China's Labor Market Dynamics under Covid-19 Pandemic: Youth, Adult, and Overall

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Abstract: At the end of 2019, COVID-19 suddenly emerged in various countries around the world. Its rampant global spread has resulted in immeasurable loss and effect for most nationalities and citizens. Unfortunately, the indeterminacy elements of economic development and environment increased dramatically especially in China caused by the pandemic situation, the depression of economy further highlighted contradiction of the employment structure. Citizens of different ages faced divergent challenges like staff reduction, great competitive pressure of obtaining occupation, and so on. As a consequence, diverse elevation of unemployment rate occurred in all citizens, youths, and adults respectively. In this article, three divergent unemployment rates for overall citizens, youths, and adults respectively are selected and the data from January 2018 to October 2022 are extracted. This research applies ARIMA Model to structure and analyze data in order to study the scope of addition and subtraction of three separate unemployment rates on account of serious pandemic. Meanwhile, based on the prediction of future trend of China's unemployment rates from January 2022 to October 2022 and contrasting it with the actual data, it can be seen obviously that over unemployment rate increases dramatically as a result of pandemic, and the most heavily affected part is one in young citizens. Finally, this paper furnishes referential recommendations for pandemic policy in economic progress and employment aspects.

Keywords: COVID-19 pandemic, China, unemployment rate, youth, ARIMA Model

1. Introduction

The sudden outbreak of COVID-19 pandemic situation caught each country around the world off guard. The development of economy inevitably suffered a huge negative impact due to it, including the decrease in import and export value, rising stress for each industry, and other comprehensive factors. According to customs statistics, the dimension of import and export of commodities increased gradually in 2019, total import and export value reached up to 3.01 trillion Yuan which created a monthly historical peak in China [1]. However, the World Trade Organization (WTO) indicated that the global trade level is predicted to shrink by 13%-32% as a result of pandemic in the "Global Trade Data and Prospects" report published on April 8, 2020 [2]. Meanwhile, China's total national foreign trade import and export volume is $9432.2 billion in the first quarter of 2020, which decreased by 8.4% year on year and 13.3% in export aspect, published by General Administration of Customs [2]. Additionally, total consumer retail sales decreased by 19% over the same period of the previous year,

the actual decline was 21.9% after deducting price factor, and investment in fixed assets fell by 16.1% [3]. The total profit of industrial enterprises above the national scale decreased by 36.7% year-on-year, 27.5% in the mining industry, 38.9 in the manufacturing industry, 28.6% in production and supply industry of electricity, heat, gas, and water, and 17.5% in construction industry [3]. It is worth mentioning that in 41 industrial categories, there is a decline in total profit of 39 industries year-on-year, the serious one is automobile industry whose decrease proportion reaches 80.2% [3]. All the reduced behaviors always are manifested by employment reduction. Thus, some studies predict that foreign exchange industry would lose 540000 to 10000000 people's direct employment opportunities [4].

The fact mentioned above further affected demand side, investment, consumption, and so on. Meanwhile, directly stroke towards tourist trade, transportation industry, catering services, and so on. Those businesses always have high personal mobility, which means the employees there have to face a high risk of getting infected especially rural migrant workers. Survey data clearly show that the proportion of peasants in accommodation and catering, transportation, and entertainment industries is very high, which are 66.4%, 56.8%, and 30% respectively [4]. The percentage of flexible employment people reach 26.3%, 28.4%, and 10% [4]. In other words, when the COVID-19 pandemic appeared, the first to suffer shut-down or lay-offs are flexible employment people. After that, such people cannot find another suitable and steady career easily because most of them are not educated.

