

The Impact of Robots Replacing Workers

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Abstract

The relationship between robots and labor force has always been a controversial problem in the world. Especially the impacts they affect the economy. So, in this project, the researcher will discuss the problem by using the employment and unemployment to express the labor force and then use Solow model to do an analysis for figuring out how robot influence the labor force and economy. And the researcher will give the suggestions and predict the future situation between labor force and robots, and economy as well.

Keywords

Robots; Labor Force; Economy; Solow Model.

1. Introduction

The first robot in the world was created in 1948 [1] and it has been more than 60 years since then. During the past sixty years, robot has been applied in every walk of the life and it has highly efficient serviced us. So, here is the problem the researcher needs to solve, whether it is necessary for us to offer the streamline jobs to labor force or the researcher should assemble robots to do those kinds of jobs, and what is the certain relationship between robots and lab the force and how they affect economic growth.

In previous surveys, the authors have always made two points. The first is that robots will displace a large number of workers, which leading to the rate of unemployment will rise and eventually the economy will decline. The second point is that while robots replacing labors, they also provide amount of job opportunities and generate great benefits, thus balancing the negative effects of robots replacing labor and, in some cases, positively affecting economic growth.

Thus, the next move is to collect the data and analyze the information by building the Solow Model in order to prove the relationship among the robots, labor force and economy and then discuss the problem under two different situations which the researcher divide into short-term impacts and long-term impacts.

However, the researcher cannot list all the data in 60 years, the researcher decided to limit the year to the last 10 years. In addition, there are so many kinds of robot and related research about it, so the researcher will give a definition of robot the researcher will discuss and the significance of the project.

First, Robots all have some kind of mechanical construction, a frame, form or shape designed to achieve a particular task and its form follows the function.

Second, robots have electrical components which power and control the machinery.

Third, all robots contain some level of computer programming code. A program is how a robot decides when or how to do something. There are three different types of robotic programs: remote control, artificial intelligence and hybrid.

A robot with remote control programming has a preexisting set of commands that it will only perform if and when it receives a signal from a control source, typically a human being with a remote control. It is perhaps more appropriate to view devices controlled primarily by human commands as falling in the discipline of automation rather than robotics.

Robots that use artificial intelligence interact with their environment on their own without a control source, and can determine reactions to objects and problems they encounter using their preexisting programming.

Hybrid is a form of programming that incorporates both AI and RC functions.

In the situation, the researcher will focus on the remote control and artificial intelligence robotic, and there will be analysis and sample in the following part.

2. Analysis

2.1. Background

After limiting the scope of the research, the researcher will discuss methodology and modeling of the project. But before the researcher do that, the researcher need to provide some basic background. National Robotists divide robots into two categories from the perspective of application environment: industrial robots in manufacturing environment and service and humanoid robots in non-manufacturing environment. According to the survey <global robotics report 2019> from IRF The researcher can find out the information the researcher need.

First, in 2018, global annual sales of industrial robots reached \$16.5 billion, which is a new record, and the number of installed robots exceeded 400,000 for the first time, an increase of 6% over the previous year. And it occupied for 54% of the market in 2019.

Second, the sales of service robots rose 32 percent to \$9.2 billion. In 2018, sales rose 61% to more than 271,000 units, which was increased from 168,000 units in 2017 and more than 10,000 units. Besides, its share of all robot sales was rising, and it occupied for 32% of the market.

However, except the two types of robots mentioned above, World Robotics introduced and first analyzed the robots' market. Despite all the media focus on robots this year, the number of installed units is still very low, which is at 3.24 percent. That is, of more than 422,000 industrial robots installed in 2018, fewer than 14,000 were robots. About 11,100 were robots in 2017. From 2017 to 2018, the growth rate of robots reached 23%. And since UR company launched the cooperative robot UR5 in 2008, the industrial robot giants in the world have launched their own cooperative robot products without exception. ABB's YuMi, fanuc's cr-35ia, kuka's LBR iiwa, and yaskawa's Dexter Bot.

From the data above [2], the researcher can see that the sales market of robots is gradually rising, and at the same time, the categories of the robot industry are also refining and becoming mature. However, the researcher still need to provide relevant data on the development of the labor market, and thus generate a statistical relationship between the robot market and labor force market.

Here are the figures.

