services has regional heterogeneity, which is conducive to narrowing regional differences in services; (iii) Cross-industry studies reported that AI development has augmented cross-industry inflows of labor and increased job competition for medium-skilled labor. This study is utmost significance to improve the employment policy of China's service industry, optimize the training system of service talents, promote the upgrading of the service industry, and promote the synchronized development of the regional service industry.

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Introduction

Artificial intelligence (AI) is a technology science that takes computerized and automated equipment as the application carrier and uses big data, the Internet, modern scientific algorithms and other technologies to develop human abilities like perception, reasoning, learning, and decision-making to complete the set goals and tasks (Zhao and Liu 2020). AI is the leading force of the fourth technological revolution. AI development has brought remarkable changes to human economy and society, garnering wide attention. Scholars have explored the impact of AI development from various aspects, including the impact on

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labor employment. The studies claimed that AI development will affect the number, structure, and income of labor employment; these effects could be positive, such as creating new job needs and optimizing the labor structure (Zhu and Li 2018), although they could also be negative, such as resulting in employment "polarization," leading to income inequality (Calum 2016). In addition, some studies claimed that the impact of AI on employment is heterogeneous, affected by the characteristics and attributes of time and space, industry, and the impact on different regions and industries is different (Autor and Dorn 2013); thus, the research often analyzes a certain industry and region. However, limited by the field of AI application, this research focuses on the manufacturing industry, the service industry, as the main force absorbing the unemployed in the manufacturing industry, which is indirectly affected by AI. Nevertheless, during the global COVID-19 pandemic, AI is rapidly applied to various fields of the service industry, such as the medical field, where doctors use AI to conduct contactless COVID-19 detection. In the catering industry, hotels use intelligent robots to provide noncontact services such as reception and delivery. In education, schools use AI to execute online teaching. In public health, the government uses AI to monitor and track various epidemic information. The broad AI application has directly affected the service industry employment. These effects have both advantages and disadvantages, as they not only create new job demands, but also lead to the unemployment of some workers, increasing employment pressure, and causing structural contradictions in employment. Then, what is the impact of AI on employment in the Chinese service industry? In particular, is the impact of services in different regions heterogeneous? The answers to these questions are directly correlate with the AI application in China's service industry, as well as the employment direction and policies of service labor in the future. Thus, elucidating the impact mechanism of AI on the service industry employment and then precisely understanding and evaluating the impact of AI on the service industry employment in China will help people better discover and understand problems, formulate effective employment policies and mechanisms for service industry labor, optimize employment structure, alleviate employment conflicts, and promote the healthy and orderly development of China's service industry.

The Theoretical Framework, Hypotheses Development, and Literature

The Correlation between AI and Employment Quantity

Regarding the impact of AI on employment, the first concern is whether AI will decrease employment? Three different views exist on this issue. The first view emphasizes the substitution effect of AI, that the large-scale AI application will decrease employment and lead to extensive unemployment (Frank,

Autor, and Bessen et al. 2019). Nevertheless, it is also highlighted that AI cannot replace all the work, which primarily replaces the work with simple repeatability, high risk, or emphasis on accuracy and efficiency (Zhou 2017), while the work with human emotional communication characteristics (Qiu and He 2020) or unconventional cognition (Frey and Osborne 2017) is hard to be replaced. Others believe that the substitution effect of AI is not constant, the substitution effect of different industries in different periods is different (He 2019). Some studies even hold a positive attitude toward the substitution effect, claiming that in the context of population aging, the substitution of AI for labor is "complementary substitution" rather than "extrusion substitution" (Chen, Xu, and Zhou 2018).AI can enable workers to focus on more "advanced" jobs (Wilson and Daugherty 2018). The second view accentuates the creative effect of AI and believes that AI can increase new employment opportunities and total employment (Wang and Dong 2020). Usually, new employment opportunities correlate with AI, such as training, interpretation, and maintenance of AI. Nevertheless, some studies claimed that the newly created employment is low, which is insufficient offset the replaced employment (Jiang and Zou 2018). The third view claims that the substitution effect and creation effect of AI have a certain degree of mutual offsetting effect (Wu et al. 2019), so it might have no significant indigenous impact on employment (Arntz, Gregory, and Zierahn 2016).

