Original Research Article

Impact of technological progress on the structure of the labor force

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Abstract: This paper explores how technological progress affects China's labor market, leading to job polarization with a rise in high-skilled positions and a decline in medium- and low-skilled roles. It discusses regional impacts, with eastern ragion gaining high-skill jobs and mid-west losing low-skill ones. The study calls for educational reforms to bridge skill gaps and reduce unemployment. It notes that while progress boosts growth, it also increases income inequality, requiring policy attention. Future research is needed to guide policy on technology's long-term employment effects.

Keywords: Technological progress; Labor market; Eastern and mid-west regions; Income inequality

1. Introduction

The global labor market has undergone significant transformations due to advancements in AI, automation, and ICT. These technological developments have decreased the demand for low and medium-skilled jobs while increasing the demand for high-skilled jobs, leading to the theory of "employment polarization" (Goos et al., 2014)[3]. This phenomenon is particularly pronounced in developed countries and is gradually impacting developing nations, including China. In China, technological progress has led to notable structural changes in employment, with a decline in low-skilled manufacturing jobs and an increase in demand for high-skilled jobs (Lucero, 2019)[2]. Regionally, the eastern part of China has seen a faster growth in high-skilled job demand, while the central and western regions have been mainly affected by the decrease in medium- and low-skilled jobs (Shen and Zhang, 2024) [12]. This study aims to analyze the impact of technological progress on China's employment structure, focusing on the phenomenon of employment polarization, considering regional and industry differences.

2. Theoretical frameworks

2.1. Theoretical foundations of the relationship between technological progress and the labor market

The interaction between technological progress and the labor market is a pivotal topic in economics, focusing on how it alters labor demand composition and employment dynamics. Skill-Biased Technological Change (SBTC) theory suggests that technological advancements increase demand for high-skilled labor while decreasing demand for low-skilled labor, particularly in IT, where high-skilled worker productivity significantly improves (Acemoglu, 1998; Autor, Levy, & Murnane, 2003)[7,8]. Task-Biased Technological Change (TBTC) theory further elucidates technology's impact on specific task types, highlighting automation's tendency to replace repetitive tasks and elevate demand for non-repetitive ones, thereby profoundly altering employment structures (Autor & Dorn, 2013)[9]. The rapid evolution of AI and Big Data technologies not only threatens low and medium-skilled jobs but also poses substitution risks to some high-skilled jobs, exacerbating skill polarization and heightening the risk of obsolescence for traditional low and middle-skilled workers (Brynjolfsson & McAfee,

2014; Bessen, 2018)[10,11].

3. Domestic and international research progress

3.1. Overseas research progress

Foreign scholars' research on the impact of technological progress on employment structure focuses on developed countries. Autor and Dorn (2013)[5] find that the labor markets in the U.S. and Europe are significantly polarized: the demand for repetitive middle-skill jobs decreases, while the demand for non-repetitive high-skill and low-skill jobs increases. Goos et al. (2014)[3] point out that globalization and technological progress have combined to lead to the outsourcing of middle-skill jobs and automation. Bessen (2018)[11]examines how artificial intelligence is further exacerbating job polarization, noting an increase in the complexity of tasks for high-skill jobs.

3.2. Domestic research progress

In China, the application of technological advances has reduced the demand for low-skilled labor, especially in manufacturing, where automation has replaced a large number of low-skilled jobs. Demand for high-skill jobs has increased significantly, especially in areas such as data analysis and programming, concentrated in information technology and high-tech industries. Shen and Zhang (2024)[12] show that technological advances have had different impacts on the east coast and the central and western parts of the country, with an increase in high-skill employment in the east and a more pronounced decrease in low-skill jobs in the central and western parts of the country. Chen and Kim (2023)[19]find that AI has had a substitution effect in financial and medical high-skill areas, suggesting that the impact of technological progress on China's employment structure is not limited to low-skill jobs.

