

Robots and the Labour Market: The Effects of Industrial Robots on Employment and Wage Levels

Haoyuan Ren *

Department of Economics, EIC training school, Shanghai, China

* Corresponding Author Email: Ren.haoyuan1608@gmail.com

Abstract. This study reviews academic journal articles and previous qualitative research on manufacturing and logistics to assess how industrial robots influence employment, wages, and the income prospects of unemployed workers. The findings show that robot adoption generally leads to a gradual decline in employment over time, especially for low- and medium-skilled workers. Although many jobs are not eliminated immediately, the tasks within those jobs often become simpler as firms introduce new technologies. This reduces the number of skills required, makes workers more interchangeable, and weakens their bargaining power, which in turn puts downward pressure on wages and limits opportunities for wage growth. The study also notes that firms typically adopt robots to improve productivity and competitiveness, enabling them to keep production sites open and maintain output with fewer employees. However, the negative effects of robots are not uniform and vary considerably across countries and industries, depending on institutional and sectoral conditions. To lessen these adverse consequences, the study recommends strengthening labor unions, encouraging participatory decision-making, and creating clear training and redeployment pathways for affected workers. It also calls for more comparative qualitative research across sectors and institutional contexts.

Keywords: Industrial robots, employment, wages, labour market, labour process.

1. Introduction

The role of industrial robots has changed dramatically in the past three decades, as increasing affordability and efficiency have allowed them to spread out from the automobile industry and into warehousing, electronics and general manufacturing. According to the International Federation of Robotics (IFR), "the density of robots in the global manufacturing workforce increased from 68 per 10,000 employees in 2016 to 162 in 2023. However, the level of adoption differs widely between countries, with South Korea leading the way with 1,012 robots per 10,000 employees, followed by 770 in Singapore, and 470 in China; this reflects differences in both industrial structure and national automation strategy" [1]. Previous research has shown that China was quickly becoming a significant player in the industrial robot market, as sales of industrial robots in China reached approximately 87,000 units in 2016, representing approximately 30% of total sales worldwide [2-4].

The potential impacts that robots have on human laborers are an ongoing area of controversy among many experts. Those who advocate for robot technology argue that the introduction of robots increases production and creates new jobs, while many experts say robots have displaced workers and limited the availability of jobs for workers. Many aggregate statistics do not fully capture the nature of how robotic technology is experienced at the level of individual workplaces. For example, even if no immediate headcount is lost, significant changes may still occur in how a workplace implements work organization, what levels of skills are required from its workforce and how that workforce is bargained with.

Policymakers, business leaders, and unions need to understand how industrial robots affect employment and wages. If robots primarily replace workers, societies may need to rethink job structures and compensation systems. If robots complement human labour, the focus shifts to training, redeployment, and redesigning jobs around human-machine collaboration. This paper goes beyond unemployment rates to examine changes in job quality, wage dynamics, and the power balance between employers and employees.

This paper focuses only on industrial robots which include collaborative robots used in industrial settings programmable machines that perform physical tasks in factories and warehouses. It does not analyse general-purpose artificial intelligence or service robots. “Automation” here refers specifically to the substitution and reorganisation of physical tasks through industrial robotics. The study relies on qualitative evidence from peer-reviewed research and edited academic volumes to provide a grounded account of how robot adoption changes work and how workers experience those changes. The central question is whether industrial robots reduce employment and wages, and under what conditions. The paper addresses this question by synthesising qualitative research and comparative case evidence across the US, Europe and China, tracing how different firm strategies and institutional settings shape what robot adoption means for jobs and pay. It argues that large, sudden job losses are not the typical pattern in established firms; instead, robotisation often reduces employment more quietly through slower hiring and attrition, while putting pressure on wages and job quality for low- and medium-skilled workers.

The structure of the remainder of the paper is as follows. Section 2 explains the methods and scope. Section 3 reviews qualitative evidence on work redesign, skills, wage pressures, job quality, and the role of institutions. Section 4 presents comparative case-based evidence. Section 5 traces mechanisms linking robot adoption to employment and wage outcomes. Section 6 presents conclusions, policy implications, limitations, and future research.