The probability of infection during COVID-19 pandemic is very high. Therefore, the motivation of citizens to work is greatly reduced. Because of the dangerousness and uncertainty about the duration of the outbreak, most people who worked in those businesses with high mobility would transfer their jobs after deep consideration. Additionally, as the policies of the government, pandemic prevention and control have been implemented for three years. Due to its bounce, there was an upgrade in pandemic prevention and control from soft isolation to compulsive isolation, to normalized isolation, and further to full liberalization. However, in this process, the policies have seriously affected labor mobility, decreased the quantity of employment in basic industry, and encumbered economic development in China. Especially in Shanghai which is the economic and financial center of China, there was a serious stagnation for one month. Plenty of small enterprises were confronted with bankruptcy risk and service industries were in a huge depression such as hotels. Even in a big company, it is not avoidable to reduce the staff to varying degrees. The data display that total number of on-campus recruitment of internet companies in the class of 2022 lopped over 15% to 20% than the previous year [5]. However, there is no significant increase in salary aspect [5]. Also, Pull Hook recruitment Data Institute report indicates that the demand index for talent has experienced an overall decline by 26% since November of the same year [5].

Employment is the process of combining labor and physical capital to obtain labor payment while creating social wealth [3]. From January to April 2020, 3.54 million new employments were created in nationwide cities and towns, less an increase of 1.05 million year-on-year. The unemployment rate in nationwide cities and towns is 6% in April 2020, which is one percent higher than in the same period in 2019 [3]. Affected by the shutdown policy, the number of employees in March 2020 decreased by over 6% than it in January 2020 [3]. Unfortunately, college graduates in China are approximately 8.47 million, refer to the affected proportion of employment of graduates during SARS in 2003, it is predicted that there are about 2.62 million would be affected [6], because of the school delay opens caused by COVID-19 pandemic, corporate recruitment is disrupted which means college graduates loss three precious months to prepare for employment [6]. According to the survey results, it is clear that there is a whiff of a decrease in employment rates of graduates, which are 86.43% (2018 class), 84.96% (2019 class), 83.63% (2020class), and 82.78% (2021 class) respectively [7].

It is worth mentioning the loss of a job is a heavy trauma for the whole family in such a severe situation including adults and youths. Something divergent is people of different ages might suffer desperate unemployment effects and rates. Therefore, it is meaningful to study how COVID-19 pandemic affected the unemployment rate among overall citizens, youths, and adults. This article selected the data for divergent three groups from January 2022 to October 2022 (National Bureau of Statistics) to process, predict, analyze and contrast, in order to put this hot issue under objective data detection. In detail, this research divides unemployment rates into three distinct situations in order to further analyze the influence of pandemic. In the beginning, refine three different data into more smooth and more stationary ways. Then, get PACF and ACF plots of them in order to build the best ARIMA Model. After that, use the data from January 2018 to December 2021 to predict the unemployment rates from January 2021 to October 2022 respectively. Finally, compare the predicted data with actual rates at the same time to see how pandemic affected three types of unemployment rates.

The remaining sections of this article are arranged as follows: Section 2 is research design, which introduces data source, ADF test, and ARIMA Model specification. Section 3 indicates the order of models, forecasts and analysis of the data of three divergent unemployment rates. Then contrast this research with existing articles, and point out the difference and innovation. Finally, the background of this research is reviewed, the research methods and contents are explained and the conclusion is elaborated in section 5. Additionally, section 6 is only relative to references in this research.

2. Research Design

2.1. Data Source

Around the world, there only a few countries could implement policies to treat COVID-19 pandemic for such a long time. Therefore, China's unemployment rates were chosen as analyzed data in this study, which extracted monthly unemployment rates for overall citizens, youths (16-24), and adults (25-59) from January 2018 to October 2022. In order to see the effects of appearance of pandemic, which was born in December 2019, two-year data without pandemic were chosen to give the comparison. It is necessary to improve all the data by logarithm and differences to make the p-value less than or equal to 0.01 in order to make the data steadier for gaining better comprehension and utilization. After getting the modified data, examine them by Augmented Dickey-Fuller Unit Root Test to get suitable values of AR(p) and MA(q) in ARIMA Models.

All the data this research uses come from the index of surveyed urban unemployment rates nationwide in National Bureau of Statistics.