Considering that China is still in the primary stage of AI development, the depth and breadth of the AI application remain insufficient, and the posts in the service industry are mainly emotional communication, which is inadequate to be replaced. Thus, we preliminarily believe that the substitution effect of AI on employment in the service industry has not been truly played, which is not enough to offset its innovative effect. Accordingly, the following hypothesis is proposed:

H1. AI development of can increase employment in the service industry.

The Correlation between AI and Employment Structure

Generally, the employment structure comprises skill structure, post structure, education structure, and age structure (Dong, Qiu, and He 2020), of which skill structure is the most concerned by scholars. Auto and Levy reported that technological progress would exacerbate the differentiation of high- and low-skilled labor, resulting in employment polarization (Autor, Levy, and Murnane 2003); this phenomenon also exists in the AI application. Reportedly, AI development has increased the demand for high-skilled labor, as the position of high-skilled labor is complex and difficult to replaced (Jiang and Zhang 2021), and AI development needs to match the high-skilled

labor. Meanwhile, AI development has worsened the employment environment of medium-skilled labor (Cao and Xu 2020), because AI has the strongest substitution effect for medium-skilled workers, which intensifies competition among medium-skilled workers and causes them to transfer to higher- or lower-skilled positions.

Thus, under the combined action of the creation effect and substitution effect, AI development of AI increases the demand for higher-skilled workers, decreases the demand for medium-skilled workers, and optimizes the employment structure. Accordingly, the following hypothesis is proposed:

H2. AI development can optimize the employment structure of the service industry.

The Correlation between AI and Employment Income

Regarding employment income, AI suggestively improves the labor income share of enterprises (Chen and Hu 2020), as well as aggravates the income gap between high-skilled and low-skilled labor (Pan 2019), expands the wage inequality based on educational returns (Jin et al. 2020) and the wage gap between industries (Autor and Dorn 2013), resulting in the income distribution skewed to highly educated and skilled labor groups (Brown and Campbell 2002). Nevertheless, some academics hold different opinions that the impact of the AI on wages depends on the correlation between the labor force and AI technology (Cai and Chen 2019); that is, it depends on whether AI develops an alternative relationship with the labor force, and when the degree of substitution of AI for labor force is higher and higher, the employment income increases first and then decreases (Hui and Jiang 2020).

Considering the reality of labor substitution in the service industry due to AI development in China, the following hypothesis is proposed:

H3. AI development can improve the income level of the service industry.

The Correlation between AI and Labor Mobility

Arguably, AI will promote the transfer of labor in different industries and regions, increase the employment of local downstream industries, other industries with high substitution of local labor, and the same industry in other places (Kong, Liu, and Kong 2020), creating differences in the speed and degree of employment structure change in different industries (Qiu and He 2020) . For example, numerous manufacturing personnel flow into traditional services, such as the wholesale and retail industry, thereby increasing the

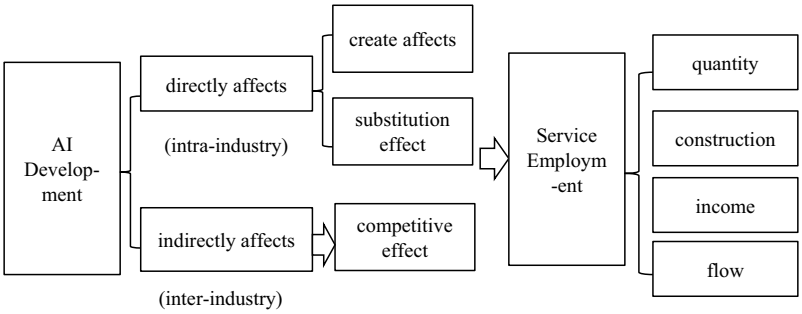

Figure 1. Mechanism of the impact of AI on employment in the service industry.

employment of traditional services. In addition, generates a group of knowledge- and technology-intensive modern service jobs within the service industry (Zhang, Li, and Liu 2020) to increase the employment share of knowledge and technology-intensive producer services and high-end services (Wang 2020).