3.3. Research gaps and innovations

Despite significant research on the relationship between technological progress and employment structure, existing studies have shortcomings, particularly in the detailed analysis of the Chinese context. Most studies focus on developed country labor markets, neglecting China's unique regional and industry characteristics (Shen & Zhang, 2024)[12]. Additionally, research on the impact of emerging technologies like AI is limited, especially in the Chinese context, despite Bessen's (2018)[18] findings on AI's differential impact on job demands. Chen and Kim's (2023)[19] study, though focused on specific industries, lacks breadth to systematically reveal AI's overall impact on employment structure. This study innovates by integrating skill-biased and task-biased technological progress theories to construct an analytical framework tailored for China, examining technological progress's impact on employment structure, focusing on its "crowding out effect" on middle and low-skilled jobs and changes in high-skilled job demand. This analysis aims to illuminate how technological change reshapes China's labor market, providing theoretical support for scientific employment policy formulation

4. Analysis of the impact of technological progress on the employment structure of China's labor market

4.1. Mechanistic analysis of the impact of technological progress on total employment

Technological progress affects total employment through substitution and creation effects. The substitution effect is significant in manufacturing and services, where low-skilled jobs are the first to be replaced (Bessen,

2018; Frey & Osborne, 2017)[11,20]. Automation drives a shift in manufacturing labor demand toward higher-skilled jobs. The creation effect, on the other hand, drives an increase in emerging industries and high value-added jobs, with Autor & Salomons (2018)[16] noting that technological advances broaden the space for high-skill job demand in the long run.3.2 A multidimensional analysis of the impact of technological progress on the structure of employment

(1) Occupational Structure

Technological advances have accelerated skill polarization, with a surging demand for high-skill jobs and a threat of substitution for traditional low and medium-skill jobs (Goos, Manning, & Salomons, 2014; Autor & Dorn, 2013)[21,9]. This trend is also evident in China's service and manufacturing industries.

(2) Industry Structure

Technological progress has profoundly impacted employment demand across industries. Automation in manufacturing boosts high-skilled jobs like R&D and design while reducing low-skilled labor demand (Bessen, 2018)[11]. In the service sector, high-end jobs are growing, while low-end traditional jobs decline due to automation (Brynjolfsson & McAfee, 2014)[17]. Low-skill jobs in automation-vulnerable industries like retail decline, while high-skill jobs in knowledge-intensive industries like finance and education increase (Frey & Osborne, 2017)[20].

(3) Regional Structural Level

Technological progress has exacerbated regional employment structure differences in China. The eastern coastal regions, with faster industrial upgrading, demand more technology-intensive and high-skilled jobs (Shen & Zhang, 2024)[12]. In contrast, the central and western regions, with lagging technological development, experience more low-skill job substitution. This regional difference reflects both industrial structure upgrading progress and education level/talent supply gaps.

4.2. Case study: The specific impact of new technologies on the structure of employment in a given industry

Technological advancements have profoundly transformed the labor landscape across various sectors. In the manufacturing sector, automation and robotics have reduced the demand for low-skilled labor while creating a surge in demand for high-skilled positions such as automation engineers and maintenance personnel, necessitating advanced technical skills and specialized training (Acemoglu & Restrepo, 2020)[14]. Similarly, the service sector has witnessed a shift towards knowledge-intensive jobs in areas like healthcare analytics, driven by technological advancements, while retail and low-end customer service roles have declined due to the rise of e-commerce and intelligent customer service systems. This trend has led to increasing skill separation and a widening gap between high- and low-skilled jobs within the service industry (Autor & Dorn, 2013; Acemoglu & Autor, 2011)[15,13]. Meanwhile, the information technology industry, being at the forefront of technological innovation, has emerged as a key absorber of high-skilled labor. The proliferation of information technology has fueled rapid growth in high-skilled jobs such as artificial intelligence, big data analysis, and cybersecurity, further boosting the demand for skilled labor across multiple industries (Chen, P., & Kim, S., 2023)[19].

