



# An Empirical Analysis of the Unemployment Rate in the United States under the COVID-19 Pandemic

Yuxuan Zhang\*

*Birmingham Business School University of Birmingham Birmingham, UK*

*\*YXZ1191@student.bham.ac.uk*

## Abstract

The outbreak of the COVID-19 pandemic led to a global financial crisis. As one of the most severely affected countries, the United States experienced a significant economic shrinking throughout the year 2021 and its economy sank into the worst recession in the last 74 years. The unemployment rate, as a typical economic indicator, has risen sharply. This paper conducted an empirical analysis to understand the impact of GDP index, exchange rate and trade deficit on the unemployment rate in the context of the pandemic. The outbreak of the pandemic severely damaged American trade and capital markets as a crisis event. It is of great practical significance to empirically analyze whether raising GDP, exchange rate and reducing trade deficit can alleviate the high unemployment rate in the United States during the pandemic. This paper used the data on the website of the United States Bureau of Labor. Multiple linear regression was performed based on time series data from June 2019 to February 2022. The results show that GDP, as the main factor, is closely related to the unemployment rate, and increasing GDP will reduce the unemployment rate. The impact of the trade deficit on the unemployment rate is not great, which may be related to its industrial structure. The exchange rate did not affect unemployment.

**Keywords-** *The unemployment rate; pandemic; GDP; exchange rate; the trade deficit*

## 1. INTRODUCTION

Since the outbreak of the COVID-19 pandemic around the world, more than 70 million cases have been confirmed in the United States (coronavirus data hub, 2021). Fields of the United States economy are taking a significant toll. Such as holiday plans were cancelled, consumers cut back on restaurant meals, and businesses were forced to close due to understaffing. The unemployment rate, as a core indicator of the utilization of labor resources, reflects the impetus experienced by growth. Also, the rise or fall of Gross domestic product (GDP), fluctuations in the exchange rate, and the current trade deficit between countries are inextricably linked to the unemployment rate. Okun's Law states that there is a negative correlation between GDP and unemployment rate changes [1]. Subsequently, the China-United States trade war during the pandemic has resulted in a serious trade deficit for the US. This research will discuss the impact of change in the United States GDP index, the China-United States trade war, and the exchange rate on the unemployment rate during the pandemic.

Considering the main factors of the United States unemployment rate and the impact of the exchange rate on the unemployment rate. Huang and Xie used panel data from the industry level to study the unemployment rate in the United States [2]. The empirical analysis results show that the rise in the unemployment rate in the United States is related to its own economic growth power. In addition, He, et al. investigated the impact of the real GDP growth rate and the exchange rate of the United States dollar in foreign economic relations on the unemployment rate of the United States in the early 1980s [3]. The author uses least square regression analysis on the unemployment rate. On the other hand, as the financial crisis spread around the world, fiscal deficits and political factors constrained exports. Tong pointed out the effect of the real effective exchange rate on long-term and short-term unemployment rates in the United States [4]. In the process of empirical analysis, she used the co-integration method to test the long-term stable relationship between variables. Although the empirical analysis was used differently, the results show that the appreciation of the exchange rate has increased unemployment in the United States to some extent, but not primarily.

When analyzing GDP and unemployment rate, Farzad empirically explored the correlation between the unemployment rate and GDP by using 25 years of American quarterly time-series data [5]. This paper assumed that the relationship between the two variables is a strong and stable negative correlation and applies the Dickey-Fuller test to the two variables and finds that both variables are non-stationary. Gui and Zhao also used the time series data to analyze the United States. However, the data was not compared with data from other countries, the model lacks certain checks [6]. Through their estimates of the United States unemployment rate under the pandemic, the period that had the greatest impact on the United States unemployment rate was April to December 2020. Moreover, Pan pointed out that the change in the number of the labor force will also have an impact on the unemployment rate during the pandemic [7]. Time series data explained the fluctuation of GDP in response to the change in time. In the analysis of both, it is found that GDP has significant economic significance to the unemployment rate.

