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Original article

The impact of industrial labour productivity on regional income differences in China

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Abstract. Since China's reform and opening up, the eastern coastal areas have taken the lead in development, and formed significant regional development differences. One of the major reasons for the differences is the significant differences in industrial labour productivity between different regions. The purpose of this report is to examine the impact of industrial labour productivity on regional income differences, clarify its impact mechanism, and provide recommendations for regional coordinated development. This report adopted a combination of quantitative and qualitative analysis. It used a regression model to examine the impact of industrial labour productivity on regional income differences in China, and made qualitative analysis to explain the impact mechanism. Through relevant analysis, this report mainly concluded three findings. Firstly, there are significant differences in industrial labour productivity between regions in China. Secondly, industrial labour productivity is proved to be an important factor affecting regional income differences in China. Thirdly, the Chinese government needs to narrow the gap in regional industrial labour productivity from multiple aspects, such as increasing human capital, strengthening technological innovation, optimising the market and institutional environment, improving the incentive mechanism, etc. The research significance of this report lies in verifying the impact of China's industrial labour productivity on regional income differences, and deeply analysing its impact mechanism. This has important policy implications for narrowing regional income differences in China.

Keywords: China's industrial labour productivity, regional income differences, regression analysis, impact mechanism, recommendations

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Влияние производительности труда в промышленности на региональные различия в доходах в Китае

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Аннотация. После реформ и открытости восточный прибрежный регион Китая занял лидирующее положение в развитии, что привело к значительным различиям в региональном развитии. Одной из важных причин этих различий является существенная разница в производительности труда в промышленности между различными регионами. В статье рассматривается влияние производительности труда в промышленности на региональные различия в доходах, выясняется механизм ее влияния и предлагаются меры по скоординированному региональному развитию. В исследовании использовано сочетание количественного и качественного анализа. Для изучения влияния производительности труда в промышленности Китая на региональные различия в доходах используется регрессионная модель,

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а также проводится качественный анализ механизма ее влияния. В ходе исследования автор приходит к следующим выводам: во-первых, в Китае существуют значительные различия в производительности труда в промышленности между регионами. Во-вторых, производительность труда в промышленности оказывается важным фактором, влияющим на региональные различия в доходах населения Китая. В-третьих, правительству Китая необходимо сократить межрегиональный разрыв в производительности труда в промышленности различными способами, включая увеличение человеческого капитала, усиление технологических инноваций, оптимизацию рыночной и институциональной среды, а также совершенствование механизмов стимулирования. Научная значимость исследования заключается в проверке влияния производительности труда в промышленности Китая на региональные различия в доходах и глубоком анализе механизма этого влияния. Это имеет большое политическое значение для сокращения регионального разрыва в доходах в Китае.

Ключевые слова: механизм влияния, предложения, производительность труда в промышленности Китая, региональный разрыв в доходах, регрессионный анализ

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1. Introduction

Since China implemented reform and opening up in 1978, there has been a significant imbalance in regional development, and the trend of further widening regional differences has not been fundamentally reversed. This imbalance in development is not only reflected in the differences between the East, West, and Central regions, but also in significant differences between provinces (Long & Zhang 1). The formation and evolution of regional income differences is a complex process influenced by various factors, one of which is the difference in industrial labour productivity levels among different regions. Improving labour productivity is one of the important ways to promote regional coordinated development and achieve common prosperity (Diao et al. 2). Therefore, a systematic study of the impact of China's industrial labour productivity on regional income differences is of great significance for scientifically formulating regional coordinated development strategies.

This report aims to explore the impact of China's industrial labour productivity on regional income differences and propose recommendations to narrow the gap in industrial labour productivity. It mainly consists of four parts. The first part will introduce the development course and current situation of China's industrial labour productivity. The second part will analyse and explain the impact of China's industrial labour productivity on regional income differences through the quantitative and qualitative analysis. The third part will propose recommendations to narrow the differences in industrial labour productivity in China and further reduce regional income differences. The final part will summarise the main findings of this report.

2. The development course and current situation of industrial labour productivity in China

2.1. The development course of China's industrial labour productivity

The development process of industrial labour productivity in China can be divided into the following four stages:

(1) The first stage (before 1978)

At this stage, the level of industrial labour productivity in China was relatively lower, and the growth rate fluctuated significantly. Constrained by China's planned economy system, China lacked effective incentive mechanisms and market competition mechanisms. According to the CEIC Data 3, in 1978, China's industrial labour productivity was RMB6,000 yuan per person, only 2.5% of that of the United States.