2. Methodology

2.1. Inclusion Criteria and Source Types

To ensure academic rigour and depth, this review includes peer-reviewed journal articles and edited academic books. A key inclusion criterion is the use of qualitative or mixed-methods research where the qualitative component is substantial and analytically central.

The review focuses on industrial robots and cobots used in manufacturing, warehousing, and logistics. It excludes gig-economy management systems and general office automation to keep the scope consistent. The main outcomes examined are changes in job numbers, job roles and task design, wage trends, including bargaining power, and job quality (work intensity, autonomy, and control).

2.2. Research and Selection Strategy

A systematic search was conducted using SpringerLink, Taylor & Francis Online, and Google Scholar. Search strings combined terms such as “industrial robots”, “automation”, “manufacturing”, “warehouse”, “logistics”, “labour process”, “qualitative”, “employment relations”, “skills”, and “wages”. The review prioritised studies that offer a direct linkage between robot adoption to employment or wage outcomes, include worker and/or manager testimony, and enable comparison across institutional contexts.

2.3. Analytic Approach

The paper uses a thematic narrative synthesis. Rather than aggregating statistical estimates, it identifies recurring themes—displacement through attrition, deskilling and task standardisation, wage restraint via bargaining threats, and institutional mediation (union power, works councils, training systems). The synthesis also notes cases where robots support employment stability or job upgrading, to clarify the conditions under which complementary outcomes emerge.

3. Literature Review

Recent qualitative research (2016–2021) suggests that robots affect employment and wages primarily through changes in work organisation, task design, and bargaining power. In US distribution centres, “goods-to-person” (GTP) systems reorganise work spatially by bringing shelves or pods to workers stationed at fixed points, thereby fragmenting tasks and simplifying labour

processes [5]. Work that previously required autonomous movement and on-the-spot decisions becomes a sequence of standardised actions around a machine-defined workflow.

The warehouse and logistics sector illustrates how robot adoption can produce labour “surpluses” without immediate mass redundancies. Even where employment levels do not fall sharply due to rapid e-commerce growth, robot-organised workflows can intensify pace, reduce discretion, and simplify tasks into narrow routines that are easier to supervise and staff [5]. In this setting, job quality changes may be as important as job quantity. The “upskilling” hypothesis, referring to robots freeing workers for more creative or complex tasks is only partly supported by qualitative evidence. Demand can increase for technical roles such as robot maintenance, programming and mechatronics [6]. However, qualitative evidence often points to skill polarisation: a smaller group of technicians gains specialised responsibilities while a larger group of operators is left with monitoring, loading/unloading, and routine interventions [7]. Lloyd and Payne describe this as a form of “digital Taylorism”, where work is standardised and performance measured more tightly after automation [7].

Evidence also suggests limited pathways for many workers to transition into higher-skill roles. Firms may prefer recruiting new workers with relevant digital skills rather than retraining older workers, contributing to gradual exits, early retirement, or reassignment into lower-valued tasks [7, 8]. As a result, employment effects can be delayed and distributed over time, rather than concentrated in a single redundancy event. A consistent theme is wage restraint even when productivity rises. While economic models may predict that productivity growth supports higher wages, workplace accounts indicate that the threat of automation can dampen wage bargaining. In UK food manufacturing, Lloyd and Payne report that managers used the falling cost and increasing reliability of robots as an argument against wage demands, weakening unions’ negotiating leverage [7]. Huang finds similar dynamics in Chinese factories: when robots take over complex tasks, remaining human tasks (e.g., loading, feeding, checking) can be reclassified as “unskilled”, which legitimises wage freezes or cuts [9]. Workers may perceive a widening gap between effort and compensation, reflecting a shift in workplace power toward management. At the same time, robots can alter job quality in mixed ways: physical strain may decline, yet mental stress can increase if machines set the pace and reduce informal breaks [5,6]. Institutional settings strongly mediate these outcomes. Krzywdzinski shows that in German automotive manufacturing, works councils and collective institutions can shape how automation is deployed in securing job guarantees, negotiating training, and steering automation toward ergonomic support rather than direct labour replacement [10]. In settings with weaker labour protections, robots are more likely to be implemented as straightforward substitutes for labour, with sharper impacts on headcount and bargaining power [7,10].