The impact of AI on the service industry not only directly affects the industry but also indirectly affects manufacturing and other industries. These indirect effects not only create employment competition and pressure on the service industry but also satisfy the needs for talents in the new service industry. Accordingly, the following hypothesis is proposed:

H4. AI development can accelerate the cross-industry flow of labor.

The Impact Mechanism of AI on Employment in the Service Industry

Briefly, AI development exerts a direct impact on the employment quantity, structure, and income of the service industry, as well as an indirect impact on other industries such as the manufacturing industry. Figure 1 shows the influencing mechanism.

Research Methodology

Research Model

Based on the research of Acemoglu and Restrepo (Acemoglu and Restrepo 2020), we constructed model (1) to test the impact of AI on the number and structure of employment in the service industry and model (2) to test the impact of AI on the income level of the service industry.

$$LnEmp_{i,t} = \alpha_0 + \alpha_1 LnAI_{i,t} + \emptyset_1 X + \sigma_i + \gamma_i + \varepsilon_{i,t} \quad (1)$$

$$LnWage_{i,t} = \beta_0 + \beta_1 LnAl_{i,t} + \emptyset_2 X + \sigma_i + \gamma_i + \varepsilon_{i,t} \quad (2)$$

where,$Emp_{i,t}$ and $Wage_{i,t}$ denote the dependent variables; $Al_{i,t}$ denotes the independent variable; I is province; t is year,σ denotes province fixed effect; γ is year fixed effect; and ε represents the random error term.

$Emp_{i,t}$ is the service industry employment in province I in year t, which is denoted by the number of employees in the service industry at the end of year t in province i. To assess the impact of AI on the employment of different industries in the service industry, we adopted the practice of Wang (Wang 2020)-the services can be divided into high-end services and non-high-end services. The high-end services comprise information transmission, software and information technology services, finance, leasing and business services, scientific research, and technical services; the remainder are collectively referred to as non-high-end services. In addition, $Emp_{i,t}$ is divided into high-end services employment (Emp_1) and non-high-end services employment (Emp_2). Meanwhile, to examine the impact of AI on the employment structure of different skilled labor in the service industry, it will be categorized into high-skilled labor employment Emp_H (i.e., the proportion of labor with a bachelor's degree or above in the service industry), medium-skilled labor employment Emp_M (i.e., the proportion of labor with junior high school or below in the service industry) and low-skilled labor employment Emp_L (i.e., the proportion of labor with junior high school or below in the service industry).

$Wage_{i,t}$ denotes the t-year service income level in I province, expressed as the end-of-year average wage in I province.

$Al_{i,t}$ is the development level of AI in the service industry. Referring to Wang (Wang 2020), we measured the robot installation density of the service industry. The robot installation density of each province was calculated by the number of robot installations in the national service industry published by IFR and the number of employees in various industries in each province. The calculation formula is:

$$Al_{it} = \sum_{j=1}^{14} \left(E_{ijt} \times QAl_{jt}\right) / Emp_{it}$$

where, E_{ijt} denotes the share of employees in the j industry in I province in the total number of employees in the national j industry in t year; QAl_{jt} denotes the robot installations amount of industry j in China in year t ; Emp_{it} signifies the number of employees in all industries in province I in year t. To examine the indirect impact of AI development in the manufacturing industry on the service industry employment, Alm was used to represent the installation density of manufacturing robots, and the calculation formula was the same as above.

Table 1. Descriptive statistics of quantitative variables.

Variable	mean	Min	Max	S. Deviation
Emp	260.98	15.7	966.1	164.53
Emp_1	51	1.6	301.5	49.06
Emp_2	209.98	14.2	669.7	124.16
Emp_H	38.14	0.2	351.3	50.35
Emp_M	95.86	0.3	463	74.34
Emp_L	126.97	11.2	340.6	73.26
Wage	5.37	1.6	15.9	2.6
AI	1.25	0.3	3.6	1.17
AIm	10.23	0.7	28.6	10.12
size	8.87	0.2	59.8	9.19
pgdp	4.39	0.6	16.4	2.67
urban	53.76	22.61	89.6	14.28
inf	40.82	3.8	80.9	18.43

X signifies control variables. Combining with the viewpoints of Wang (Wang, Niu, and Sun 2020) and other scholars, we selected four control variables: (1) size, service industry scale, measured by the gross output value of the service industry in each province. Usually, the larger the industry size, the bigger the demand for labor. (2) pgdp, level of regional economic development, expressed as regional per-capita gdp (¥10,000/person); (3) urban, level of urbanization, expressed by the percentage of urban population at the end of each year; (4) inf, information level, expressed by province internet penetration rate. All variables were logarithmic for uniform dimension.