2.2. Augmented Dickey-Fuller (ADF) Unit Root Test

Augmented Dickey-Fuller (ADF) Unit Root Test is always used to examine the relationship between lag difference terms "m" and the orders of AR(p) and MA(q) in ARIMA Models [8]. In other words, this test is one method to estimate whether the sequence is stationary by testing whether the roots of unity exist. In common, the p-value is less than or equal to 0.01 means that the sequence is steady. As we can see in Table 1, the t-statistic for overall citizens, youths, and adults are 0.0031, 0.0156, and 0.2376 respectively, which means the sequences for overall citizens and youths are stationary. Therefore, it is necessary to modify the unemployment rate for adults by logarithm and difference, then get the steady array whose p-value equals 0.0099.

Table 1: ADF test.

Variables	t-statistic	p-value
Raw		
Overall	-4.302	0.0031***
Youth	-3.820	0.0156**
Adult	-2.696	0.2376
Difference		
Adult	-3.962	0.0099***

2.3. ARIMA Model Setting

ARIMA (Auto-regressive Moving Average) Model is a type of common random time series model, set up by Box and Jenkins. Therefore, it can be named B-J method as well [9]. The time series domain analysis methods reveal the law of development of time series in sequence autocorrelation aspect, mainly including AR Model, MA Model, ARIMA Model, and ARCH (autoregressive conditional heteroskedasticity model) and various derived models [c]. ARIMA Model relied on AR and MA Models to develop, which possesses a high accuracy in the short-term forecast. Also, own the advantage of overcoming a lack that AR and MA Model can only deal with stationary time series [10]. Meanwhile, compared with ARCH Model, it has a simple structure and features of few input variables [10]. The principle relies on is that some time series are random variables depending on time (t), although a single sequential value that constitutes the time series has uncertainty, there is a kind of regularity for the change of the entire sequence, which can be described by mathematical model like ARIMA Model [9]. The analytical investigation of ARIMA Model demonstrates intrinsically the structure and characteristics of time series and gets the best prediction in the lowest variance [9]. Additionally, ARIMA Model is only suitable and has relative accuracy for short-term forecasts [9]. In this research, ARIMA Model is used to forecast the unemployment rates from January 2022 to October 2022 for overall citizens, youths, and adults respectively. And then use the forecasting data created by ARIMA Models to contrast with reality.

ARIMA Model is marked as ARIMA (p, d, q), d represents the order of difference, and p and q express the order of autoregression (AR) and moving average (MA) respectively [9]. Its general expression is as follows:

$$y_t = c + \varphi_1 y_{t-1} + \cdots + \varphi_p y_{t-p} + \theta_1 \varepsilon_{t-1} + \cdots + \theta_q \varepsilon_{t-q} + \varepsilon_t \tag{1}$$

In the formula mentioned above, y(t) represents the d-order difference array, ε_t is noise sequence, φ, and θ are the fitting parameters of AR and MA Models respectively [10].

3. Empirical Results and Analysis

3.1. Order of ARMA Model

Generally speaking, building ARIMA Model has three divergent stages, which are pattern recognition, order determination and parameter estimation, and model test [10]. Pattern recognition is mainly on a base of ADF test, PACF (Partial Autocorrelation plot), and ACF (Autocorrelation plot) to confirm the consequence is stationery and order of model (d, p, and q). Parameter estimation is mainly on AIC (Akaike Information Criterion) and BIC (Bayesian Information Criterion) in order to choose the best-fitted model. And model test principally includes the significance examine of parameter estimation and whether the residuals are random independent white noise [10].

After taking the logarithm for each unemployment rate, the data become relatively stationary. The figure below (Figure 1) indicates three divergent groups of PACF and ACF plots, which are for overall, youth and adult unemployment rates respectively. The plots contribute to choosing suitable lag order for both AR(p) and MA. It is demonstrated obviously that the value in lag 4 coincides practically with the critical value, which means it is able to be considered as one of the values of AR(p) in ARMA Model constructed for overall unemployment rate. Therefore, as we can see, there is only one part beyond the critical values for every PACF and ACF plot in the same ARMA Model mentioned before.　In other words, the value of AR(p) can be chosen in numbers 1, 4, and 8 and MA(q) value equals 1.

