

Exploring the Effects of Automated Production Lines on Traditional Manufacturing Jobs

Conghao Luo*

Jinan Xinhang Experimental Foreign Language School, Jinan, China

* Corresponding Author Email: 1714010604@stu.hrbust.edu.cn

Abstract. When famous companies such as BMW and Fast introduced fully automated production lines, some workers lost their jobs. This article mainly studies the impacts of automated production lines on labor market, including the job opportunities of high-skilled and low-skilled employees, worker's wages and two important effects which are replacement effect and creative effects. In the research, I analyze the labor market situations of several economies and use some important data to show the current labor market trends. The result is that the introduction of automation will increase employment opportunities for high-skilled workers, but workers' wages may fall because the tasks of labor are smaller than those of machines. Meanwhile, the extent of impacts of replacement and creative effect on labour market might depends on time period and the relevant size between those. According to impacts, the policies for protecting labor force and increasing economic growth rates have been proposed. It is also expected that more job positions would be provided when the labor could adjust to the development of automated production lines in the future, and the productivity of firms will be improved dramatically.

Keywords: Labor market, Automated Production Lines, Future Development, Wages.

1. Introduction

With the continuous development of technology and the government's policy support, artificial intelligence technology is widely used in various fields, such as intelligent robots in restaurants to provide food delivery services, intelligent customer service and automobile intelligent factories. For example, Shaanxi Fast auto drive Refco Group Ltd, an auto parts production company, has put into use an automatic assembly cantilever line that can achieve multi-station automatic assembly. After the first smart production line was put into use, not only is production efficiency improved by 40%, but product consistency is also further guaranteed. Although, the number of people working on the line was reduced from 17 to 7, the maximum number of products produced per day was increased from 450 to 750. As a result, artificial intelligence technology may have a great contribution to manufacturing, which can improve production efficiency and increase the quality and reliability of products. The introduction of artificial intelligence technology can produce substitution effect and creation effect. Substitution effect will have a negative impact on the labor market when companies invest in machines to replace human labor, which may reduce employment opportunities, while the creation effect may increase the demand for labor. The ultimate effect on the market depends on the relative size of the substitution effect and the creation effect.

2. Impacts and Policies

The use of automated production lines will lead to both positive and negative effects. Based on the impact of the analysis below, some policy recommendations will be proposed.

2.1. Positive Impact

2.1.1. Creative effect

As AI technology reduces production costs, it may help companies take advantages of economies of scale to expand and create jobs, which is called creation effect. The increase in the size of enterprises leads to a higher level of employment demand. Therefore, the creation effect achieved by

the application of artificial intelligence technology in the automobile manufacturing industry as an example can offset the replacement effect, which is reflected in the increase of the scale of labor demand [1]. In addition, an increase in productivity of firms will cause the productivity effect, which means that cost savings from automation will increase consumer demand and increase the demand for labor in non-automated industries, and thus it will further increase productivity [2]. In German market, the study found that the introduction of one automation device by a manufacturing company would decrease two job positions, but an increase in the size of the market would likely lead to additional jobs in the tertiary industry, and thus it could offset the impact of unemployment in manufacturing [3].

2.1.2. Impact on High-skilled Workers

For those highly skilled workers, the employment rate will increase as AI is applied in enterprises. For one thing, the automation equipment in the factory production line requires highly skilled workers to innovate and develop. So, in terms of research and development, it will increase the demand for highly skilled workers. For another thing, the fully automated production line requires skilled workers to be practical to maneuver equipment and ensure that there will be no mistakes in the production process, and thus it will ensure the efficiency of the fully automated production line. The inefficient allocation of skill demand and resources across different firms may be the main reason for the growth in demand for highly skilled workers. Highly skilled workers can coordinate with the development of artificial intelligence because they are likely to be more skilled in the operation of new types of equipment. According to the table 1 below [4]. When an industry's Industrial Structure Advancement (ISA) value is greater than 1.4055, the demand for highly skilled workers increases by 1.1%. When the ISA is higher than 1.4055, the demand for highly skilled workers rises by 3.4%.