When a country starts to run a trade deficit, it means that the country's foreign trade is in a disadvantageous position during the period. Wang established an output analysis model for trade and employment to measure the employment effects of China and the United States, respectively [8]. The empirical results show that the healthy development of The United States-China trade can better promote manufacturing employment in the United States and reduce the unemployment rate. However, since the data introduced by the author's model is only from 2000 to 2014, the results of the data are not convincing for the current trade situation. Yin compared the United States-Japan trade deficit and the impact of The United States-China trade deficit on Employment in the United States through empirical analysis [9]. The authors tested the stationarity of the time-series data through the Vector Autoregressive Model and decomposed the variance of the forecast error. Ren pointed out that the trade friction between China and the United States was gradually amplifying the negative effects on both sides [10]. For the United States market, the slump in the United States exports to China has exacerbated inflation in the United States which is likely to have an impact on unemployment. Firstly, this research presents an introduction and a related literature review. In the second place, the relevant hypotheses and the variables and data used in the model have been described. Thirdly, the research explains the results of the model and gives an analysis and finally summarizes the whole research.

## 2. METHODOLOGY

In the data and empirical analysis literature, some analysis of the impact on the unemployment rate is only in the healthy state of the national economy without the environment based on the pandemic. Meanwhile, in the

empirical analysis, some data are too old to analyze the United States economy under the pandemic. To this end, this research makes an empirical analysis of the unemployment rate in the United States based on updated data. Time series data and multiple linear regression are used to analyze the unemployment rate in this research on GDP, the exchange rate between China and the United States, and the impact of the trade deficit on the unemployment rate in the United States.

### 2.1. Empirical approach

In the method of empirical analysis, Qian used regression analysis to analyze the factors and type decomposition of China's unemployment rate changes [11]. The author took the unemployment rate from 1981 to 1996 as the explanatory variable, and the unemployment rate of the previous year, economic growth rate and structural change index as the explanatory variables. The author referred to the STO index used by Stoikov [12]. "E" represents the total number of employees, " $E_i$ " represents the public economy, " $\Delta E$ " represents the change rate of employment.

$$STO = \sum_{i=1}^n |\Delta E_i - \Delta E| E_i / E \quad (1)$$

$$u_t = 0.746 + 0.601u_{t-1} - 0.052Y + 0.033F + 2.246STO \quad (2)$$

The regression analysis and the T-statistic of the variables is very high, which has statistical significance. This indicated that all explanatory variables influence the unemployment rate. In the empirical analysis of this research, the researchers will take the unemployment rate during the pandemic as the explained variable, and the data of exchange rate, GDP, and trade deficit as the explanatory variables, using regression analysis to judge the impact of the unemployment rate.

Moreover, Tong used the number of registered unemployed in cities and towns in different provinces in China as the explained variable, and the explanatory variables were the regional GDP, CPI education expenditure and population and performed multiple linear regression [13]. Firstly, the author preprocessed the data and found that the effect of CPI on the unemployment rate was not significant. At the same time, the population and GDP in the model were significant in multiple models. For this model, only the interaction term of population and GDP was saved. Due to the marginal effect, the impact of population on unemployment is non-linear. For this reason, the author added the square term of population and  $\ln$  (GDP) to the model to improve the model. After nonlinear processing of the variables, the model was as follows.

$$Y_i = \beta_0 + \beta_1 edu fee_i + \beta_2 popu * GDP_i + \beta_3 \ln GDP_i + u_i \quad (3)$$

The results of the model suggest that GDP should not only be considered when making economic policies, but education spending and controlling population growth

should also be considered. The author's method of preprocessing the multiple linear regression model and testing multicollinearity is inspiring to the researcher. The modelling process in the paper and how to analyze the results according to the data can be referenced in this research.