Descriptive Statistics

Considering the availability of robot installation data, we used panel data of 31 provinces and autonomous regions in China during 2007–2020 are used for analysis. The data were collected from the Tertiary Industry Statistical Yearbook, China Labor Statistics Yearbook, China Statistical Yearbook, China Internet Development Report and IFR report of the International Federation of Robotics. Table 1 presents the descriptive statistical values of national panel data.

Results

The Results of the Model

According to models (1) and (2), this part validates the impact of AI development on the number, structure, and income level of the service industry employment. Provinces and time factors were controlled for all models, and fixed-effect models were used for estimation. Table 2 reports the estimation results of the models.

Table 2. Basic regression result.

	Employment quantity			Employment structure			Employment income
	LnEmp	$LnEmp_1$	$LnEmp_2$	$LnEmp_H$	$LnEmp_M$	$LnEmp_L$	LnWage
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LnAI	0.163***	0.37***	0.401***	0.075*	−0.094*	−0.107	0.42***
	(0.046)	(0.06)	(0.057)	(0.047)	(0.056)	(0.108)	(0.023)
Lnsize	0.209***	0.048	0.123	0.241***	0.155*	0.153	0.053
	(0.072)	(0.094)	(0.09)	(0.074)	(0.088)	(0.169)	(0.037)
Lnpgdp	0.256***	0.033	0.271**	0.236***	0.281***	0.47***	0.098**
	(0.062)	(0.081)	(0.078)	(0.064)	(0.076)	(0.147)	(0.032)
Lnurban	−0.133	0.748***	−0.14	−0.065	−0.07	−.579**	0.392***
	(0.109)	(0.142)	(0.136)	(0.112)	(0.133)	(0.256)	(0.055)
Lninf	−0.267***	−0.172***	−0.321***	−0.224***	−0.15***	0.188**	0.036*
	(0.037)	(0.049)	(0.047)	(0.038)	(0.046)	(0.088)	(0.019)
Cons	0.669	2.837***	.083	0.268	−0.492	−1.72	9.787***
	(0.553)	(0.725)	(0.693)	(0.57)	(0.678)	(1.305)	(0.282)
Obs	434	434	434	434	434	434	434
R^2	0.9913	0.9929	0.9904	0.9901	0.9849	0.9793	0.994

The figures in brackets are heteroscedasticity robust standard errors, *, ** and *** represent significance levels of 10%, 5% and 1% respectively, the same below.

The Correlation between AI and Employment Quantity in the Service Industry

According to columns (1)-(3) of Table 2, the estimated coefficients of AI for Emp, Emp_1, and Emp_2 were significantly positive, suggesting that the current AI development in China promotes the service industry employment as a whole. Thus, H1 is verified.

This result suggests that the substitution effect of AI on employment in the service industry is weaker than that of compensation and creation. There are three reasons. First, it is owing to the characteristics of the service industry. Unlike the manufacturing industry, most jobs in the service industry are characterized by human emotional communication, demanding direct communication between people; thus, the substitution effect of AI is relatively low. Second, AI compensates for reducing jobs owing to the substitution effect by expanding the employment demand of the services industry. On the one hand, the AI application can alleviate the information asymmetry of the service industry, decrease transaction costs, optimize resource allocation, and then enhance production efficiency, decrease the price of service products, stimulate social demand and drive the demand for jobs. On the other hand, AI promotes economic development, improves residents' income level, and gives people more leisure time (Yang 2021), which increases the social demand for leisure, entertainment, healthcare, and other service products and drives the demand for related jobs. Third, AI not only creates new business forms and models of service industry, but also brings a large number of new jobs and increases new demand for jobs. It also empowers the traditional service industry, promotes the transformation and upgrading of the traditional service

industry, increases the intelligent, high-end and personalized needs of the service industry, further refines the work tasks, and generates new demand for segmented posts.