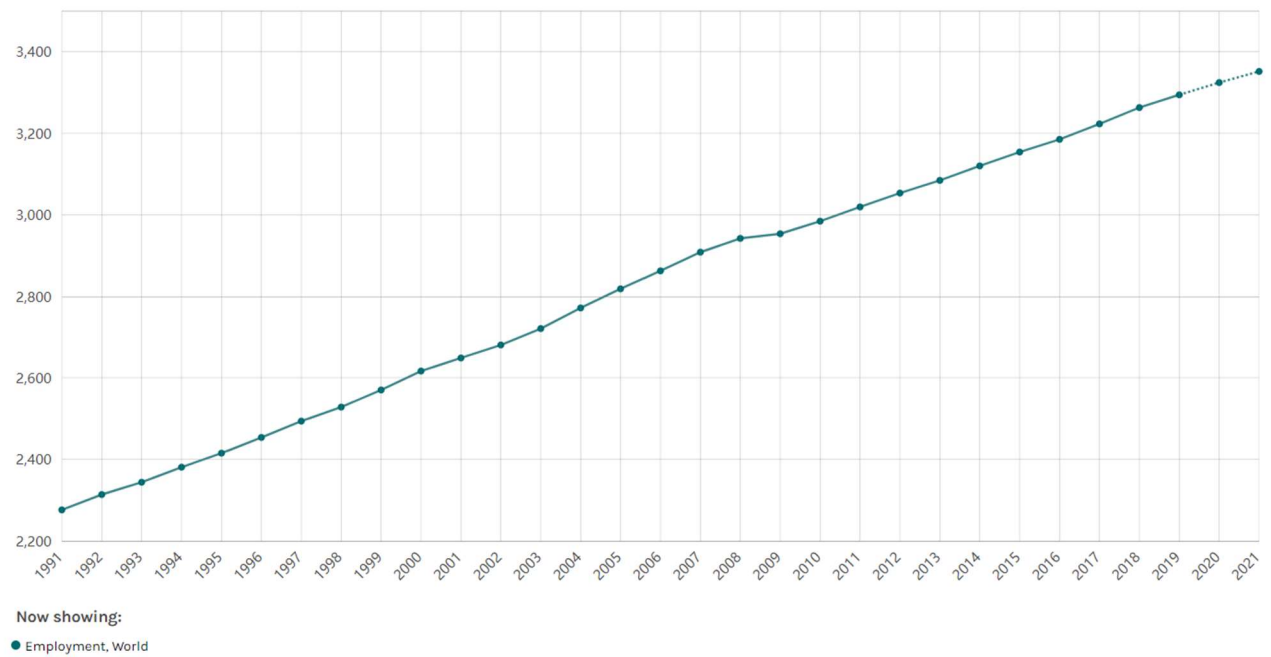


Figure 1. Employment Source:(n.d.). World Bank Open Data | Data. Retrieved from <http://data.worldbank.org.cn>