Similarly, according to PACF and ACF plots in both youth and adult unemployment rates, it is obvious that the value of AR(p) is selected in numbers 1, 2, 6, and 10 in ARMA Model for youth unemployment rate, 9 in the that for adult unemployment rate, and value of MA(q) equals to 1 in ARMA Model for youth unemployment rate, 0 in that for adult unemployment rate respectively.
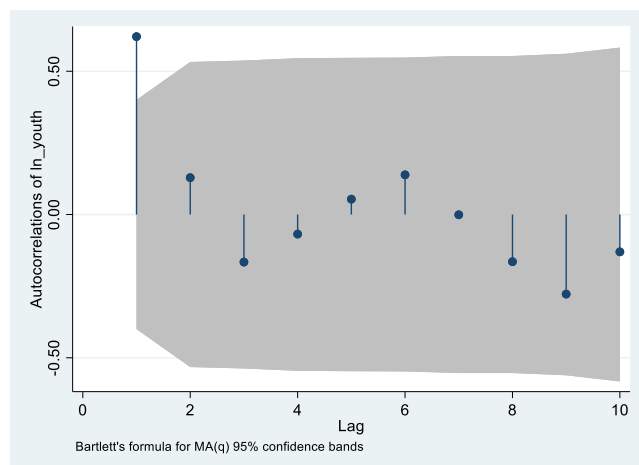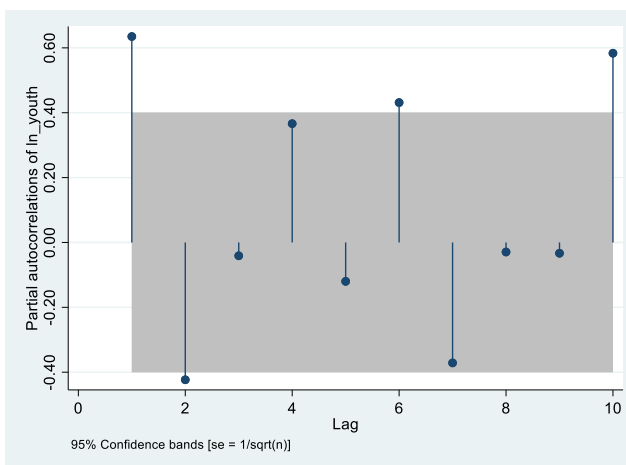
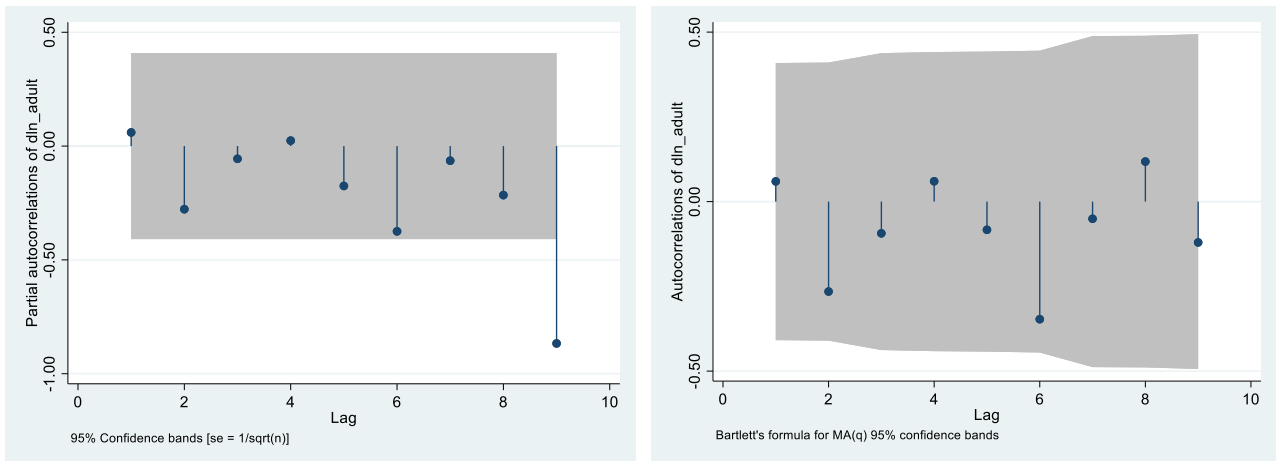PACF   ACF