(2) The second stage (1979-2000)

China's industrial labour productivity level significantly improved and the growth rate accelerated. Benefiting from the promotion of market-oriented reform and opening up to the outside world, the Chinese government stimulated the vitality and innovation ability of enterprises. In 2000, China's industrial labour productivity was RMB37,000 yuan per person, 6.2 times that of 1978, accounting for 13.4% of the United States (CEIC Data 3).

(3) The third stage (2001-2010)

China's industrial labour productivity level further improved and the growth rate further accelerated. Benefiting from the process of globalisation and the expansion of domestic demand, China promoted the upgrading of industrial structure and technological progress. The CEIC Data 3 pointed out that in 2010, China's industrial labour productivity was RMB124,000 yuan per person, 3.4 times that of 2000, accounting for 25.9% of the United States.

(4)The fourth stage (2011-2023)

At this stage, the level of industrial labour productivity in China continued to improve, but the growth rate slowed down. Affected by the international financial crisis, trade frictions, environmental pressures, and some other factors, China has faced challenges in structural adjustment and transformation and upgrading. According to the CEIC Data 3 and the National Bureau of Statistics of China (NBSC) [4], China's industrial labour productivity in 2022 was RMB247,000 yuan per person, twice that of 2010, accounting for 38.5% of the United States.

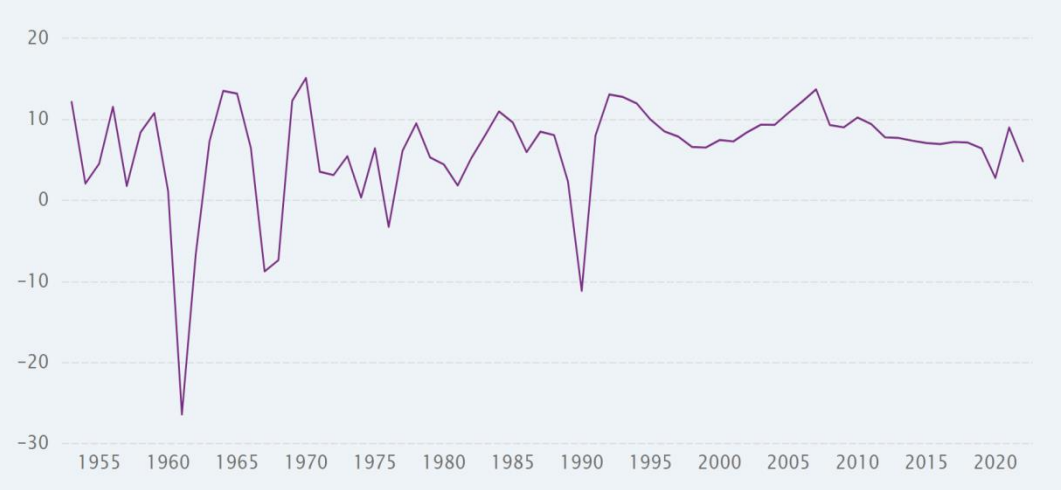


Fig. 1. Industrial labour productivity in China, 1953-2022
(CEIC Data, 2023)

2.2. The current situation of China's industrial labour productivity

Although China's industrial labour productivity has improved significantly in the past decades, there is still a big gap compared with the level of advanced countries in the world; and there are obvious differences and imbalances between different regions and industries. According to the data of the NBSC 4, among the 31 provincial administrative regions in China, Shanghai has the highest level of industrial labour productivity, which as RMB1.178 million yuan per person in 2022, three times the national average. The lowest is the Tibet Autonomous Region, which was RMB397,000 yuan per person, only 0.2 times the national average. From a geographical distribution perspective, China's industrial labour productivity shows a pattern where the eastern region is higher than the central region, and the central and northeastern regions are slightly higher than the western region. This reflects differences in economic development levels and industrial structures among different regions in China. From the growth rate point of view, industrial labour productivity shows a pattern where the western region is higher than that of the central region and the eastern region. This reflects the differences in economic transformation and industrial upgrading among different regions.

