Forecasting the Unemployment in the US Under COVID-19 Based on the ARIMA Model

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Abstract. This paper discusses the unemployment rate of the United States before and during COVID-19. The unemployment rate is always the most important index used to measure the current state of a country's economy. The labor market since COVID-19 hit in March 2020 displays some changes due to the government's policies and economists' advice. This paper uses the autoregressive integrated moving average (ARIMA) model to forecast the future tendency of unemployment in several aspects, such as the layoffs and discharges rate, job openings rate, and hire rate. The research is mainly about how to use different variables to examine the changes in unemployment in the United States after the outburst of the COVID-19 pandemic in March 2020, and comparing the labor market before and after COVID-19. The assumption that the COVID-19 pandemic does not bring a negative influence on the unemployment rate was overturned after collecting the data and using the model to test, and this paper has drawn a new conclusion.

Keywords: The US unemployment rate, COVID-19, ARIMA model.

1. Introduction

The COVID-19 pandemic has been taken place in the US in March 2020 and the overall economic situation has been changed a lot during the pandemic. People's lifestyles were compelled to change due to the government's policies and the economic situation was not optimistic as well. During the great pandemic, it is normal that the labor market will be influenced a lot since the society is mainly composed of people and the job searching rate reflects people's basic guarantee of living. In the week which ends on March 21, there was an unprecedented unemployment insurance filing which were around 3.3 million workers doing that. This has never happened before, even during the time of great recession [1]. This was what the COVID-19 first taken place in the US, and it has already brought instant and dramatic changes to the labor market in only a few weeks. When talking about the labor market, the unemployment rate must be talked about since it represents the number of unemployed as a percent of the labor force. When discussing the unemployment rate in macroeconomics, the finding rate and separation rate must be taken into consideration. The job-finding rate is the pace at which the jobless workers move into the labor market, whereas the separation rate is the "quitting rate" of workers at their positions. The job-finding rate can tell people more about the persistence of unemployment on each person's basis while the unemployment rate gives people information about how much slack is the labor market [2]. Macroeconomists have been collecting data and finding empirical evidence, and they used the data to elicit a conclusion – Most people think the unemployment rate increases in recessions as firms fire workers. However, most people are wrong. According to the macroeconomists' research, the unemployment rate does not increase during economic depressions since they use the Labor Flow Model which takes the separation and finding rate into account. In terms of the model, they believe that the separation rate increases in recessions instead of the unemployment rate. During the COVID-19 pandemic, the US economic situation has been depressed and the government had to issue policies that restrained the development of corporations including some listed companies and small businesses. Since the companies have faced a financial crisis, they have to make changes to the labor and capital, and labor will be the first to be cut. People depend on their jobs and salaries to survive, and the living standard of the citizens reflects a country's economic situation.

When this paper first made an assumption about the US labor market and the unemployment rate during COVID-19, the unemployment rate is assumed to not increase at the beginning of the pandemic since there will be the time cost and the cost of hiring new workers which will make the companies minimize their profits. Companies faced the economic crisis at that time and if the owners want to sustain the living of the companies, they have to find ways to minimize the cost. Therefore, they would not choose to fire workers at the beginning since time does not allow the owners to hire new workers, because it needs time to be acquainted with their new jobs and throw into them for new workers. However, after collecting data from the U.S Bureau of Labor Statistics and building the ARIMA model to forecast the future tendency of the US labor market in several aspects, this assumption was overturned. BLS was one of the most authoritative institutions in the US to collect data and gather specialists' thoughts about the labor market. The most traditional and followed index of labor market well-being was provided by BLS household and employer surveys [3]. The ARIMA model was used as a reference to see the future data and situation of the labor market in the United States, and it can reflect the influences of the COVID-19 pandemic on the unemployment rate since if the pandemic had negative impacts on the labor market, then the forecasting data should go up and back to the normal average of the data before COVID-19 appeared in the US.

2. Layoffs and Discharges Rate

As Figure 1 shown, an ARIMA model is built to forecast the future tendency of the layoffs and discharges rate which shows that the rate falls back to the average before COVID-19. The ARIMA model is denoted as ARIMA (0, 0, 1) with a non-zero mean which means MA (1), and the model may be referred to base on the non-zero parameter. Time series data Xt where t is an integer index and Xt are real numbers. This paper also considers the parameters of the moving average and the error terms. The error terms are generally assumed to be independent, identically distributed variables. The model uses the data from BLS which includes the period span from 2000 to 2022 (22 years), enough to be used as references to forecast the future trend.

