The Impact of COVID-19 for Agricultural Exports

Zejin Xu

Arcadia High School California, CA91006, United States

40982@students.ausd.net

Abstract. The Covid 19 Pandemic in 2020 greatly impacted different countries' economies as well as their various business sectors. One of the biggest concerns at the time among experts was the possibility that there was going to be a food shortage, as the widespread pandemic disrupted the global food supply chain. Thus, analyzing agricultural exports during the pandemic is extremely important because it provides valuable insights about the resilience as well as the weakness of the global food supply chain under disruptive circumstances. This paper decided to specifically study the pandemic's effects on China's agricultural export, as China is one of the biggest countries in exporting agricultural products. Data on the value of China's agricultural export before and after the pandemic is extracted. The ARIMA model was used to analyze and predict values of agricultural products if the pandemic did not occur. The predicted value is then compared with the actual value, and discussions as well as conclusions about the pandemic's significant impact on agricultural export in China are drawn.

Keywords: Covid-19; Agriculture; Export.

1. Introduction

The first instance of pneumonia that has no known cause was reported to the authorities on December 8th, 2019. By the end of January 2020, there were already about 6000 cases in China's mainland. The World Health Organization officially announced that the Covid 19 Pandemic is a "public health emergency of international concern." Provinces in China have responded to this incident to varying degrees, such as lockdowns. People were restricted from leaving home, let alone work. The connection between provinces was also cut down to limit virus' spread. Before long, the pandemic took the world by storm, and on March 11th, 2020, WHO officially declared Covid 19 as a global pandemic. All businesses around the world were affected. Some needed to adapt to the new circumstances while others completely shut down and declared bankruptcy. National economies of different countries were also impacted by this pandemic, including both import and export of various sectors. This paper is going to look specifically at agricultural exports and analyze how they were affected by Covid 19.

Agriculture is one of the foundations of China's national economy. China is actually one of the major agricultural producing and consuming nations in the world. [1]. Over the past 40 years of reform in addition to the opening-up policy, the productivity of China's agriculture has improved substantially [2]. Agricultural export is therefore the key factor that contributes to China's title as the world's largest export economy. Furthermore, Bilateral agricultural trade has grown quickly since the turn of the twenty-first century, and the amount of trade has reached all-time highs. [3]. However, as the pandemic hit in January 2020, the world's economy was shocked. The Coronavirus disrupted the global economy, and especially international trade [4]. This implies that the pandemic had a profound impact on the import and export economies of China. This disruption of the global economy worried some experts and prompted them to think that there will be a nation food shortage, as the global supply change is affected. These are logical assumptions since China is the fourth-biggest exporter of agricultural products in the world and the largest exporter of agricultural goods worldwide. [5]. Severe disruption could cause food insecurities in the rest of the world. Fortunately, none of those assumptions came true. In contrast to the prior year, China did experience a 17.2% decline in January and February of 2020. [6], which is still significant.

Previous studies on both exports of agricultural products and the pandemic's effects highlight how the exports were significantly impacted. They also highlight how China was still negatively impacted by the pandemic even though it is the world's most promising and resilient export economy. However, this paper aims to provide a new perspective to the study of pandemic's effects on agricultural exports. The paper will employ ARIMA model from data extracted on agricultural export before the pandemic to predict agricultural export values as if the pandemic did not occur. Then the predicted values and the actual values will be compared to each other to offer valuable insights about just how strongly the pandemic affected China's agricultural exports. As a result, steps and precautions can be taken if disruptive circumstances were to occur again.

The following research will be structured as follows: information about the data source, data stability, and the model in this paper is covered in Section 2. Section 3 follows, with a full discussion of the results of the predictions from the ARIMA model, as well as additional analysis on the predicted value and the agricultural export's behavior. Following that, there is a discussion on the study's focus, objective, and importance. Finally, Section 5 reiterates the conclusion briefly.

2. Research Design

2.1. Data Source

This research uses data from The General Administration of Customs of China, or GACC. In the monthly bulletin, the GACC provides Major Export Commodities in Quantity and Value. The values of agricultural products are gathered. The data spans from January of 2018 to December of 2023. For the ARIMA model, only data before January 2020 was used to predict values that accurately represent what the agricultural exports trend looks like if Covid 19 did not happen. However, data after January 2020 to December 2023 is still recorded in order to serve as comparisons to the predicted values.