Overall
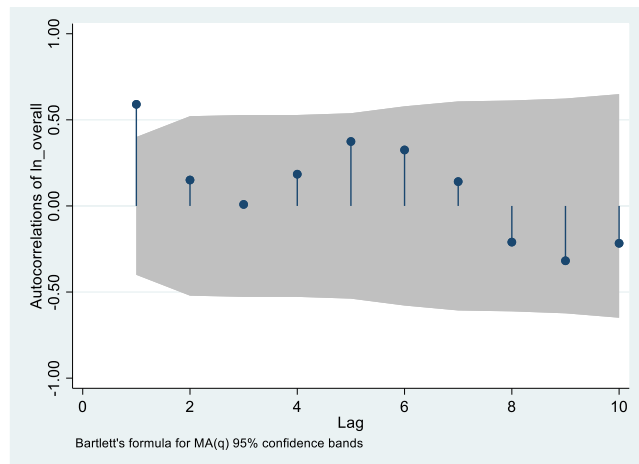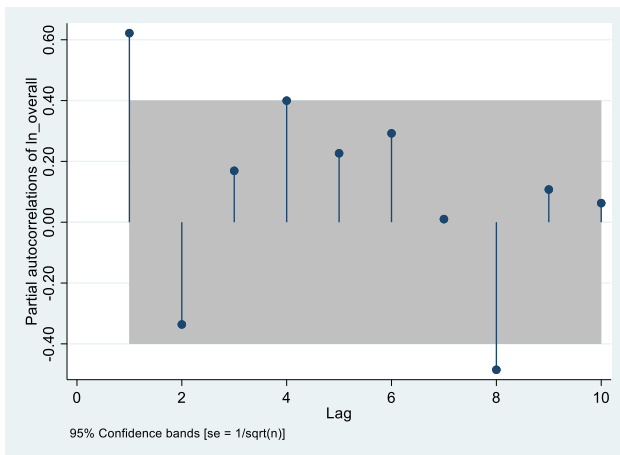
Youth

Adult

Figure 1: PACF and ACF.
Photo credit: Original

3.2. Verification, Prediction, and Analysis

After constructing the models, residuals tests are used, which certify accurately all the residuals of models are white noises (see Table 2).

Table 2: Residual test.

Model	Portmanteau (Q) statistic	Prob > chi2
Overall	14.7887	0.1400
Youth	9.3388	0.5003
Adult	8.4968	0.4850

Unemployment rates for overall citizens, youths, and adults are mentioned below, in Figure 2, it is clear to see that there is a peak for all the data from January 2018 to September 2022 which is 6.2%. That is the time COVID-19's appearance around the world. Before that, a relatively stationary unemployment rate for overall citizens fluctuation. In the second plot, it is demonstrated that according to the trend before, the forecast has to decrease to 5.09% which is opposite to the reality that has a dramatic rising to 6.1% which is only 0.1% lower than the peak for the whole data.

In Figure 3, the whole data, has a rising trend. Before September 2022, it reaches the second peak (16.8%), which is only 3.1% lower than the peak. It is clear that the unemployment rates of youths outdistance far away than overall citizens' and adults' ones. As for the prediction part, it is expected to decrease after January 2020. However, exactly the opposite is true, unemployment rates of youths dramatically rise in the first quarter, and then decline rapidly at the same speed until it gets the same percentage before the appearance of COVID-19 pandemic.