## 2.2. Methodology of Data Collection

In this research, the data collection is divided into two stages. The main research methodology is collecting the primary data from the US Bureau of Labor Statistics. And the second data in this research is mainly from academic books and periodicals. These secondary data can be downloaded from the Internet or from journal databases. And the data is shown in TABLE 1.

## 2.3. Data Processing and Modelling

Based on this research, the researcher investigates changes in GDP in the United States, the United States exchange rate fluctuations against China, and the United States-China trade deficit on the unemployment rate during the pandemic. The researcher chooses time-series data because the data is collected at different times and changes over time. By collecting and arranging the data, the researcher found that the pandemic began in December 2019. To facilitate the comparison between the economic situation of the pandemic and the healthy economic situation, the researcher counted every month from the second half of 2019 to February 2022. The researcher uses the United States unemployment rate as a dependent variable and data on GDP, exchange rates, and trade imports and exports as explanatory variables. The model for this can be expressed as

$$Unrate_i = \beta_0 + \beta_1 GDP_i + \beta_2 ER_i + \beta_3 EX_i + \beta_4 IM_i + \beta_5 TD_i + u_i \quad (4)$$

The " $\beta$ " is the correlation coefficient used to explain the independent variable to the dependent variable, and " $u$ " is the error term existing in this regression. However, because the data in the observation of GDP and imports and export are too large compared with the unemployment rate, the model will have an insignificant phenomenon in the regression process. The researcher carries out data changes, i.e., logarithmic transformations, for the three variables of GDP, Export, and Import. In this way, the relationship between the data can be more easily seen, and the absolute value of the data can be reduced to make the data more stable. Thus, the model changes to:

$$Unrate_i = \beta_0 + \beta_1 \ln GDP_i + \beta_2 ER_i + \beta_3 \ln EX_i + \beta_4 \ln IM_i + \beta_5 TD_i + u_i \quad (5)$$

**TABLE 1. DATA ILLUSTRATION**

Data name	Abbreviation	Data definition
Unemployment rate	Unrate	The number of employed people who meet all employment conditions is still unemployed.
Gross Domestic Product index	GDP	The final production activity of all resident units in a country (or region) over a given period.
Exchange Rate	ER	The rate of exchange between two currencies.
Exports	EX	Physical goods leave the place of production and are shipped around the world.
Imports	IM	Purchase of raw materials, products and services for production or consumption from non-local residents.
Trade deficit	TD	The balance between Export and Import.

## 3. RESULTS AND DISCUSSION

In this regression model, 30 observations were used for GDP, 32 observations were used for import and export data, and 33 variables were used for other data, since the data on the official website had not been updated to February 2022 in time. The data is shown in TABLE 2. The investigator conducts multiple linear regression on the model by using STATA, and the results are shown in TABLE 3.

The results show that under the influence of the pandemic in recent two years, the fluctuation of GDP and import and export trade will affect the unemployment rate. But changes in exchange rates did not affect the unemployment rate. According to STATA regression, the fluctuation of the exchange rate between the United States and China in the linear regression model is not significant. GDP and the United States-China trade import and export data are significant at the level of 1%. For the variable of GDP, the T-statistic is -17.67 and the corresponding p-value is less than 0.001. The coefficient estimate is negatively and statistically significant at 1% level. It indicates that a 1% increase in GDP index is associated with a decrease in the unemployment rate of -1.08 units,

ceteris. As for the exchange rate, the estimated coefficient is negatively -1.057 and the p-value is 0.237. The p-value of these explanatory variables is not significant, so there is no explanatory power if the variation of the unemployment rate. In addition to export, the coefficient estimate is negatively -7.75 and statistically significant at 1% level since the t-stat is -3.62 and the p-value is less than 0.001. one percentage point increase in export will decrease the unemployment rate by -0.0775 units, ceteris paribus. Meanwhile, the t statistic and p-value of the import are 23.85 and 0.000, respectively. The coefficient is positive and significant at 1% level. So, a one percentage point increase in imports will also increase the unemployment rate by 0.2385. Finally, the estimated coefficient of trade deficit, 0.0006, is positive. The p-value is less than 0.001, and it is significant at 1% level. This suggests that the United States-China trade deficit increases will increase the unemployment rate by 0.0006 units for each dollar.