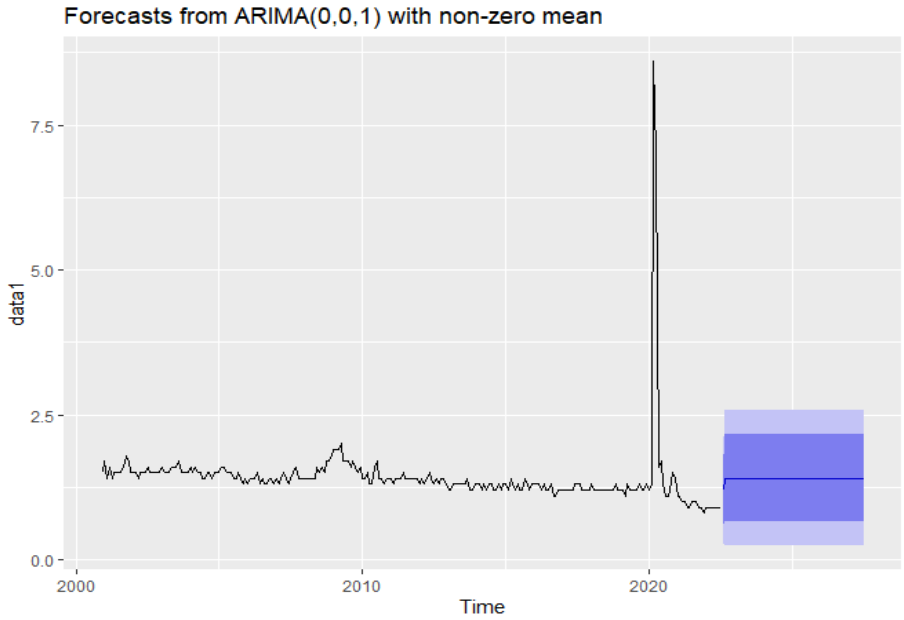

Figure 1. Forecast of layoffs and discharges rate
(Photo credit: Original)

Layoffs and discharges are the number of layoffs and discharges during the entire month. The COVID-19 pandemic's quick changes to the economy make it impossible for policymakers to examine the labor market using official metrics. This poses a serious threat to the country's status quo because they will need to develop new policies to address the problem. Thus, the economists find a layoff notices file under the Worker Adjustment and Retraining Notification (WARN) Act which

provided timely data during the COVID-19 pandemic in some states in the US. According to the data provided, it found that the number of WARN layoffs rose dramatically from around 1000 per week to 7000 per week just from February to late April [4]. In March 2020, the COVID-19 pandemic has been taken place in the United States and the number of layoffs increased dramatically as soon as the pandemic started to being economic crisis to the corporations. The entrepreneurs take immediate actions which include firing the workers according to the data. Moreover, it obtains the similar conclusion from the BLS data. From the United States Bureau of Labor Statistics, the layoffs and discharges rate are about 2.0% from 2000 to 2020 February. However, since March 2020, the data grow sharply to about 8.0% which is an anomaly.

3. Hire Rate

The hire rate is closely related to the finding rate which has been discussed in the beginning. Firing workers at the beginning of the pandemic or economic depression is not seen as a wise decision from macroeconomists' point of view. If entrepreneurs lay off employees, it is inevitable that they need to spend time and energy recruiting and training new workers. Then, the companies would have to pay more to the workers during the economic recession. It is not simple to hire capable and cheap labor during that time. The time cost and money cost will lead the company to a larger burden and the company will easily bankrupt. When exit rates increase dramatically, hire rate were more stable and robust during the pandemic. More than 80% of the situation showed that exit from employmet brought more influences to unemployment, rather than decreased hiring [5].

The COVID-19 epidemic caused the unemployment rate to rise by 10.3 percentage points in April 2020 (BLS 2020). By April 2020, 25% of people who were employed in April 2019 were no longer working. After using the ARIMA model to predict the tendency of higher rates (in Figure 2) for future five years, it is found that the hire rates will become to be a little higher than the average level before the pandemic. The reason that the rate becomes a little bit higher may be that the companies need more workers to rebuild the system and develop their companies. According to the model, the hire rates will mainly be around 4.3% but there may be a range of change from 3% to 5.3%.