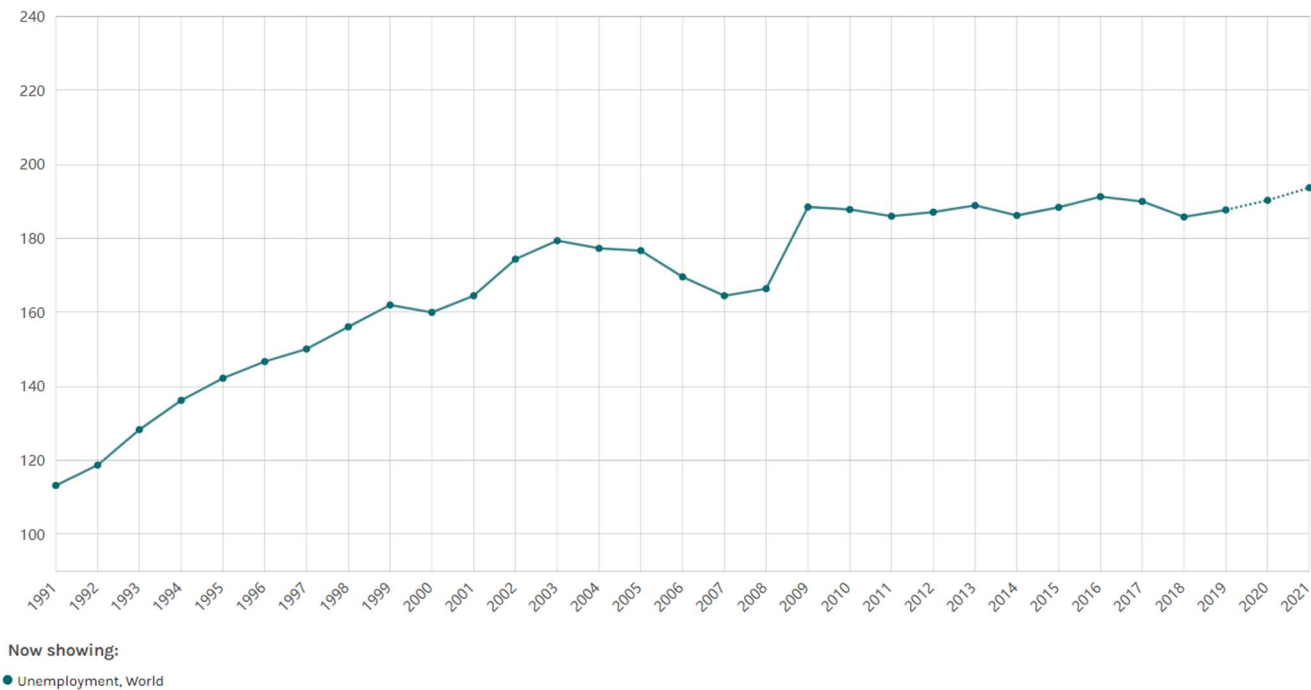


Figure 2. Unemployment Source:(n.d.). World Bank Open Data | Data. Retrieved from <http://data.worldbank.org.cn>

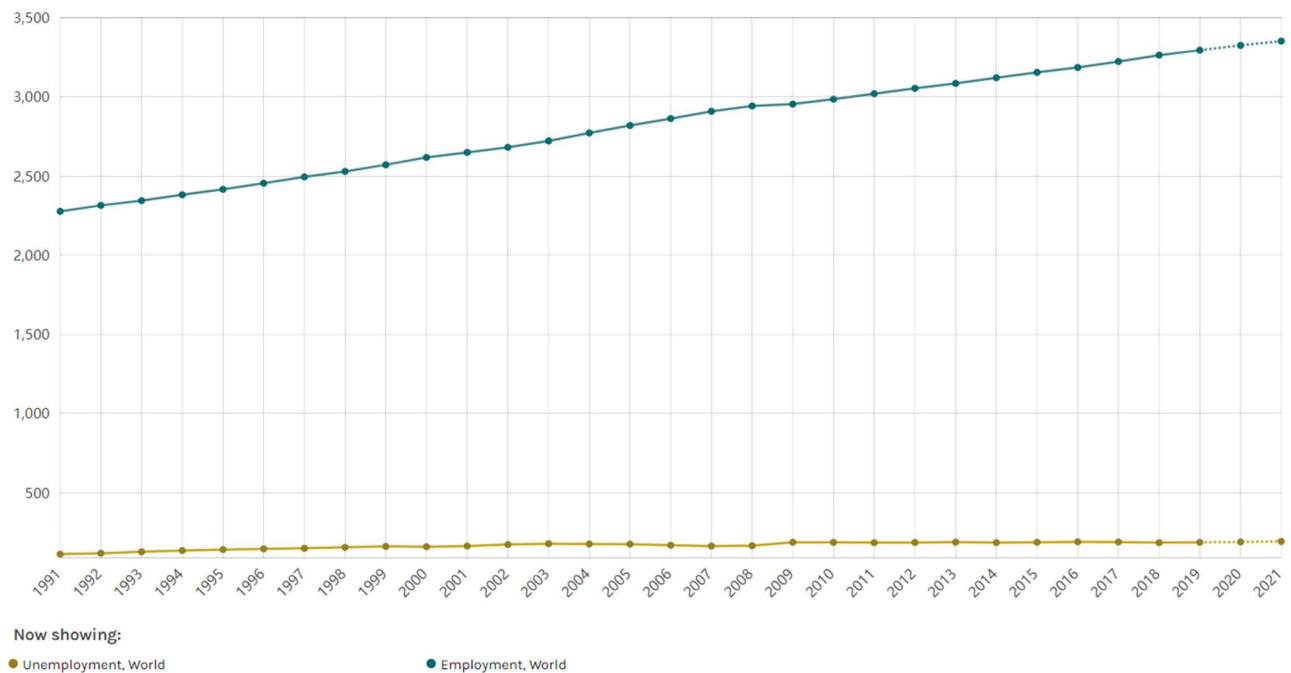


Figure 3. Comparison with employment and unemployment Source:(n.d.). World Bank Open Data | Data. Retrieved from <http://data.worldbank.org.cn>