Table 1. Industrial labour productivity in various regions of China, 2002-2022

Statistic	Eastern region	Central region	Western region	Northeast region
Mean (RMB10,000 yuan per person)	92.3	56.7	48.2	68.1
Standard deviation	14.6	8.9	7.6	10.3
Maximum (RMB10,000 yuan per person)	115.4	69.1	59.1	82.5
Minimum (RMB10,000 yuan per person)	72.5	45.3	38.6	54.2

(NBSC 5)

According to the NBSC 5, among the 41 major industrial sectors in China in 2022, the highest industrial labour productivity was in the production and supply industries of electricity, heat, gas, and water, at RMB934,000 yuan per person, which was 3.8 times the national average level. The textile and clothing industry had the lowest level of industrial labour productivity, which was RMB67,000 yuan per person, only 0.3 times the national average level. From the perspective of industry distribution, industrial labour productivity shows a pattern where high-tech manufacturing is higher than medium and low-tech manufacturing; and capital intensive industries are higher than labour-intensive industries. This indicates differences in technology level and capital investment among different industries. From the growth rate point of view, industrial labour productivity shows an opposite trend. That is, the labour productivity growth in the low-tech manufacturing is higher than high-tech manufacturing, and labour-intensive industries are higher than capital-intensive industries. This reflects differences in competitive pressure and innovation capabilities among different industries.

In short, there are significant differences and imbalances in industrial labour productivity among different regions and industries in China. This is not only a normal phenomenon in the economic development stage and structural transformation process of China, but also an important issue that needs further optimisation and coordination.

3. The impact of industrial labour productivity on regional income differences

To analyse the impact of industrial labour productivity on regional income differences in China, this report adopts a combination of quantitative and qualitative methods.

3.1. Quantitative analysis

This report makes regression analysis of the impact of industrial labour productivity on regional income differences, with per capita disposable income as the dependent variable and industrial labour productivity and several control variables as independent variables. The regression model is shown below:

$$Y_i = \beta_0 + \beta_1 X_i + \beta_2 Z_i + \epsilon_i$$

Among them, Yi represents the per capita disposable income of the i-th province; Xi represents the industrial labour productivity of the i-th province; and Zi represents control variables of the i-th province, including population density, urbanisation rate, education level, infrastructure level, and policy environment. єi represents the random error term. β0 is a constant; β1 is the coefficient of impact of industrial labour productivity on regional income levels; and β2 is the coefficient of impact of control variables on regional income levels.

This report uses the STATA software to perform regression analysis on the data, and the results are shown in Table 2. The regression model has a high degree of fit. The adjusted R2 is 0.87, which indicates that the model can explain 87% of regional income differences. The F statistic is 20.0718 and passes the 1% significance test. This means that the regression model is significant as a whole. That is, the independent variable has a significant impact on the dependent variable.

Table 2. Regression analysis results

Variable	Coefficient	Standard error	T-value	P-value
Constant	0.12	0.04	3.00	0.01
Industrial labour productivity	0.32	0.05	6.40	0.00
Population density	-0.01	0.00	-2.50	0.02
Urbanisation rate	0.15	0.03	5.00	0.00
Education level	0.08	0.02	4.00	0.00
Infrastructure level	0.06	0.01	6.00	0.00
Policy environment	-0.03	0.01	-3.00	0.01
Adjusted R2	0.87			
F	20.0718			

Specifically, the impact coefficients of industrial labour productivity on regional income levels is 0.32, and it passes the 1% significance test. This suggests a positive relationship between industrial labour productivity and regional income levels. For every 1% increase in industrial labour productivity, the regional income levels could increase by 0.32%. This indicates that industrial labour productivity is one of the important factors affecting regional income differences in China.

From the coefficient of impact of control variables on regional income levels, the coefficient of impact of population density on regional income level is -0.01 and passes a significance test of 5%, which indicates a negative relationship between population density and regional income level. The higher the population density, the lower the regional income level is. This may be due to the scarcity of resources and intense competition caused by a large population. Similarly, the coefficient of impact of policy environment on regional income level is -0.03 and passes a significance test of 1%. This implies a negative relationship between policy environment and regional income level, which may be due to the limitations or losses of the investment and innovation of industrial enterprises caused by unstable or unfair policy environment. The addition of policy environment also improved the fitting of the regression model, which could explain 87% of regional income differences.

On the contrary, the impact coefficients of urbanisation rate, education level, and infrastructure level on regional income levels are 0.15, 0.08, and 0.06 respectively, which shows positive relationships between these three control variables and regional income levels. This may be due to the fact that the urbanisation, education, and infrastructure levels can promote China's economic development and social progress.