2.2. Augmented Dickey–Fuller (ADF) Test

Testing to see whether or not the data is stationary is the first step before proceeding to construct the ARIMA model. Based on the ADF test conducted in Stata, the p-values in Table 1 for the log-return is larger when compared to the critical value. Thus, this paper is not able to reject the null hypothesis regarding smoothness or stationarity. If the test is performed on the first order differencing of the time series, the null hypothesis can be rejected because the p-value will be less when compared to the critical value. Consequently, the first order difference of the time series is smooth and stationary, and the ARIMA Model may be constructed using it.

Table 1 ADF Test

	t-statistics	p-value
Ln value	2.943	0.1488
1st order difference	4.495	0.0015

2.3. ARIMA Model

2.3.1 Autoregressive (AR) Model

The expression for an autoregressive model with a lag of p, or AR (p), is as follows: $X_t = c + \alpha_1 X_{t-1} + \alpha_2 X_{t-2} + \cdots + \alpha_p X_{t-p} + \epsilon_t \quad t = 1,2, \dots T$. In the expression, ϵ_t is either the error term or a white noise process. Typically, AR models are limited to data that is stationary.

2.3.2 Moving Average (MA) Model

Instead of using prior predicted variable values in a regression, a moving average model utilizes previous prediction errors in a model that mimics a regression. A moving average process of order q, MA(q), is a time series $\{Xt\}$ if: $X_t = c + \epsilon_t + \theta_1 \epsilon_{t-1} + \theta_2 \epsilon_{t-2} + \cdots + \theta_q \epsilon_{t-q}$, where $\epsilon_t$is white noise. It is possible to compare every value of X_t to the latest prediction errors as a weighted moving average.

2.3.3 Autoregressive average moving (ARMA) Model

The autoregressive average moving model, or ARMA, is the combination of both autoregressive model as well as the moving average model and has an order of p and q. Thus, a times series $\{X_t\}$ is said to follow an ARMA (p, q) process if: $X_t = c + \alpha_1 X_{t-1} + \alpha_2 X_{t-2} + \cdots + \alpha_p X_{t-p} - \theta_1 \epsilon_{t-1} - \theta_2 \epsilon_{t-2} + \cdots - \theta_q \epsilon_{t-q} + \epsilon_t$.

2.3.4 Autoregressive Integrated Moving Average (ARIMA) Model

By introducing and enabling differencing on the series, the ARMA model is able to extend on to non-stationary series and produces the ARIMA Model. ARIMA (p,d,q) is the generic non-seasonal model in which each of the three parameters represents a distinct portion of the mode. The moving average part's order is q, the autoregressive part's order is p, and the degree of initial differencing involved is d. The following expresses the whole model: $X'_t = c + \alpha_1 X'_{t-1} + \cdots + a_t X'_{t-1} + \theta_1 \epsilon_{t-1} + \cdots + \theta_q \epsilon_{q-1} + \epsilon_t$. Notice that X'_t means that the series is a differenced series, and it could have been differenced more than one time. With the ARIMA model, the stationary first log difference of the data on agriculture export in China can be used to create predictions based on its past values that would assume the absence of Covid 19 pandemic.

3. Empirical Results and Analysis

3.1. ARIMA Specification

Making sure the data is stationary is the first step in using the ARIMA model to forecast the data. The Dicky-Fuller unit root test has already shown that the data's initial logarithmic difference is stationary based on table 1. Consequently, the involved degree of first differencing, or d, is 1. Since the ARIMA model combines the moving average and autoregressive models, its final two parameters, p and q, need to be determined. Usually, based solely on the data, a time plot cannot be utilized to determine suitable values for p and q. This is when the Autocorrelation Function (ACF) plot and the related Partial Autocorrelation Function (PACF) plot are useful. PACF plot addresses this issue. In contrast to ACF, PACF calculates the correlation between $X_t$and X_{t-k} after lag effects are taken into account. Both plots of the stationary data are displayed in Figure 1. The first component beyond the x-axis is 5, indicating that AR(P) is of order 5 and MA(q) is of order 1, based on the fixed order result of the two images in the first row in Figure 1. As a result, p and q have respective values of 5 and 1.