The Figure one and figure two respectively represents the employment and unemployment of past years, and figure 3 is the contrast of employment and unemployment. From the figures above, the researcher can see that the employment and unemployment is at a rising trend, but the researcher can learn that the increasing of employment is much huger than the unemployment's. So, there may be a relationship between the rouse of employment and unemployment's. According to the equation:

$$L=E+UE$$

The researcher can get:

$$\frac{L}{L} = \frac{E + UE}{L}$$

Then the researcher simplify the equation:

$$1=\varepsilon+u$$

So, when ε rises, u falls, and there is a negative correlation between the employment and unemployment.

Through the data above, the researcher can see the ratio of employment has been risen and unemployment has been fallen. Then, the next job is to explore the more detailed relevance among the robots, employment and unemployment, and also build Solow Model with some certain examples.

2.2. Solow Model

According to the background information, the researcher can clearly know that robots play an increasing important role in the society, which can replace some workers. First of all, I want to talk about the difference between the workers and the robots. It is clear that many factors influence one worker how much they can produce such as the health condition and the years of schooling. This means that the healthier the worker is, the more the worker can produce. Meanwhile, the more schooling years for a worker, the people will have a higher productivity in the normal condition. According to these factors, it will cause the productivity unstable, which means that different people have different productivity and it is very difficult to regulate all workers to be same.

However, robot will not have this kind of the problem. All the robots are identical and they almost have the same productivity. Meanwhile, robots can work for a long time without relaxing, which means that robots are more effective than the human. Therefore, many firms began to invest more money in AI, which can help their firms to increase the amount of output and also reduce the cost in the labor force.

Then, I will use a specific firm, Amazon, to analyze the Data about it. Before starting talking about the AI in the Amazon, I would like to introduce the basic information about this firm. Amazon, the largest online e-commerce company in the United States, is located in Seattle, Washington. Amazon is one of the earliest e-commerce companies on the Internet. It was founded in 1995. At the beginning, it only operated online book sales business, but now it has expanded to a wide range of other products, and has become the largest online retailer with the largest variety of goods in the world and the second largest Internet company in the world.

At Amazon, artificial intelligence (AI) is the field of computer science dedicated to solving cognitive problems commonly associated with human intelligence, such as learning, problem solving, and pattern recognition. According to the data from the Amazon, the researcher can clearly see that the investment of Amazon is continuously increasing.

The investment of Amazon is 26.98 billion in 2016. However, this number increase to the 85.47 billion, which is a huge gap between these two data and the researcher can states that Amazon pay more attention to the investment. Then the researcher will use Solow model to show what is the result of increasing the investment.

Then, what is Solow model. The Solow Growth Model is a standard neoclassical model of economic growth, which is developed by Robert Solow. This model has three basic sources for output(Y): labor (L), the share of the investment (α), capital (K) and knowledge (A). Here is the basic formula of the Solow model:

$$Y=AK\alpha L^{1-\alpha}$$

Therefore, the researcher have already known the capital increase because of the growth of the investment, Amazon reinvests 3 percent of its revenue. Besides that, the researcher need to know the labor and the productivity. According to the data from the Amazon, there is an increasing of the employees at the same time when the investment increases. Amazon total number of employees in 2016 was 341,400, but Amazon total number of employees in 2019 was 798,000[3]. This means that the number of the employees have a dramatically increase during this period. As a result, the labor also grows. Meanwhile, the share of the investment does not change a lot and the researcher assume α does not change there. Finally, the researcher need to know about the productivity. According the reporter from the Amazon, AI and machine learning powers three popular Amazon products: Alexa, the Amazon Go Store, and the Amazon recommendation engine, which spread to the whole company of the Amazon rather than one part. Especially in Amazon's Fulfillment Center, Amazon bought a robotics company called Kiva

Systems for \$775m (£632m) in 2012. At the end of 2014, Amazon said it had 15,000 robots in 10 centers. And by 2015, that number had risen to 30,000. Now, there were more than 200,000 robots in warehouses around the world. Hence, the researcher can conclude that the robots will also increase the productivity of the Amazon.