**TABLE 2. DATA DESCRIPTION**

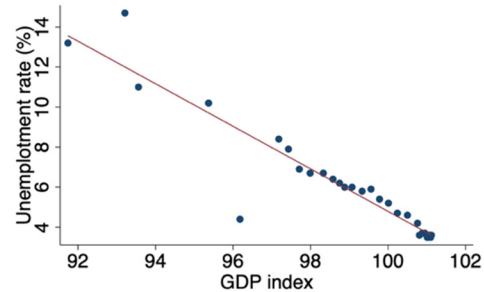
Variable	Observations	Range	Unit
Unrate	33	from 2% to 16%	percentage
GDP	30	from 90 to 102	index
ER	33	from 6.34 to 7.11	USD/CNY
EX	32	from 6,827 to 16,636	billion dollars
IM	32	from 22,720 to 48,033	billion dollars
TD	32	from -15,892 to -31,397	billion dollars

**TABLE 3. RESULT OF MULTIPLE LINEAR REGRESSION**

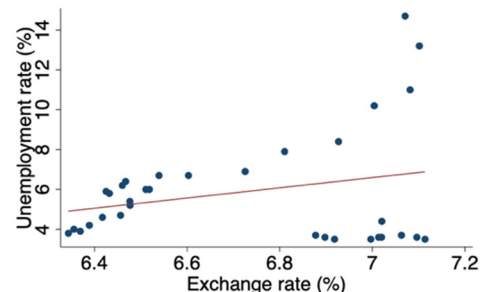
Unrate	Coefficient	SE	T value	P-value	[95% confidence Interval]
lnGDP	-108.42	6.14	17.67	0.00	[-121.08, -95.75]
ER	-1.06	0.87	1.21	0.28	[-2.86, 0.74]
lnEx	-7.76	2.14	3.62	0.00	[-12.17, -3.34]
lnIM	23.86	6.27	3.81	0.00	[10.93, 36.79]
TD	0.00	0.00	3.24	0.00	0.00
Constant	349.31	58.05	6.02	0.00	[229.5, 469.12]

When analyzing the results of the model, the researcher found that the  $R^2$  was 0.942 which was close to 1, indicating that the model had a good fitting level and had a certain experimental value. Thus, the researcher fitted each explanatory variable. In addition,

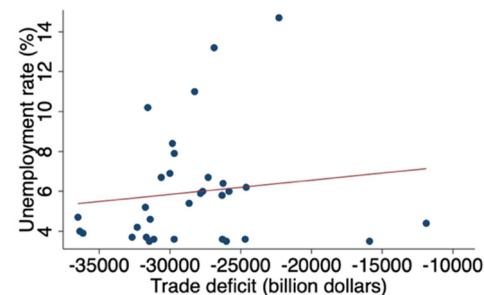
autocorrelation is an inevitable problem in time series. To test the validity of the model, the researcher conducted an autocorrelation test and found that there is no autocorrelation problem in the model. As for the GDP, the impact of GDP on the unemployment rate is consistent with expectations, the more GDP increases the unemployment rate will fall the faster the number of unemployed people will decrease. The empirical results are shown in Figure 1. (a), which shows that the larger the GDP of the United States in the past two years, the smaller the unemployment rate. There is a strong correlation between GDP and the unemployment rate. As a core control variable, GDP has a strong ability to explain the unemployment rate.