As can be seen about the unemployment rate of adults in Figure 4, the same thing happened as it for youths. There is a rising trend after January 2020 and then regresses to the original percentage. However, the only different thing is that unemployment rates for adults use the double time to finish the regression than youth ones. It is also worth mentioning that the forecast here is only for reference because the unemployment rate is relatively stationary, there are nine zero-value in 23 values after the difference the array.
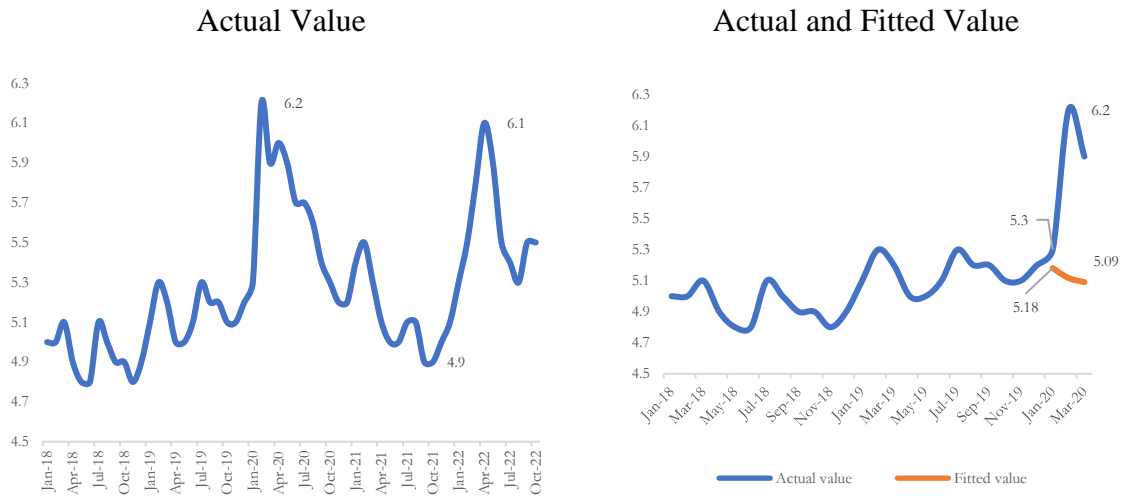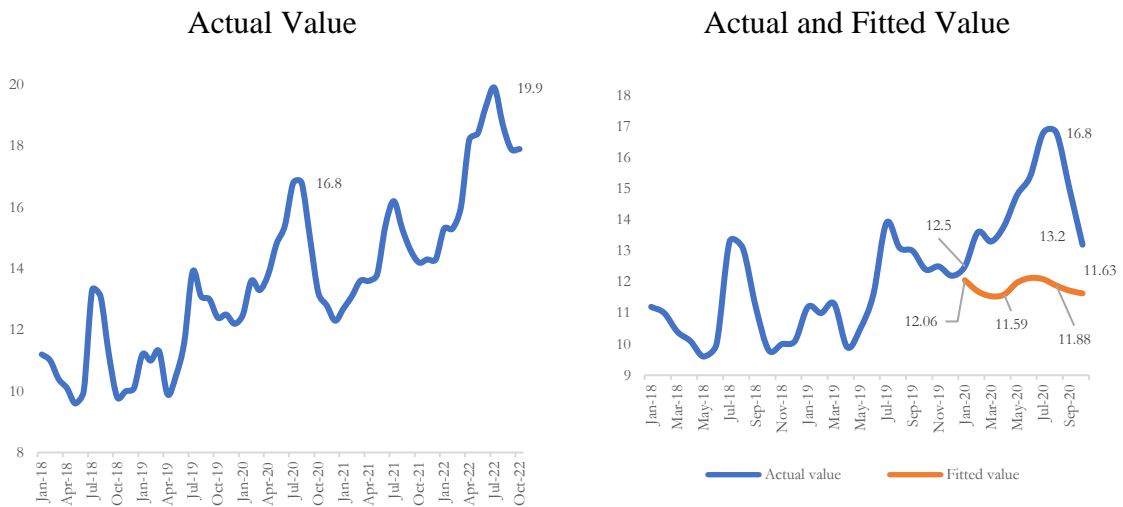
Figure 2: Overall.
Photo credit: Original