According to the Solow model, all of the A, K, L increase and α is the same, which can lead to the increase of the output for the whole company. But whether robots will replace the employees is a controversial issue. According to the fact of Amazon, it is not true. Rather than that, appearance of the robots also triggers the increase of the workers. The reason for this phenomenon is robots replace some workers but also create new jobs at the same time. All in all, the researcher conclude the robots will not replace the people, which will also promote the economics growth.

However, someone worries about this new trend of popularizing the use of robotics in the future whether possibly increases unemployment of workers by replacing their jobs as they have higher efficiency. Furthermore, on the basis of the Solow model, the higher investment of capital will bring the higher outputs with greater profits and give firms advanced technology with positive feedback to re-improve the possible output. The efficiency and effect that robotics can gain is better than labor force. According to the previous model application of the Solow model, it is obvious to observe and find the advantage of investing artificial intelligence and robotics for boosting the outputs and profits. Moreover, based on this condition, the firms will choose to put more resources in robotics and artificial intelligence for production. This conclusion possible indicates that firms will put greater resources in extending the potential of robotics rather than increasing employment opportunities which is not beneficial for workers.

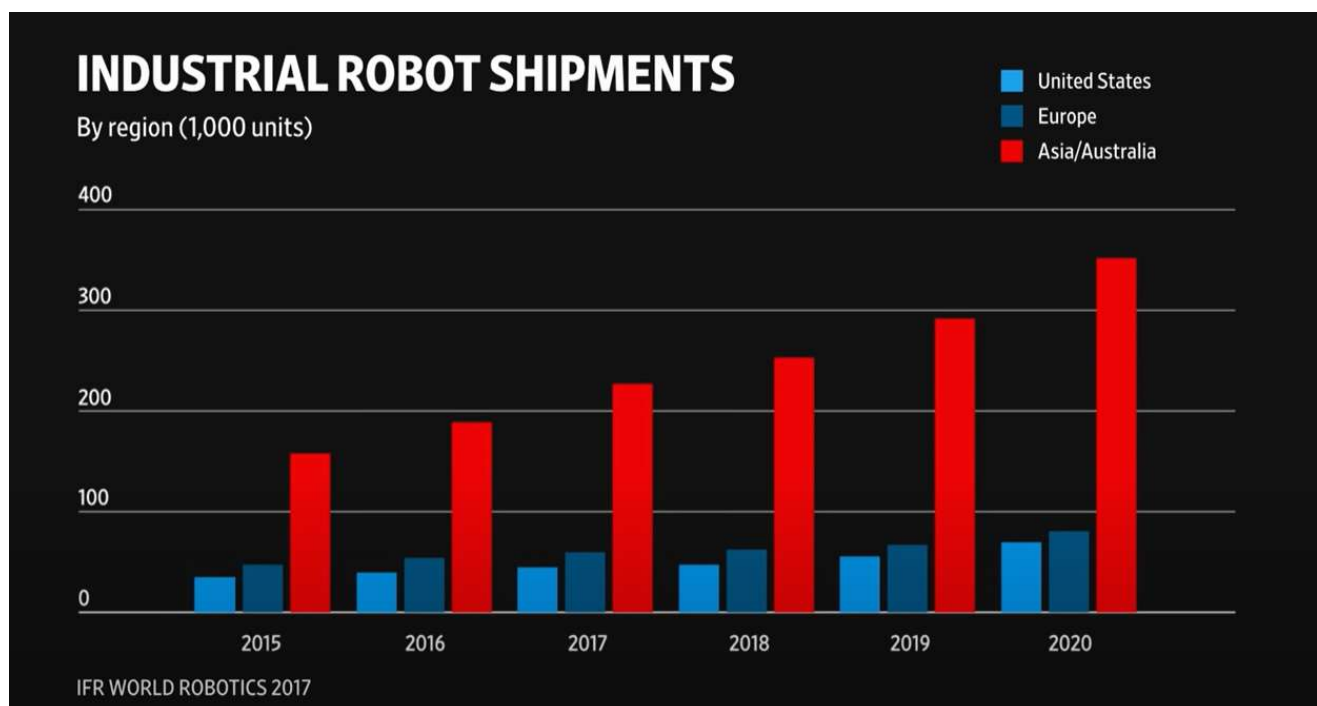


Figure 4. Industrial robot shipment Source: (n.d.). YouTube . The Robot Revolution: The New Age of Manufacturing | Moving Upstream - YouTube. Retrieved from <http://www.youtube.com/watch?v=HX6M4QunVmA>