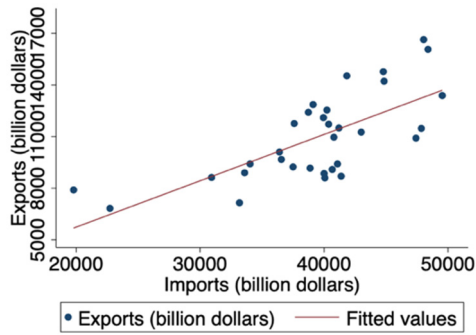
(a)



(b)



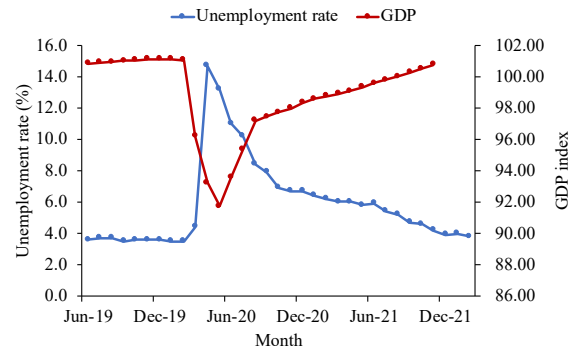
(c)



(d)

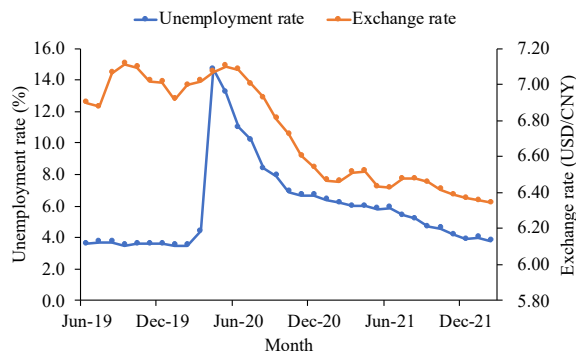
**Figure 1.** (a) A line chart of unemployment and GDP index (b) A-line chart of unemployment and Exchange Rate (c) A line chart of unemployment and trade deficit (d) A line chart of exports and imports.

Compared with other explanatory variables, the rise in GDP has the greatest impact on the unemployment rate. An increase in GDP means that there will be more jobs in the market to attract people to work and even migrants. The results state that a steady increase in the size of the labor force and the level of productivity can keep the unemployment rate stable. At the same time, the relationship between the unemployment rate, the exchange rate and the trade deficit are shown in Figure 1. (b) and (c), respectively. Normally countries with healthy economies can attract global capital flows. And capital flows are an important driver of exchange rates. The corresponding p-value is insignificant. The results indicate that exchange rate fluctuations do not affect the unemployment rate. On the other hand, if there is a negative effect, it will be slightly. There is no significant linear relationship between the trade deficit and unemployment, only a small amount of data suggests that a reduction in the deficit reduces the unemployment rate, but it is not a major factor. The result is a brief demonstration of the relationship between the United States unemployment rate and the United States economic growth and several foreign economic relationship variables under the influence of the pandemic in the past two years. The empirical analysis shows that the main factor affecting the unemployment rate in the United States GDP, while the trade deficit has a few impacts on the United States economy. The effect of unemployment is only a small part, and fluctuations in exchange rates have little effect on unemployment, the researcher discussed the results. The researcher combined unemployment and GDP trends over the past two years. The result is shown in Figure 2. .



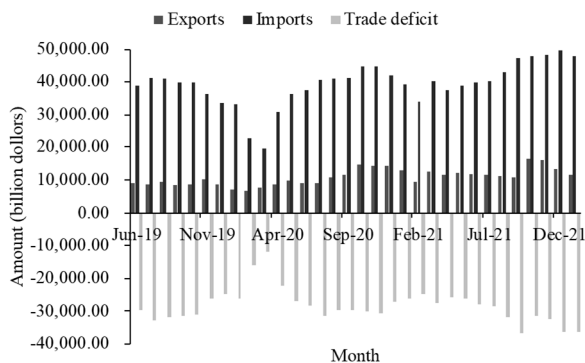
**Figure 2.** The trend of the Unemployment rate and GDP.