Table. 1 Employment in automated firms

Threshold model.

Variables	High	Low
Robot $\leq$ 1.4055	0.011*** (0.002)	
Robot $>$ 1.4055	0.034*** (0.004)	
Robot $\leq$ 1.4131		−0.010* (0.005)
Robot $>$ 1.4131		−0.288*** (0.007)
cons	−37.043*** (7.035)	179.727*** (48.044)
Control	Yes	Yes
R ²	0.7568	0.6780

Meanwhile, the diagram below also illustrates the changes in number of high skills workers in France manufactured industry. Until 2017, the number of high-skilled workers at bottom 50% companies will increase by 60%, while the number of high-skilled workers for top 50% companies will increase by about 140%. [4]. As a result, highly skilled workers will have more employment opportunities in automated enterprises in figure 1.

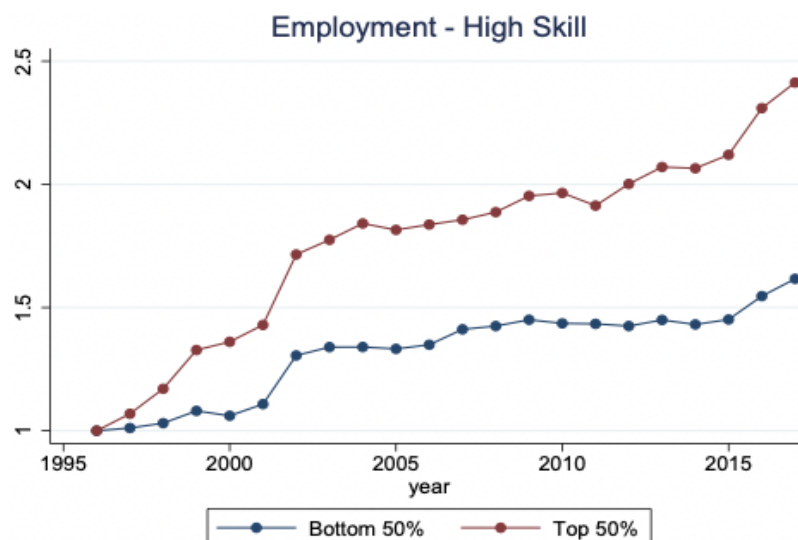


Fig. 1 Employment for high-skilled workers

2.2. Negative Impact

2.2.1. Replacement Effect

As artificial intelligence is used in the manufactured industries, the replacement effect would be caused. When a company reaches a fully automated production line, the workers on the original production line will be replaced by machines. For example, on automated production lines, 50 percent of the quantity of tasks by the labor force are replaced by artificial intelligence [5]. Automation technology is the increase in capital application. It could increase the percentage of companies' output performed by automated equipment and decrease the percentage of tasks performed by labor force. Therefore, enterprises will use more machinery and equipment to replace the application of labor. For example, in the automotive industry, continuous innovation and research and development, when automated tasks are created, the role of labor will be directly replaced, and thus the demand for labor will continue to decrease. Such as on the whole car frame, car parts and other production processes [6]. In fully automated production lines, low-skilled workers used to make goods are replaced by machines. This is because they have low occupational mobility, they can only skillfully complete their own work and they cannot transfer to other fields to work.

2.2.2. Impact on Workers' Wages

The application of artificial intelligence has a clear impact on the income of employees. The average salary of automated workers or high skilled workers is higher than that of non-automated workers or replaced employees. Also, with the automatic transfer of employees, the income increases significantly. In US labor market, some people predict that adding one unit automation device will result in six workers lose their jobs; If there is one automation device in every 1,000 people, workers' wages would drop by 0.5% [7]. Moreover, for those who do not acquire high skills, people may prefer to take low-skilled jobs, such as production line workers. From the point of view of supply and demand in the labor market, quantity demanded will exceed quantity supplied and thus the shortage will be caused. So, workers' real wages would be below the new market equilibrium wage after the change of demand for job positions. Therefore, it is more likely to cause the income inequality, which means that high-skilled workers may receive high incomes, while low-skilled employees face to be unemployment or receive lower income.