However, Surprisingly, when people see the unemployment rate in worldwide, unemployment rate is not consistent for the people expectation. From 2009 to 2019, the world unemployment rate is decreasing steadily and basically return to the state when the world did not experience the great recession [4]. The same situation also happened in the east Asia and China, which are

vital in robotics production. China are maintaining a constant state of unemployment rate since 2009. Compared to China, the east Asia is steady declining in unemployment rate. From the bigger sight to the small sight, Amazon also has this condition. Since Amazon created the automatic robots and put them into work in 2012, the number of employees is still stable increasing. Although the percentage of new employment opportunities decreased gigantically in 2013 and 2014, it rebounded from 2015 to 2017, especially in 2017. In 2017, the increasing employee percentage reach 65.79% which is the time that Amazon automatic robotic field is mature [5]. In result, from data perspective, the robotics do not seem to influence a lot in employment. Nevertheless, it is not overall and comprehensive to get conclusion through those data. It is necessary to analyze in different facets for the impacts of robotics targeted to the employment condition.

2.3. The Type of Replaced Employment

First of all, it is important to see what kind of sector of production are mostly replaced by robotics. Nowadays, the robotics replacement is mainly concentrated in industry part which is secondary sector of production. For instance, the robots that Amazon invents and applies to the production are responsible for the transportation and distribution of commodities. Those robots can easily manage the commodities of each consumer and distribute into different part. Then, they can transport those goods into the delivery sector. They are small and quick to finish the work of transport and distribution compared to the human force. Therefore, they can replace the original workforce who is responsible for transport. However, industry production, the secondary sector of production does not contain huge percentage of workforce. Even those developing countries like China, which is the biggest world manufacturing country, only has 28.8% workforce working in industry in 2016[6]. In contrast, China has 43.5% workers in service part in 2016. In 2006, there is only 32.2% workforce in service. This possible implies that the sector of production worldwide is now transforming into service part. In other developed countries, their workers even have much higher percentage in service sector compared to industry sector. There are relatively less people worked in secondary sector, and most employment replacements by robotics happen in secondary sector. Therefore, the phenomenon that employment is replaced by robotics do not affect a lot in society and people's life because this effect does not take place in important sector, service part.

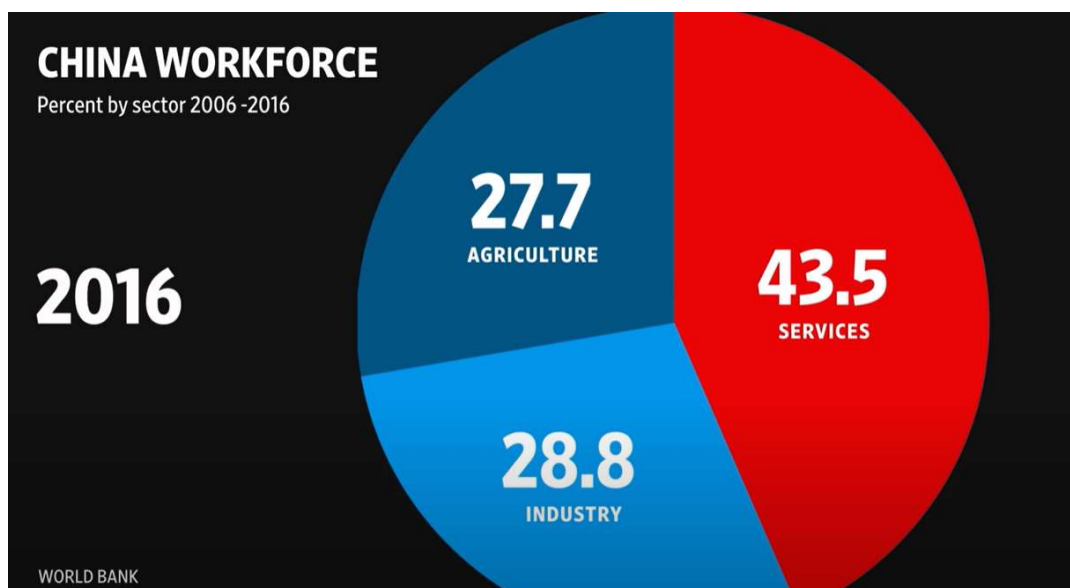


Figure 5. The ratio of China workforce Source: (n.d.). YouTube. The Robot Revolution: The New Age of Manufacturing | Moving Upstream - YouTube. Retrieved from <http://www.youtube.com/watch?v=HX6M4QunVmA>