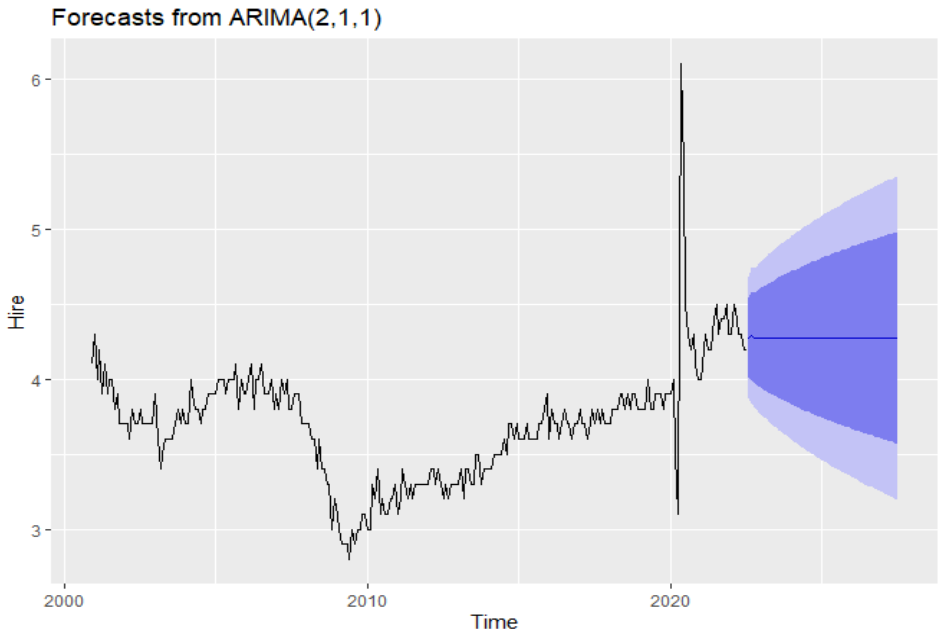

Figure 2. Forecast of hire rate
(Photo credit: Original)

According to BLS, the hire rate is not as stable as the layoffs and discharges rate from 2020 to 2022. The hire rate was about 3.5% to 4% from 2000 to 2007, but when the financial crisis of 2008 or called as Global Financial Crisis (GFC), the hire rate decreases dramatically to around 2.0%. This

data represents that the hire rate will decrease when there is an economic recession. During the GFC, financial institutions from all over the world suffered and one of the most famous events is the bankruptcy of Lehman Brothers on September 15, 2008. When looking at the 2020 COVID-19 pandemic, BLS shows that there is also a sudden decrease in the hire rate from 4% to about 3%. Nevertheless, the hire rate proliferated suddenly to above 6% which has never been reached since 2000 and even earlier. There are several reasons behind this change, but the most significant one may be that the government issued new policies to try to make the economic situation get back on track. The companies have to hire more workers to ensure the production and working of the corporations, so the hire rates suddenly come high.

4. Job Openings Rate

Since the labor market's main function is to hire workers, the job openings rate truly reflects the companies' and the labor markets' willingness to absorb more working force. If the employers need more workers and want to hire workers, there will be a colossal number of job openings, and this is a sign of confidence in the economy and a demand for labor is very important the labor market [6]. When the labor market is capable and willing to hire more workers, then it is a healthy economic situation. Although a colossal number of people firmly believed that the job openings rate will be very low during the economic depression, the data and the testing results may not be as same as what they thought. Due to the covid-19 virus, lots of workers made decisions to leave their jobs earlier than they planned before since there are higher risks of losing their jobs during the pandemic [7]. There are many workers who lost confidence to find jobs during the economic crisis and they tend to retire themselves instead of the corporations firing them. Such a situation may create an illusion that the job openings rate will be extremely low so that there are lots of unemployed people and the unemployment rate is high during COVID-19. The ARIMA model built (in Figure 3) shows a decrease of job openings since 2020 COVID-19 pandemic. Nevertheless, the rate is still higher than most of the time period from 2000 to 2020 which is around 4%, and ARIMA (2, 2, 1) is applied to measure this variable.