Regarding industry-specific impact, non-high-end services are marginally more affected by AI development (0.40) than high-end services such as information transmission, software and information technology (0.37), owing to the low employment threshold of non-high-end services and their easier acceptance of labor outflows from other industries.

The Correlation between AI and Employment Structure in the Service Industry

As shown in Table 2, columns (4)–(6), the estimation coefficient of AI development Emp_H was significantly positive, but the estimation coefficient of Emp_M was significantly negative, and the estimation coefficient of Emp_L was negative, but not significantly indigenous, indicating that AI development exerts different effects on different skill levels of labor in China's service industry. It improves the employment level of high-skilled labor, but decreases the employment level of low-skilled labor and optimizes the employment structure of service industry as a whole. Hence, H2 is verified.

Although AI development has improved the employment structure of China's service industry, there is no theoretical employment "polarization" phenomenon nationwide. There are two reasons. First is related to the development stage of AI. AI is still in the early stage of development, and its application in China's service industry is limited in scope and depth, and its substitution effect on low-skilled labor has not yet been fully played. Second, related to the industry characteristics of the service industry, the work of the service industry is mostly based on people, people need to directly participate in emotional communication and exchange, with certain irreplaceable. However, notably, AI, such as service robots, has extended tasks to reception and communication and has begun to challenge work characterized by emotional communication, which will exert a negative impact on the employment level of low-skilled labor in the service industry.

Moreover, the employment structure is the result of the combined effect of labor demand structure and supply structure (Pan 2018). Although AI upgrades the employment structure of the service industry, it also creates a contradiction between supply and demand of employment. Society increases the demand for high-skilled labor in the service industry, but its supply is inadequate, resulting in the "supply shortage of high-skilled labor." In contrast, the substitution effect of AI has led to an increase in unemployment, "oversupply" and more intense job competition among low-skilled labor. If this contradiction cannot be solved, it will cause serious social contradictions.

The Correlation between AI and Employment Income in the Service Industry

As shown in column (7) of Table 2, the estimated coefficient of AI development level on Wage is significantly positive, suggesting that AI development improves the income level of China's service industry. Consequently, H3 is established. There are two reasons: (i) AI improves the production efficiency of service industry, expands production capacity, increases the total output, and then improve the income level of the service industry; (ii) AI development increases the skill requirements for the workforce in the service sector and improves the overall quality of the workforce, matched by a corresponding increase in income levels.

However, this does not mean that the income levels of workforce in different skills and positions have increased to the same extent, and further analysis is needed in conjunction with the specific workforce.

Robustness Test

To test the robustness of the benchmark regression results, we referred Sun and Hou (Sun and Hou 2019), and replaced the measurement indexes of explained variables and explanatory variables. The development level of the AI index denotes the practice of Yu (Yu 2020), and uses the logarithmic representation of the total social asset investment of information transmission, software and information technology services.

Considering that fixed-asset investment has a certain cycle from production to use, we used the lag data to test. The explained variable service employment-related indicators were replaced by the growth rate of regional service employment-related indicators.

Robust regression results (Table 3) showed that AI development exerted a significant positive impact on the overall employment level of China's service industry and the employment level of non-high-end services. In addition, it exerted a significantly positive impact on the employment of high-skilled labor and labor income level in the service industry, but a significantly negative effect on the employment of medium-skilled labor, aligning with the basic regression estimation result, and further verifying H1–H3.

Table 3. Estimated results of robustness test.

	Employment quantity			Employment structure			Employment income
	LnEmp	$LnEmp_1$	$LnEmp_2$	$LnEmp_H$	$LnEmp_M$	$LnEmp_L$	LnWage
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LnAI(−1)	2.4*	4.44	2.242*	3.565*	−4.53**	0.691	0.011**
	(1.3)	(2.78)	(1.215)	(2.7)	(2.283)	(1.316)	(0.004)
Cons	42.37	346.4*	−10.45	58.67	77.14	−7.37	9.47***
	(83.02)	(177.9)	(77.64)	(172.5)	(145.9)	(84.1)	(0.272)
Obs	434	434	434	434	434	434	434
R^2	0.9937	0.9528	0.9239	0.9755	0.9354	0.9435	0.9941

Regional Heterogeneity Analysis

Arguably, AI development is conducive to improving the employment number and income level of China's service industry, optimizing the employment structure, and the conclusions are very stable. Thus, will AI development have the same impact on the number, structure, and income of service employment in different regions of China? To further validate whether differences exist in the impact of AI development on service industry employment in different regions of China, we divided 31 provinces and autonomous regions of the country into three major regions: the eastern, central, and western regions. After controlling factors such as size,pgdp, urban and inf, the subsample regression is carried out. The regression estimation results are shown in Table 4.