2.4. The Appearance of New Employment

Not only does the percentage of sector of production play a significant role in the impacts of increasing appearance and application of robotics, but also the increasing new job opportunities by robotics give positive side effect. When some jobs are replaced and disappeared by robotics, some robotics-related jobs also appear to the sight and cover the gap of the loss employment. Taken Amazon again as the example to illustrate, after Amazon invented the automatics robots and applied in transports and distribution to replace the jobs of original labors, there are also new jobs created based on that robotics. Since those commodities that robotics distributes and carry need people to define and confirm whether they correctly allocate the goods, it is magnificent to have people to receive and check the commodities. Obviously, those unemployed labor can just fit the jobs and cover it. Therefore, there are no gap with increasing unemployed labor because of appearance of robotics. This effectively suggests that the short-term phenomenon of unemployment can be solved. All in all, it is an element contributing the possibility of replacement of employment by robotics.

2.5. The Population Growth and Distribution in the Amazon

For considering the increasing rate of employment of Amazon employee, it is crucial and magnificent to check the recent actions that the Amazon decides. After analyzing this action and remove the other possible element that contributes to the fluctuation of numbers of labor employment, the researcher could observe the impacts of automatic robotics bringing to the labor-force. Taken 2017 year as an example, in that year from June to October, the employment increased about 160 thousand workers. Although at that time the Amazon brought a huge supermarket which offered them total 90 thousand job opportunities. After eliminating the numbers of employment that the purchasing the supermarket gains, Amazon still extend thousands of employed opportunities in this year. Moreover, Amazon offered 14 thousand new employment opportunities at online which includes 7000 software engineers and 2500 salesmen. Those data demonstrate clearly that Amazon steady broadens their labor-force and increases the number of employees.

2.6. The Amazon Stock Market and its Internal Value

Furthermore, it is also vital to observe the value of Amazon from stock market [7]. Through observing the stock market of Amazon, the researcher could find the achievement of Amazon. From 1997 to 2020, the value of stock market boost from 1.5833 to the current value 2477 dollars. Especially, the Amazon stock market value increases astoundingly [8].



Figure 6. The stock market of Amazon Source: (n.d.). <https://www.msn.com/en-us/money/stockdetails/fi-a1nhlh>.

3. Conclusion

3.1. Conclusion

Although the rise of robots will lead to the loss of a large number of labor force, but, the efficient productivity of robots, considerable cost recovery time, and the emergence of numerous of new jobs caused by the rise of robots, will still promote economic growth.

3.2. Forecast

From the conclusion above, the researcher can see that the economy will increase since the highly efficient and the great number of jobs which is created by robot. And it has been proved by the data. So, next, the researcher are going to do the forecasts of the trend of the future economic growth.

According to the past information, the employment has increased and unemployment has been declined for the past 10 years, and the investment of robots in lots of countries has also been increased. The researcher assume those development trend of index stays still, and then the researcher can predict that there will be an interpret point in the future. From the following formulas, the consume level will increase when the output is up. Finally, the economy will be promoted.

$$y = F(k, l)$$

$$y = c + i$$

$$c = (1 - s)y$$

3.3. Problems and Future Study

However, there will be some problems in this forecast. The researcher cannot guarantee the situation would not change when the technology is developed, which means the researcher cannot make sure that the robots will not be independent to solve the task when the technology is mature. If it does, it will be a problem that the robots can still generate the same number of jobs, and whether it will be more efficient when robot can work without human beings or not. So, the next step is to do a linear regression analysis, and express the relationship among the efficiency of robots, labthe force, and the economic growth by the equation. And then give some more detailed suggestions by comparing the former indexes by the correlation coefficient.

3.4. Recommendations

And according to the data and conclusion the researcher gets, the researcher will give the suggestions. First, it is crucial to keep investing the technology of robot. The governments and companies still need to enhance the productivity of robots. Second, the training for the labor force need to be adopted. The labor force not only just need higher productivity, but also high degree of education for a more tacit cooperation with robots. Third, government need to build certain policies to protect the employment in tertiary industry and encourage the development of tertiary industry. Then the secondary industry with high proportion of robots should manage to achieve a fully automatic industry. Hence, more labor forces in secondary industry can flow into tertiary industry. However, the researcher still needs to guarantee the productivity of secondary industry and equitable disturb the amount of robot and labor force, and eventually maximum the productivity the researcher can have.

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