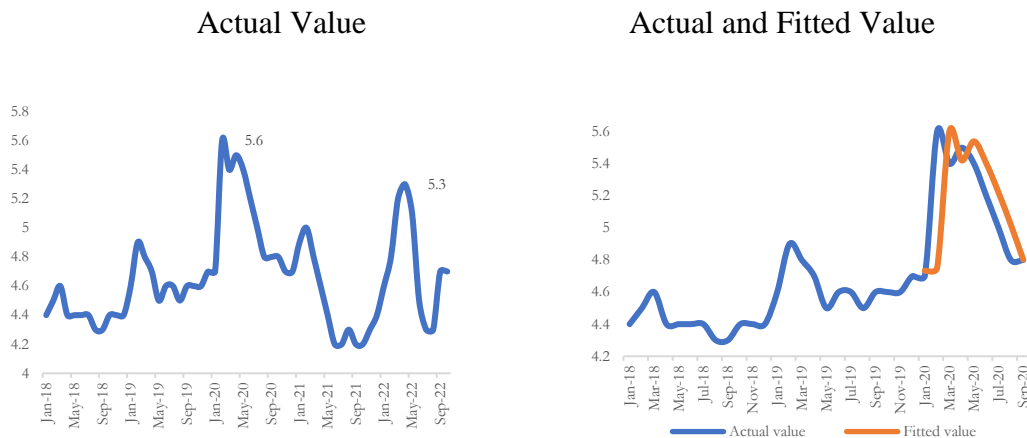Figure 3: Youth.
Photo credit: Original

Actual Value

Actual and Fitted Value

Figure 4: Adult.
Photo credit: Original

4.   Discussion

It is clear that there is a huge effect on the employment rate regardless of age. Three divergent groups' unemployment rates are congruously increasing after the appearance of COVID-19 pandemic. That is the reason why there is no similarity between the forecast and prediction. However, not only the pandemic can affect unemployment rate, there are a few elements in this research. Therefore, it is only can be said that pandemic has a negative influence on employment rate, rather than it caused an increase in unemployment rate.

In the previous study, there are only a few articles about the unemployment rate in China. The difference between this article and others' research is that they focused on seasonal changes in unemployment rate of overall citizens in China, but this article concentrates on the unemployment rate of overall citizens, youths, and adults in detail in order to deeply indicate the effect of COVID-19 pandemic on it. There is not enough strong seasonality in the original data, which is the reason why ARIMA Model is chosen rather than SARIMA Model like the previous study.

Additionally, pandemic has a more serious effect on unemployment rate of adults rather than youths, because the convalescence is longer, which is twice of youths. The first reason for it could be youth always have the less hands-on background and work experience. The stability of their jobs is always poor, which caused a fact that they are easier to be expelled in such conditions of economic depression. The second one is that they are commonly stronger and more resistant, which means they can be qualified in every industry. The attractiveness of the service business for youth makes its labor shortage be filling up rapidly.

To face the situation now, the first thing that should be done is economic recovery. After China's full liberalization, the government should recover the policy of foreign trade as soon as possible in order to bring the hoped-for economic recovery. Then, issue various new notifications in inland areas to motivate people to go back to work, consider the cost of COVID-19 pandemic for employment, and provide appropriate compensation in order to increase the output of basic consumables. Meanwhile, abolish real estate policy to stabilize local economy and finance, and increase the number of labor positions to solve the problem of employment.

5.   Conclusion

COVID-19 pandemic seriously led to the great pressure of employment competition, decreasing total profit, low motivation, limited salary, and high layoff rate. In other words, it caused a dramatic falling down in employment rate and a negative effect in the quality of national life. The unemployment rate of youth is a serious issue because generally, it should be two or three times more than adults around the world, especially in OECD countries, however, it is almost 3-4 times in China. This research uses ARIMA Model to analyze three divergent unemployment rates of overall citizens, youths, and adults respectively in detail, in order to indicate which age group has the most affected unemployment rate caused by COIVD-19 pandemic. As a results, the youth unemployment rate increases by approximately 4.6%, which is 3.6% and 0.9% higher than overall citizens and adults respectively. However, it only uses about 5 months from the highest proportion in 2020 and 2021 to reach the same level before the appearance of COVID-19 pandemic. 8 months and 10 months are used to do the same thing by unemployment rates of overall citizens and adults, which can clearly demonstrate even though unemployment rate of youth has experienced the most serious effect, it is the most resilient. Additionally, there is still the highest point in July 2022 for all the data, which is 3.1% higher than July 2020. It further means the unemployment rate of youth in China has become a serious issue that has to be concentrated.

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