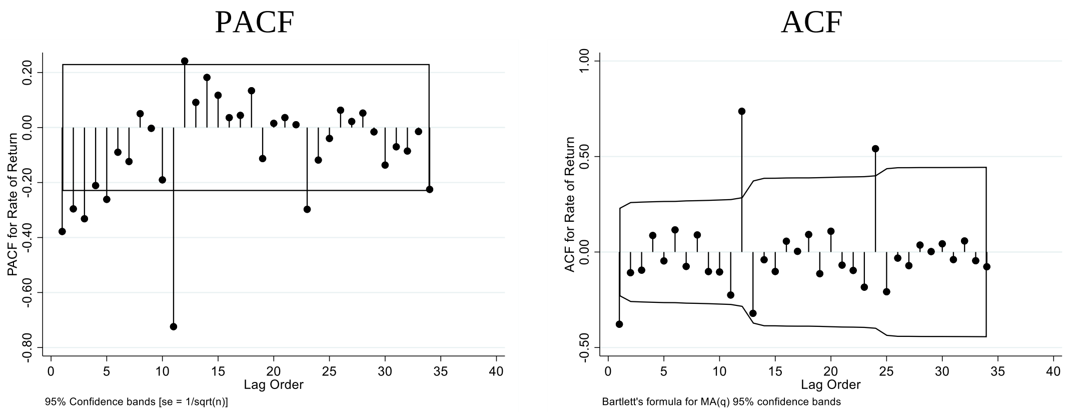

Figure 1 Model order identification

Photo credit: Original

3.2. ARIMA Estimation Results and Explanation

After the ARIMA model is built with the appropriate parameters derived from the ACF and PACF plots, the Portmanteau test for white noise is applied to the model. The results are displayed in table 2 below.

Table 2 Residual test

Model	Portmanteau (Q) statistic	Prob > chi2
ARIMA (5,1,1)	116.1481	0.0000

With a p value of 0, this paper rejects the null hypothesis and concludes that the residuals are not stationary and white noise. However, this doesn't affect this research's usage of ARIMA model to predict the trend characteristics after Covid. Because the model is not used for quantitative trading, the small errors can be ignored, and thus the model can be used for ARIMA estimation. The estimation results of the ARIMA forecasting are recorded in Table 2 below. Along with the estimated values, the differences of the fitted values and the observed values are calculated, as well as the difference percentage. The data was put into a graph in Figure 2 below as well.

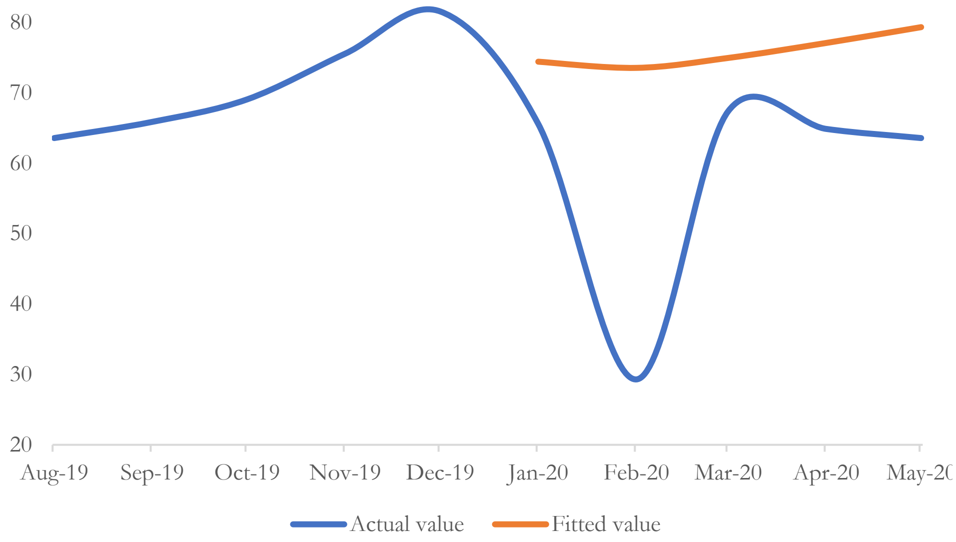

Figure 2 Actual value and predicted value

Photo credit: Original

It can be clearly observed from both Table 3 and Figure 2 that the fitted or estimated values by the ARIMA model are higher than the actual value, with the highest difference percentage being 60 percent in February 2020.