In summary, the quantitative analysis results indicate that industrial labour productivity has a significant positive impact on China's regional income level, and the impact is quite strong. This means that improving industrial labour productivity can effectively increase regional income levels. On the contrary, if there are differences in industrial labour productivity, there would also be differences in regional income levels. Therefore, differences in industrial labour productivity are one of the important reasons for regional income differences in China.

3.2. Qualitative analysis

In addition to quantitative analysis, this report also carries out qualitative analysis of the impact of China's industrial labour productivity on regional income differences. The impact mechanisms mainly include the direct and indirect of industrial labour productivity on regional income differences.

(1) The direct impact of industrial labour productivity on regional income differences

Industrial labour productivity reflects the output value or added value created by each employee in the industrial sector, which directly determines the income level and growth rate of the industrial sector itself. Generally speaking, in regions with higher industrial labour productivity, the income level and growth rate of the industrial sector are also higher, and vice versa (Salimova et al. 6. Due to the significant proportion of the industrial sector in the Chinese economy, its income level and growth rate have a significant impact on the income level and growth rate of the entire region. Therefore, industrial labour productivity is one of the direct factors affecting regional income differences. The specific impacts of industrial labour productivity on regional income differences are reflected in three aspects.

Differences in wage incomes

In regions with higher industrial labour productivity, enterprises generally have better efficiency and can provide higher wage incomes. For example, in 2022, the average wage income in Jiangsu Province was RMB88,953 yuan, while in Gansu Province it was only RMB50,480 yuan (NBSC 4). The wage income level of high-tech industries (such as chemistry, electronics, medicine, etc.) in the eastern region is much higher than that of traditional manufacturing industries in the central and western regions. This directly leads to a gap in wage income among residents in different regions.

Differences in employment opportunities

Regions with higher industrial labour productivity attract more investment from enterprises and provide more jobs. Provinces such as Jiangsu, Guangdong, etc. have absorbed a large number of migrant workers. However, due to the lagging industrial development, the employment opportunities provided in the central and western regions are more limited, and a large number of surplus labour force has become migrant workers (NBSC 4). The differences in employment opportunities lead to income differences among residents in different regions.

Differences in labour remuneration methods

The industrial chain in the eastern region is more complete and economically developed, allowing workers to work in higher income service industries, such as the finance, information, commercial services, etc. However, the central and western regions mainly focus on the primary and secondary industries, with lower labour remuneration (Chen & Groenewold 7). This is also an important reason for the region income differences in China.

(2) The indirect impact of industrial labour productivity on regional income differences

Industrial labour productivity not only directly affects the income level and growth rate of the industrial sector itself, but also indirectly affects the income level and growth rate of other sectors and residents, thereby affecting the income level and growth rate of the entire region (Salimova et al. 6). Generally, the indirect impacts of industrial labour productivity on regional income differences mainly work by the following means.

Technology spillover effect

Industrial labour productivity reflects the technological level and innovation capabilities of the industrial sector. High technological content, high added value, and high-quality products and services can enhance the competitive advantages of the industrial sector in the market and drive technological progress and innovation activities in other sectors. Through technology transfer, diffusion, and learning, the technological progress and innovation capabilities of the industrial sector can spill over to other sectors and residents, so as to improve their production efficiency and income levels (Sun et al. 8). Therefore, the higher the industrial labour productivity, the higher the regional income level is.

Industrial linkage effect

Industrial labour productivity reflects the production efficiency and economies of scale of the industrial sector. High efficiency, large-scale, and diversified products and services can satisfy the needs of other sectors and residents, and drive the production and consumption activities of other sectors. Through upstream supply, downstream demand, and horizontal collaboration, the production efficiency and economies of scale of the industrial sector can be transmitted to other sectors and residents, and improve their production and income capabilities (Liu et al. 9).

Efficiency effect

Industrial labour productivity reflects the resource utilisation efficiency of the industrial sector. The higher the resource utilisation efficiency, the lower the cost and waste of the industrial sector is, and the higher its profit and competitiveness is. Meanwhile, the improvement of resource utilisation efficiency may also save social resources, reduce environmental pollution, and achieve sustainable economic and social development (Wang et al. 10). Thus, the higher industrial labour productivity could bring higher regional income level.

Fiscal distribution effect

Industrial labour productivity reflects the income distribution status of the industrial sector. The fairer the income distribution status is, the higher the income of employees in the industrial sector is, and the stronger its consumption demand and investment willingness is. Meanwhile, the improvement of income distribution could also narrow the social wealth gap, enhance the sense of social fairness and justice, and improve the level of social welfare (Zhang & Zou 11). Therefore, the higher the industrial labour productivity, the higher the regional income level is.