Taken together, qualitative studies suggest that robots rarely eliminate jobs overnight in established firms. Instead, they often quietly restructure work: tasks become more repetitive and measurable; skills become more polarised; wage pressure tends to increase; and job quality may decline through intensified pace and reduced autonomy. Importantly, these outcomes are not technologically predetermined: where unions are strong, training systems credible, and worker participation institutionalised, robots are more likely to be introduced in ways that support workers rather than primarily strengthening managerial power [7,10].

4. Case-based Comparative Evidence

This section examines three qualitative cases to illustrate how similar technologies produce different outcomes across institutional contexts: German premium automotive manufacturing, UK food processing and logistics, and Chinese electronics manufacturing [7,9-11].

In the German automotive industry, Krzywdzinski analyses a premium car producer characterised by strong unions, influential works councils, and a skilled workforce supported by vocational training [10]. In this setting, collaborative robots were introduced primarily to address ergonomic risks and support an ageing workforce, rather than to cut jobs directly. Works councils engaged in negotiations over implementation and secured commitments on employment stability. As a result, adjustment

tended to occur through reduced hiring and natural attrition rather than mass redundancies. Wage levels remained protected by sectoral agreements, though workers reported that productivity increases were not always matched by proportional gains in bonuses [10]. This case suggests that strong institutions can convert automation into a managed process of gradual change.

Lloyd and Payne report contrasting outcomes in UK food manufacturing and logistics, where union coverage is lower and cost pressure is intense [7]. Firms adopted automated packing lines and palletising robots to protect margins and cope with labour supply constraints. Workers described robots as “pacemakers” that intensified the pace of work and tightened control. Robots enabled output expansion without proportional hiring, limiting entry-level opportunities. Nominal wages largely stagnated, and standardised procedures reduced the value of tacit knowledge and increased worker interchangeability, weakening bargaining power [7]. Here, robots did not necessarily trigger sudden layoffs but contributed to deskilling, wage restraint, and poorer job quality.

In Chinese contract electronics manufacturing, robot adoption has been supported by “machine substitution” initiatives and competitive pressure in global supply chains. Butollo and Lüthje describe how automation strategies under “Made in China 2025” interact with cost competition and labour management [11]. Huang reports that robots were used not only to raise productivity but also to reduce dependence on large shop-floor workforces and limit labour unrest [9]. In some accounts, automated lines sharply reduced the number of operators, while only a small subset of displaced workers moved into machine-tending or maintenance roles. Remaining manual tasks were reclassified as “unskilled”, helping firms freeze or reduce pay [9,11].

Across these cases, the same broad wave of robot adoption produces divergent outcomes. In Germany’s coordinated system, collective institutions channel automation through negotiation, prioritising employment security and managed adjustment. In the UK’s more liberal setting, robots more often intensify work and constrain wages under cost pressure. In Chinese contract manufacturing, robots can function as direct labour substitutes within a policy and competitive environment that supports rapid “machine substitution”. These differences suggest that institutions, power relations, and firm strategy are at least as important as the technology itself.

5. The Effects of Robots on Jobs and Pay: Mechanisms and Process Tracing

Qualitative evidence indicates that robots affect employment and wages through several interconnected mechanisms rather than a single pathway. This section traces three main mechanisms, displacement through attrition, deskilling and the weakening of bargaining power, and a productivity–competitiveness narrative used in managerial decision-making and wage bargaining.

First, displacement through attrition. Contrary to the popular image of abrupt mass layoffs, workplace studies often describe gradual employment reductions.

More robots will mean that more of the time workers will not be subject to physical or mental demands than with fewer robots. This is because robots will have more flexibility than humans do when it comes to meeting the demands of their jobs and will also provide greater productivity than the demand for new workers [10]. As the demand for labour grows and fewer new employees are hired, employers’ long-run goal of reducing employment will no longer require the need for many new employees to replace retired workers or those who have quit. This will eventually reduce local employment opportunities for those affected by the use of robots. As robots are able to perform repetitive tasks, employers will not be able to differentiate their employees from each other based solely on physical capabilities. Instead, they will rely on robots to provide them with all necessary worker skills and capabilities. Robotisation (the introduction of robots into the workplace) will embed knowledge required to perform repetitive tasks into the robotic system and software and allow companies to eliminate the need for workers’ tacit knowledge [5,7,9]. As a result, the jobs of employees performing the same jobs will become interchangeable. In countries that allow employees to negotiate wages at lower rates than employers negotiate with trade unions, using this practice will prevent wage growth [7].