Table 3 Actual value and predicted value

	Actual value	Fitted value	difference	Difference (%)
Aug-19	63.6			
Sep-19	65.9			
Oct-19	69.1			
Nov-19	75.6			
Dec-19	81.6			
Jan-20	65.6	74.453987	-8.85399	-11.89%
Feb-20	29.3	73.575958	-44.276	-60.18%
Mar-20	67.4	74.987223	-7.58722	-10.12%
Apr-20	64.9	77.116038	-12.216	-15.84%
May-20	63.6	79.363949	-15.7639	-19.86%

All other difference percentages, all over 10 percent, are also significant and cannot be ignored. The extremely high difference percentage in February mainly reflects the start of Covid, when it spread around the globe. It is reasonable to conclude that the pandemic therefore exerted a significant impact on the agriculture export in China. The estimated values from the ARIMA model, which reflects the agriculture export if Covid did not occur, were all higher than the actual value, demonstrating that Covid 19 decreased agricultural exports. From the graph, it can also be observed that agricultural export levels are steadily recovering after the major hit in February. However, it is still lower than pre-Covid numbers, further highlighting the strong impact of the pandemic on agricultural export levels. With all the data as well as the graph below, this new perspective of studying and looking at Covid 19 Pandemic's impact of agriculture export aligns with all other studies, it concludes that the COVID-19 epidemic has weakened the agriculture sector's resilience, which will have a long-lasting effect on the structure of the world food supply chain. [7]. Furthermore, even though China's agricultural export levels have been steadily rising since Covid, China's export competitiveness is encouraged to be further improved [8] in an attempt to catch up to pre-Covid levels. This study also reveals that even the biggest export economies like China, which has both strong regional and product patterns [9], is still vulnerable to global disruptions like the Covid 19 Pandemic. Thus, it was not surprising to have experts worry that there might be a food supply shortage across the globe. Along with Covid 19, there are also other factors that might have contributed to this sharp decrease in agricultural export for China. The high population in China is one such factor. China has been importing more agricultural products than it has been exporting since 2004. [10]. This is because there is an extremely high demand for food inside China, and especially during a global pandemic, more food, or agricultural products, needs to go into China to meet its high population demands, instead of getting exported out. Furthermore, the steady recovery of China's agricultural export also reveals that it is indeed one of the strongest export economies in the world. However, other countries might not be able to recover so fast, or in some cases recover at all. Therefore, it is crucial for countries to always prepare for the chance of a global disruption, as even the biggest export economy could be significantly impacted.

4. Conclusion

The purpose of this research is to offer a novel perspective on how China's agricultural export levels were impacted by the pandemic. This viewpoint provided an analysis of export values both with and without Covid. Pre-Covid agricultural export data from the General Administration of Customs of China was utilized to estimate and forecast the values of agricultural exports using the ARIMA model. The overall result of this study clearly aligns with all other similar research on the pandemic's effects on export economies. This study, however, demonstrated that agricultural export of China was specifically impacted heavily by the pandemic. It reveals how agricultural export levels dramatically decreased due to the Covid-19 outbreak, especially at the beginning. Even though the data illustrates that China is recovering successfully ever since, it is still not up to the estimated values generated by the ARIMA model, emphasizing that the pandemic had a long-lasting impact on China's agricultural export, or the export economy in general even after the pandemic is declared to be over. This highlights China's unpreparedness for the pandemic as well as demonstrating how even the world's biggest export economy is not immune to global disruptions. Through this disruption, the world should understand that it is crucial to stay prepared even in times with no disturbances. With that in mind, countries around the world should enforce legislation that strengthens the export sectors of their economy, including agriculture. Legislation could include better export regulations as well as new export laws. This is to avoid a global crisis, such as food insecurities, when a significant disruption like Covid occurs. Of course, this paper also has its insufficiency. For example, the ARIMA model is not fit to build models with higher orders to perform long term prediction and analysis. The ARIMA model utilized to predict the agricultural export values if Covid did not occur is also not guaranteed to be accurate. However, it does serve as a general comparison for this paper to fully interpret what impact Covid had on the agricultural export sector of China.

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