As shown in Figure 2. , The trend shows that in April 2020 the GDP of the United States dropped significantly from 101.03% to 93.21% while the unemployment rate rose sharply from 4.4% to 14.7%. Because the pandemic began to spread in the United States in February 2020 and broke out in April, the number of confirmed cases and deaths of the pandemic in the United States has severely hit the labor market, causing structural problems such as labor shortages, and a sharp downward trend in GDP. About three million Americans applied for unemployment benefits and more than 20 million were unemployed in March. In the context of the economic blockade, many unemployed people were forced to give up looking for jobs. The labor force participation rate dropped significantly, and unemployment pressure increased, resulting in a 4.8% decline in the GDP of the United States in the first quarter of 2020. The movements of exchange rates and unemployment are also shown in Figure 2. below. The researcher used the real effective exchange rate. Real effective exchange rate refers to the effect of a country's foreign trade balance on the bilateral nominal currency exchange rate. The sum of these bilateral nominal exchange rates is the nominal effective exchange rate. The nominal effective exchange rate can comprehensively reflect the changes in a country's foreign trade balance. It can be seen from Figure 3. that in the past two years, although the unemployment rate fluctuated greatly, the exchange rate fluctuation remained relatively stable. There is obviously no consistent relationship between the exchange rate and the unemployment rate. It is difficult for researchers to determine a definite relationship between the two indicators.



**Figure 3.** The relationship between the Exchange rate and the Unemployment rate.

In addition, the researcher collated imports and exports data between the United States and China over the past two years and found that the United States has been running a trade deficit during that period. The data is shown in Figure 4. That's because, despite the impact of the pandemic, trade frictions between the United States and China have been a problem. The trade deficit between the United States and China continues to grow due to the trade war between the United States and China through "tariff war" and "technology war."



**Figure 4.** The trade deficit in the United States.

The United States is the number one importer and China is the number one exporter and trade between the two countries has a huge impact on unemployment rate. As the negative impact of tariffs on United States exports; inflation and capital markets exacerbated the United States economic slowdown. The United States manufacturing, transportation and storage industries and business services saw an increase in unemployment rate. However, it can be seen from the model that trade deficit cannot be regarded as the main influencing factor. This is because the trade deficit is formed according to the comparative advantages of each country and is the inevitable result of global industrial division. Different industries have different unemployment rates. For the United States, the trade deficit is only in goods, while services such as data processing, banking, accounting, insurance, and other trade activities have always dominated.

## 4. CONCLUSION

The pandemic had instigated a global economic downturn. Hit by the pandemic, the United States economy shrank for the first time in a full year since the 2008 international financial crisis. The pandemic has weighed on economic activity, employment, and inflation in the United States. More people are applying for unemployment aid, and the significant increase in unemployment as the pandemic intensifies is putting enormous pressure on the nation's economic recovery. For this reason, researcher analyzed the unemployment rate as explained variables, while GDP, exchange rate fluctuations and trade deficit were explained variables. Research indicates that GDP has a strong linear correlation with unemployment rate, trade deficit has a certain impact but is not the main factor, while exchange rate has no impact on unemployment rate. The impact of the pandemic has led to a sharp decline in the United States economy. Unemployment rate increase means that more Americans will lose all or part of their means of livelihood, and America's economic growth momentum will also weaken. GDP, exchange rate and trade deficit as major macroeconomic indicators can explain the economic situation in the United States under the pandemic environment, so researcher explored the relationship between macroeconomic indicators and unemployment rate. Corporate managers, finance major students and citizens can learn about the changes in the United States economy in the past two years by reading this research, and quickly understand how the unemployment due to productivity reforms will be affected by those economic indicators. The unemployment rate measures a country's economic development and is also related to the happiness of the people. When uncertain disasters come, the government can adjust economic policies according to the unemployment rate to avoid more serious losses to the country.

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