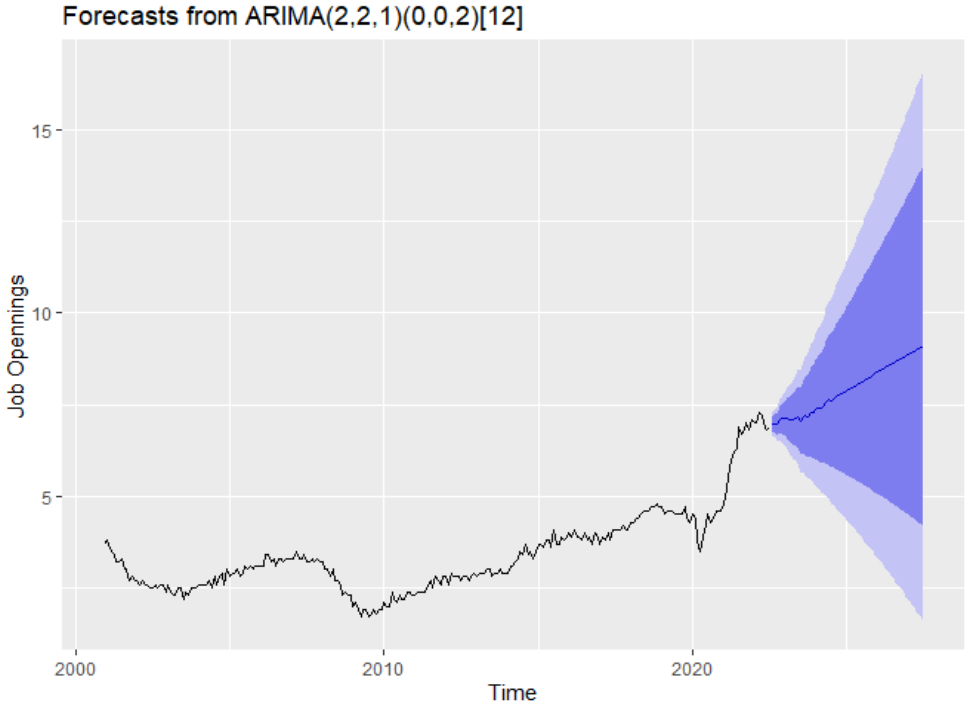

Figure 3. Forecast of job openings rate
(Photo credit: Original)

5. Discussion

The empirica results show that the unemployment rate actually increases during COVID-19, and at the beginning of the pandemic, the changes were dramatic. This overturned what this paper has assumed before that the pandemic and the economic depression will not bring an enormous negative impact on unemployment. Except for the layoffs and discharges rate, both the other two variables display a sudden decrease at the beginning of the COVID-19 pandemic and then proliferate from 2021 which illustrates the unstable situation of the labor market during the economic strike and depression. The ARIMA models show that all three variables will be back to the average level since 2022, although there may be a huge span of changes for the next five years' forecasts. The fault tolerance should be built when the government and economists research this topic, especially the labor market since it is a fluid market. The market's instabilities are difficult to accurately capture for accurate projecting, despite the fact that the econometric phenomenon can reach a variety of external variables [8]. Therefore, the only recommendation is that the government and policymakers use the model as a reference. From this paper's view, the US government endeavored to ensure that the economy ran on time when COVID-19 occurred by reopening the market. The unemployment rate initially rose significantly, but it quickly decreased once the government implemented new regulations and reopened the market. It declined even more swiftly than predicted by economists in 2021, the seventh-fastest year for job growth since World War II with a total jobs growth of 4.6 percent [9]. Therefore, the government's obligation and the most significant job is to always pay attention to the trend of the world exonomyand predict the next changes in the situation, and be ready to face economic crisis at any time. It is crucial that the foresighted governments and organizations begin to consider how to deal with the short-term and long-term effects of the economic catastrophe brought on by COVID-19 [10].

6. Conclusion

The layoffs and discharges rate, the hire rates, and the job openings rate all can represent the unemployment rate of the United States. However, they are just used as references when the government thinks about a broad view of the true economic situation. The end goal is to make people in the country have works to feed themselves and therefore, the labor market is such an important field. To fulfill that, government should come up with methods and plans which will make the companies and the markets go through the crisis. When there is an economic depression taking place suddenly, since it has happened, what the government should do to make the corporations guard against it. At last, the ARIMA model cannot give the economists and the governments exact data for the future trend, they can only be used as references for future policy issuing and the government should find measures to make the unemployment rate stable and sustain at its normal level.

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