Table 4 shows that the impact of AI development on the eastern, central and western region of China is different, presenting regional heterogeneity.

Regarding employment quantity, the service industry in the eastern region was significantly positively affected by AI development, especially high-end services such as information transmission, software, and information technology. When the development level of AI increased by 1%, its employment increased by 0.439%. In the central region, the non-high-end services, such as wholesale and retail industries, were primarily affected AI development, with an impact degree of 0.254, while the high-end services were not affected significantly. Although the service industry in the western region is significantly positively affected by AI development, the impact of AI on its specific industries is not significant.

The main reasons for such differences are as follows. First, owing to the unbalanced economic development level in the eastern, central, and western regions, the eastern region, with a relatively developed economy has a higher degree of acceptance and AI application, leading to a higher level of AI development than that in the central and western regions (Figure 2), and the impact of AI on its employment is more apparent. Second, owing to the

Table 4. Regional regression results.

		Employment quantity			Employment structure			Employment income
Region	Variable	LnEmp	$LnEmp_1$	$LnEmp_2$	$LnEmp_H$	$LnEmp_M$	$LnEmp_L$	LnWage
eastern	LnAI	0.200***	0.439***	0.397***	0.152**	−0.026	0.074*	0.346***
		(0.061)	(0.112)	(0.107)	(0.061)	(0.104)	(0.104)	(0.033)
	Obs	168	168	168	168	168	168	168
	R^2	0.994	0.994	0.989	0.993	0.984	0.985	0.997
central	LnAI	0.087	0.148	0.254**	0.041	−0.122	−0.02	0.551***
		(0.094)	(0.12)	(0.119)	(0.094)	(0.121)	(0.135)	(0.046)
	Obs	126	126	126	126	126	126	126
	R^2	0.976	0.969	0.962	0.976	0.996	0.966	0.996
western	LnAI	0.238*	0.217	0.209	0.234*	−0.06	1.01***	0.319***
		(0.138)	(0.163)	(0.153)	(0.142)	(0.15)	(0.322)	(0.066)
	Obs	140	140	140	140	140	140	140
	R^2	0.991	0.99	0.991	0.99	0.996	0.966	0.992

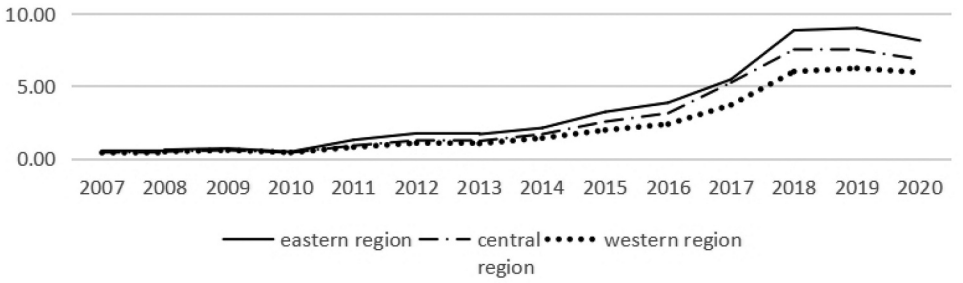

Figure 2. Changes in the development level of AI in the eastern, central and western China.

different development level and industry structure of the service industry in the eastern, central, and western regions, the development level of the service industry in the eastern region was higher, and has more advantages in high-end services (Figure 3), while the development level of the service industry in the central and western regions was relatively weak, and the central region had a comparative advantage in non-high-end services. Therefore, the difference in the development led of the service industry in different regions leads to different effects of AI on employment.