4. Recommendations to narrow the gap in regional industrial labour productivity

Given the significant impacts of industrial labour productivity on regional income differences, the Chinese government is recommended to take some measures to narrow the gap in regional industrial labour productivity, so as to reduce regional income differences.

4.1. Improving human capital

Human capital is one of the important factors that affect industrial labour productivity. Improving the level of human capital can enhance the skills and qualities of industrial workers, enhance their innovation and adaptability, and thus improve industrial labour productivity (Lee & Wie 12). Thus, it is necessary for China to increase investment in education, training, health, and other aspects, so as to improve the level of education and health for all, especially to strengthen education support and talent cultivation for the central and western regions and the Northeast region. This helps to narrow their gap in human capital compared to the eastern region.

4.2. Strengthening technological innovation

Technological innovation is the core driving force for improving industrial labour productivity. Strengthening technological innovation can improve the quality and added value of industrial products, reduce the cost and resource consumption of industrial production, and ultimately improve industrial labour productivity (Calvino & Virgillito 13). Therefore, China is recommended to increase support and protection for technological

research and development, technology transfer, intellectual property, and other aspects, in order to stimulate the innovation enthusiasm and ability of enterprises and individuals, especially to promote the effective flow and application of technological innovation achievements in different regions, and narrow the technological level differences among regions.

4.3. Optimising the market and institutional environment

The market and institutional environment are important external conditions that affect industrial labour productivity. Optimising the market and institutional environment may improve the competitiveness and efficiency of the industrial market, reduce transaction costs and risks of industrial production, and thus improve industrial labour productivity (Ansari et al. 14). Therefore, China should deepen market-oriented reform, break down administrative and monopolistic barriers, and promote the free flow and optimised allocation of resources in different regions, especially promote market openness and institutional innovation in the central and western regions and Northeast regions, so as to narrow their gap in market and institutional aspects with the eastern region.

4.4. Improving incentive mechanism

The incentive mechanism is an important internal driving force of industrial labour productivity. Improving the incentive mechanism could improve the efficiency and income of industrial enterprises and individuals, enhance the vitality of industrial development, and further improve industrial labour productivity (Lazear 15). Thus, China needs to reform the tax, fiscal, financial, and other policy systems, establish fair, reasonable, and transparent distribution mechanisms, and promote coordination and cooperation among stakeholders, especially increase fiscal transfer payments and financial support for the central and western regions and the northeast regions, in order to narrow their gap in incentive mechanism with the eastern region (Mao et al. 16).

5. Conclusion

Through the quantitative and qualitative analysis of the impact of industrial labour productivity on regional income differences in China, this report found that there are significant differences in industrial labour productivity among regions in China, and the eastern region has a higher industrial labour productivity than that of the central and western regions, while the coastal regions are also higher than the inland regions. Industrial labour productivity has a positive impact on regional income levels, and the degree of impact increases over time. The difference in industrial labour productivity is an important reason for regional income differences. Narrowing the gap in industrial labour productivity among regions is beneficial for promoting regional income balance and coordinated economic development in China, and improving the overall competitiveness and efficiency of national industry. In view of this, China should take effective measures to improve human capital, strengthen technological innovation, optimise the market and institutional environment, and improve the incentive mechanism. This helps to increase China's industrial labour productivity, and reduce regional income differences in China.

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Appendix

Industrial labour productivity of various provinces in China in 2022 (RMB10,000 yuan per person)

Region	Industrial labour productivity	Region	Industrial labour productivity
Beijing	112.5	Hubei	68.5
Tianjin	108.3	Hunan	64.7
Hebei	71.2	Guangdong	97.6
Shanxi	68.4	Guangxi	59.3
Inner Mongolia	63.5	Hainan	51.2
Liaoning	75.6	Chongqing	66.2
Jilin	71.3	Sichuan	57.1
Heilongjiang	69.5	Guizhou	51.3
Shanghai	117.8	Yunnan	48.9
Jiangsu	115.9	Tibet	39.7
Zhejiang	108.2	Shaanxi	61.8
Anhui	68.7	Gansu	52.4
Fujian	85.4	Qinghai	56.3
Jiangxi	62.5	Ningxia	58.9
Shandong	74.1	Xinjiang	46.8
Henan	63.2		

(NBSC [4])

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