5. Impact of technological progress on the demand for skills in the labor market

5.1. Trend analysis of changing skills needs

Technological advances have profoundly impacted the pattern of skill demand, significantly increasing the need for cognitive and specialized technical skills.Autor & Dorn (2013)[15] noted that the spread of automation

and computer technology has reduced the need for repetitive labor while increasing the need for innovation, problem solving, and interdisciplinary integration skills (Brynjolfsson & McAfee, 2014)[17]. In China, the rise in demand for specialized skills such as data analytics and artificial intelligence programming in fields such as information technology and financial services has also led to an increase in demand for vocational education and training.

5.2. Highlighting the skills mismatch

Technological advances have reshaped the demand for skills, leading to a mismatch between skill supply and market demand, which in turn exacerbates structural unemployment. Goos et al. (2014)[21] point out that technological iterations have made traditional skills uncompetitive and emerging skills under-supplied, leading to structural unemployment and reduced market efficiency (Acemoglu & Restrepo, 2020)[14]. In China, the skills gap continues to widen as some workers struggle to keep up with the technical requirements of their jobs due to a lack of necessary training (Chen, P., & Kim, S., 2023)[19]

5.3. Response strategy: Deepening the reform of the education and training system

In the face of changing skill needs, deepening education and training reforms has become a top priority. Brynjolfsson and McAfee (2014)[10] suggest increasing investment in lifelong learning and vocational training to adapt to the rapidly changing technological environment. Autor (2015)[1] points out that strengthening school-business collaboration can effectively enhance workers' skills, especially in areas such as technical training and areas such as data analysis. For China, vocational education and skills training need to be closely aligned with market demand in order to enhance the technical adaptability and market competitiveness of workers. This will not only help alleviate employment pressure, but also promote sustainable economic development.

6. The impact of technological progress on labor market inequality

6.1. Analysis of the phenomenon of rising income inequality

Technological progress has exacerbated income inequality to some extent, especially the gap between high-skilled and low-skilled workers. Daron Acemoglu and David Autor (2011)[13] show that technological progress has significantly contributed to the rapid growth in income of high-skilled workers, while the income of low-skilled workers has grown relatively slowly, or even declined. This phenomenon is particularly evident in China, especially between the eastern seaboard and the central and western regions. High-skilled laborers in the developed eastern seaboard have benefited from the rapid development of technology-intensive industries, while low-skilled laborers' income growth has lagged behind (Shen & Zhang, 2024)[12].

6.2. Highlighting the problem of unequal employment opportunities

Technological progress not only increases income inequality, but also brings about inequality in employment opportunities. Higher-skilled workers are more likely to have access to high-quality jobs as a result of technological progress, while lower-skilled workers are at a greater risk of losing their jobs, and Autor et al. note in their 2008 study that low-skilled workers are gradually being marginalized as a result of automation of their jobs, a trend that is particularly pronounced in developing countries.

7. Conclusions and outlook

This paper analyzes the impact of technological progress on the employment structure of China's labor

market, with the main conclusions focusing on four aspects: total employment, structural differentiation, skill demand and inequality. The “substitution effect” and “creation effect” of technological progress coexist, reducing low-skill jobs but also promoting the growth of high-skill jobs. With regard to the structure of employment, demand for high-skill jobs has risen, while middle- and low-skill jobs have gradually declined, especially in coastal areas with a high degree of automation in the manufacturing sector, and the expansion of the service and information technology sectors has exacerbated the structural imbalance. In addition, technological advances have widened inequality in the labor market and exacerbated income disparities between regions and groups. Policy-wise, education and skills training should be reformed to emphasize the demand for high skills, promote technological innovation and industrial upgrading, and improve balanced regional development. The limitation is that this paper is based on the theoretical analysis of the literature and lacks the support of empirical data, and some of the conclusions may have limitations. Second, the impact of specific technologies (e.g., artificial intelligence, automation) in different industries and jobs is not exhaustively categorized and explored. In the future, the long-term impact of specific technologies on various industries and jobs should be further analyzed to enhance the precision of policy guidance.

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