2.2.3. Evaluation

The impact of fully automated production lines on the labor market depends on time period. In the short run, the application of automated production lines will substantially replace low-skilled workers on the production line, and the replacement effect plays a major role. Simple tasks that workers do, such as assembling parts or installing frames, can be replaced by machines, and it is complicated for

them to move on to a new field of work. However, in long run, automation will dramatically increase productivity. It is more conducive to expand the production scale of the firms and increase the job positions in other aspects of the firms, such as equipment maintenance and equipment use management. In the long run, the creation effect will offset the substitution effect in the short run, and eventually the labor market will return to equilibrium or expand. Moreover, the relative size of the creation and substitution effects also determines changes in the labor market. If the creation effect is greater in the long run than the substitution effect is in the short run, there will be more jobs in the labor market in all industries and especially in non-automated industries; vice versa.

3. Policy

Businesses' efforts to align their strategies with the skills of their current employees will provide them with skills retraining and upskilling programs. The future of the workplace depends on the actions of individuals and businesses. Interpersonal relationship processing and human resource management play an important role in catering to the development of science and technology and promoting the productivity of industry and workforce [8].

3.1. Education and Training

Companies or governments need to understand which jobs could easily be replaced by automated machines. After that, they should provide workers with on-the-job training or skills training in other fields, so that they are more competitive to find jobs when they are employed. In training, they should promote the synergistic development of workers' skills with AI technology to prevent workers from being easily replaced again.

3.2. Tax/Subsidy

If governments or relevant organizations lack information about AI, it could undermine firms' ability to respond to the impact of AI technological advances, and thus the catastrophic consequences will be caused. After governments know enough about the impact of AI on the labor market, they can decide whether to tax or subsidize AI or robots to supplement the labor force or reduce unemployment. For example, when companies do not use automated equipment to improve productivity enough, the government should subsidize production efficiency, making it easier for companies to expand and create more job positions. If they're doing it in an incomplete way and understanding the impact of these technologies on the labor market, it's going to have a negative effect of slower economic growth, fewer jobs, lower wages [9].

4. Future Development

In the future, the confrontation between creation effects and substitution effects may not be obvious [10]. More workers will combine automation tasks with labor tasks. For example, workers have interpersonal skills or problem solving skills, and machines cannot automatically correct errors in production. The trend of combining workers and automated machines in production lines will be more obvious. But this requires specialized training in education, such as people's problem-solving skills and having esoteric knowledge. Therefore, in the next few decades, it seems to me that there will be more and more job opportunities and more rapid economic growth with the development of both automated machines and workers, but it also puts pressure on the economy's resource allocation.

5. Conclusion

In conclusion, when companies are likely to introduce more automated equipment to speed up production efficiency or increase output, automated production lines may have several certainly positive and negative impacts on the labor market. For the positive impacts, it may cause creative

effects like expanding the size of the market and adding more jobs in other positions. Moreover, workers with high skills will be more attractive for companies to introduce because it can help them increase the quality of automation equipment as an example. On the other hand, in the short run, replacement effects may occur. For instance, some low-skilled workers doing simple jobs can easily be replaced by automated equipment. Also, when AI is used by companies, employees' salaries may be reduced. This may be because the tasks of the workforce have been reduced. Based on the effects described, some policies will be proposed. Training or expanding the skills of low-skilled workers and government subsidies or taxes play an important role in alleviating the impacts. In the future, the gap between the creative effect and replacement effect will be relieved and people will have more job opportunities.

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