Regarding the employment structure, the labor of different skill levels in the eastern and western regions was equally affected by AI development, exhibiting a U-shaped feature, while the impact of labor in the central region was not obvious, showing that the impact of AI on the skill structure of service labor was heterogeneous, which was affected by various factors such as the development level of AI in different regions, the structure of the service industry, the quality of labor, and the mobility obstacle.

The eastern region is rich in labor resources with high overall quality (Figure 4), with relatively low labor flow barriers between industries and regions. Thus, the structure of demand and supply can be well matched, and the employment structure has been improved significantly. The central region is dominated by non-high-end services, such as transportation. As the employment substitution effect and creation effect of AI on these industries are

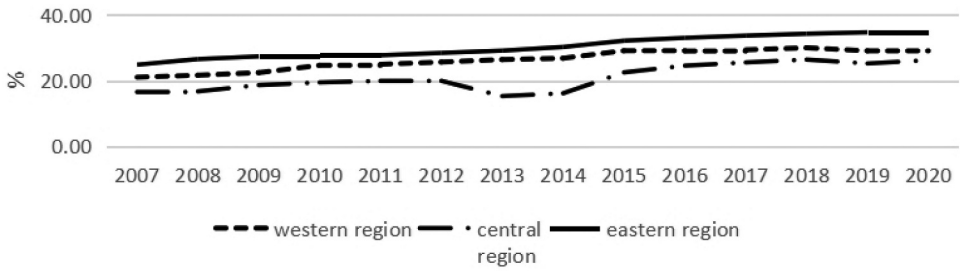

Figure 3. Ratio of high-end services output value to the total service industry output value in the eastern, central and western China.

Figure 4. Proportion of labor force with different skills in China's service industry in 2020.

unclear, so the impact on employment structure is not apparent. Although the development level of AI in the western region is relatively low, the proportion of high-end services is relatively high and on an upward trend (Figure 3), and its geographical location is relatively remote from the eastern and central region, with a relatively large outflow barrier of talents. Thus, AI development can markedly affect its employment structure.

Regarding employment income, the eastern, central, and western regions were significantly positively affected by AI, but the degree of impact was marginally different. The central region was the highest affected, with an impact coefficient of 0.551. The western region was the lowest affected, with an impact coefficient of 0.319, showing that AI development can narrow the income gap of the service industry between regions, decrease the outflow rate of service talents in central and western regions, improve the attraction rate, and then narrow the regional difference of service talents, and promote the coordinated development of China's service industry.

Further Analysis of the Influencing Mechanism: A Cross-industry Analysis

As the main channel to absorb the employment of the manufacturing labor, the service industry is also indirectly influenced by AI development in the manufacturing industry. Then, what is the effect of indirect influence under the current development level of AI? To answer this question and elucidate the impact mechanism of AI on the service industry employment, we took Alm as the core explanatory variable after controlling the four factors of size,pgdp, urban and inf,and substituted it into models (1) and (2) for regression analysis. Table 5 shows the estimation results.

The results showed that the development of manufacturing AI exerted a significant positive impact on the overall service industry employment, suggesting that the development of manufacturing AI indirectly improved the overall service industry employment. There are two reasons) the intelligent development of the manufacturing industry improved the production

Table 5. Impact of AI development in the manufacturing on employment in the service industry.

	Employment quantity			Employment structure			Employment income
	LnEmp	$LnEmp_1$	$LnEmp_2$	$LnEmp_H$	$LnEmp_M$	$LnEmp_L$	LnWage
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LnAIm	0.112***	0.255***	0.276***	0.052	−0.065*	−0.073	0.289***
	(0.138)	(0.041)	(0.039)	(0.032)	(0.039)	(0.074)	(0.016)
Cons	0.483	2.414***	−0.375	0.182	−0.385	−1.601	9.307***
	(0.525)	(0.049)	(0.658)	(0.541)	(0.644)	(1.239)	(0.019)
Obs	434	434	434	434	434	434	434
R^2	0.991	0.993	0.99	0.990	0.985	0.979	0.994

efficiency, raised the income level of workers, and gave them more leisure time, which led to the increase in the demand for social service products, and then the demand for service labor. (ii) The AI application in the manufacturing industry accelerated the cross-industry flow of labor, and the surplus labor diverted from manufacturing flew into the service industry, increasing the supply of service labor. Hence, H4 is verified.