Thirdly, there is a narrative about how productivity and competitiveness help describe what a company is doing with its robots. Management will typically try to frame the need for robots in terms of how they can help reduce unit labour costs, improve the consistency of quality, and help keep companies competitive. Thus, management may argue that automating the manufacturing process helps to keep the jobs that would otherwise be lost due to a plant closing or relocating to another country. Under this framework, robots are essentially used to produce more units of output with less labour in a way that may help to keep manufacturing plants in high-wage countries operating [10]. In China, robots are viewed as an important resource to help manage fluctuating wages, as well as improve the overall production environment to manage ongoing supply-chain pressures [9,11]. Thus, the narrative surrounding automation has the potential to impact wage negotiations by framing the need for wage restraint as a prerequisite for continued investment and facility success.

The way these strategies develop and function is impacted by the regulatory framework (i.e., the legal framework) of the country, the firms involved, and their overall corporate strategies. In countries with strong employee representation and the use of works councils and trade unions, there exist negotiated rights to training, strategic influence over job design, and resistance to severe deskilling of workers. As such, overall training and skilled job strategies of the firm are more likely to result in a managed adjustment strategy (e.g., job redesigns) and the potential for increased complements between human and machine [10]. Conversely, in countries with limited labour legislative protections, corporations have much greater ability to use substitute labour and extensive control through automation combined with wage suppression [7,9].

A firm's approach to automation will influence the amount of job displacement due to this technology; certain companies are focused on quality and supply skilled people with robot assistance for manual labour-based and ergonomic tasks, but maintain their knowledge of the skill sets required for supervision of robots performing these types of duties, while cost-reduction-oriented (or low-wage) firms will generally deploy robotic systems to reduce the number of employees required to conduct a task (employee headcount) and to simplify the processes associated with these manual and ergonomic tasks and make more work tasks the same across all employees, thereby reinforcing the ideas of wage restraint and optimising job degradation [6, 7, 9, 10]. As such, the use of robotic systems for task completion is not a cause for determining the level and amount of wage and job loss associated with the robotic systems used in the workforce; instead, it will depend on how automation is governed and strategically utilised.

6. Conclusion

According to this article, industrial robots are generally decreasing the intensity of labour in manufacturing processes as well as causing stagnant job growth. Due to hiring freezes and employee attrition, the use of robots has caused a significant decrease in available jobs. Additionally, when industrial robots take over manufacturing tasks that were previously done by low- and medium-skilled workers, they also reduce the bargaining power of these workers by making their jobs easier (more easily interchangeable) and subsequently lowering the pay of those workers. As such, these effects of the use of industrial robots are quite variable based on the level of collective organisation in place and based on the extent to which cost-reduction strategies are utilised by firms in any given industry.

Policy recommendations are informed by qualitative evidence. Government and community-based business groups must take action to help manufacturing hubs that face structural vulnerability due to job losses resulting from automation by creating stronger training/retraining pathways, creating realistic pathways for workers who have lost their jobs or had them downgraded, and supporting local economic development efforts (i.e., creating multiple employer industries) so they will not rely on a single employer/industry. In addition, creating formalised procedures for employer and employee participation in developing new technology and developing the pace and form of robot use can ensure that workplace productivity improvements result from skill development, safer workplaces and equal

distribution of the benefits of new technologies, as opposed to simply enhancing the power of managers.

This research would be enhanced through access to more detailed qualitative cases from a larger number of industry areas and countries; however, much of the analysis is focused on Western Europe and select cases from China and the UK. It will also be important for future research to conduct a more expansive comparative qualitative analysis that includes additional sectors and types of institutions than what has currently been done. Additionally, future research will be useful in evaluating the dynamics of workplace change, in terms of post-adoption adjustments or the interactions among collective bargaining practices, training programs, and work redesigns that lead to either complementary or substitutive worker outcomes.

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