Second, in terms of the industrial structure, the employment of high-end services and non-high-end services are both positively and significantly affected by AI development in the manufacturing industry, but the non-high-end services was more affected, and the influence coefficient was 0.276, suggesting that the labor force from the manufacturing industry flows to various industries in the service industry. Nevertheless, owing to the difference in the employment threshold of the industry, the labor force from manufacturing industry flows more into non-high-end services such as wholesale and retail industry.

Finally, regarding the employment structure, AI development in the manufacturing industry exerted a negative and significant impact on the medium-skilled labor in the service industry, but no significant impact on other skilled labor, showing that the separated labor was largely medium-skilled. They aggravated the competition of medium-skilled posts in the service industry, further deteriorating the employment environment of medium-skilled labor in the service industry.

Conclusions and Discussion

Conclusions

The impact of AI development on employment in the service industry includes direct and indirect impact. The direct impact is creation effect and substitution effect, while the indirect impact is competition effect. As AI development in China is still in the initial stage, AI cannot completely replace the work tasks with emotional characteristics in the service industry; thus, its substitution effect has not been fully played, resulting in a significant promotion of employment in general.

The impact of AI on employment in China's service industry is not only regional heterogeneity, but also industry heterogeneity. First, in terms of the overall employment numbers structure and income level, both eastern and western regions are positively and significantly affected by AI, while the central region is not. Second, in terms of specific industries, the eastern region is primarily affected by high-end services, such as information transmission, software and information technology, while the central region is mostly affected by non-high-end services such as wholesale and retail, while the western region exerts no obvious influence on industries.

AI development accelerates the flow of labor across industries. The AI application leads to a large number of manufacturing surplus labor flowing into the service industry, and mainly into the wholesale, retail, and other non-high-end services. Moreover, because they are mostly medium-skilled labors, the competition for medium-skilled jobs in the service industry is intensified and the employment environment for medium-skilled labors is worsened.

AI development is conducive to narrowing the regional gap in service talents. Although the service industry in the eastern region has obvious advantages in AI development and the quality of labor force, AI development has also improved the income level of the service industry in the central and western regions, narrowed the regional gap in service income, decreased the outflow rate of service talents in the central and western regions, and improved the attraction rate, which is conducive to narrowing the regional gap of service talents.

Discussion

This study suggests improving the service personnel training system and optimizing the service personnel structure. Considering the "supply demand mismatch" problem of the service industry employment due to AI development, the government, universities, enterprises, and other organizations should formulate policies and take measures per the new job requirements. First of all, from the top-level design, on the one hand, the government promulgates preferential policies and measures related to AI talents training to guide the direction of service talents training on the whole. Conversely, we should focus on the reemployment of the replaced labor, provide preferential policies, and support policies for reemployment, and avoid social contradictions due to a large number of unemployment. Second, colleges and universities should promote educational reform, improve talent training programs according to social needs, and reinforce university-industry cooperation, cultivate new service talents to truly fulfil the needs of AI society, and make up the shortage of supply. Finally, service enterprises can improve their employees' knowledge and abilities by

providing vocational training and continuing education for new positions, so that they can better adapt to the requirements of new positions in the era of AI.

In addition, seize the development opportunity of AI to optimize the structure of China's service industry. The positive impact of AI on employment of high-end services should be used to improve its industrial output value and efficiency and increase the proportion of high-end services. Moreover, AI application in non-high-end services should be expanded and deepened to promote the intelligent and advanced development of non-high-end services to optimize the structure of China's service industry and promote the transformation and upgrading of the service industry.

Furthermore, encourage the cross-regional flow of AI service talents and promote the synchronized development of the service industry among regions. The government establishes a sound cross-regional flow policy of AI talents in the service industry from a macro-perspective, providing institutional guarantee for the cross-regional flow of talents in the service industry. Besides, it is crucial to vigorously fortify the exchange and cooperation of AI talents in the service industry in the eastern, central and western regions. The eastern region should help the central and western regions to improve the AI skills of labor force in the way of talent transfer, expert guidance, exchange, and learning, so as to narrow the regional gap and promote the coordinated development of China's service industry among different regions.

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