

Analysis of the Influences of Covid-19 on the UK Financial Market from a Time Series Perspective

Yiding Wang^{1,*}

¹ Department of mathematics with finance, The University of Manchester, Manchester, M13 9PL, England

* Corresponding Author Email: yiding.wang@student.manchester.ac.uk

Abstract. The outbreak of the Covid-19 began on December 28, 2019 and has continued to this day. The outbreak of the Covid-19 has caused varying degrees of impact on the financial markets of various countries, causing fluctuations in the stock markets of various countries to varying degrees. This article selects FTSE 100, UK daily new and Global daily new (except UK) from January 24, 2020, and uses ARMA-GARCH model and VAR model to model and analyses the data and to study how Covid-19 is affecting the UK stock market. At the same time, this article will also draw the conclusion that Covid-19 will have a greater impact on the UK stock market in the short term, but then as consumers gradually accept the fact that Covid-19 will coexist with the stock market for a long time, Covid-19 will have a greater impact on the UK stock market. The long-term impact on the UK stock market will level off. In addition, this article will also give some suggestions to investors, so that investors can better avoid the risks brought by Covid-19. For example, investors can choose the right time to invest according to our image.

Keywords: British, Covid-19, Stock market, Time series model.

1. Introduction

Since ancient times, human society has faced various epidemics, such as smallpox, Ebola, and SARS. The latest epidemic that is spreading around the world today is Covid-19. It has caused heavy damage to all fields in all countries around the world, and the economic field is the first to bear the brunt. Countries and organizations in the world have invested a lot of financial resources to prevent the spread of the epidemic. As of the first draft of this report, the number of confirmed cases of the Covid-19 has reached 608,205,847, of which 23,554,519 have been confirmed in the UK, placing a heavy burden on the medical system, and increasing the economic burden of various countries. In order to prevent the further spread of the epidemic, various countries have also adopted various measures, such as China's blockade of areas and frequent nucleic acid testing, policies such as the cancellation of direct flights between the United Kingdom and other countries, which have increased the country's financial burden and made many industries unable to function normally. The number of businesses that are operating, closed and the unemployed are increasing day by day. According to Abdulla S, consumer confidence in the UK fell 17% in the last three months of 2020 and more than 31% of consumers said they were saving more as they lost their commute to work at home due to job losses [1].

The decline in consumer confidence has led people to only dare to invest their own money in some low-risk financial management. Through the investigation of existing data and literature, this article predicts that the Covid-19 will reduce consumer confidence, withdraw funds from the stock market, and have an impact on the real economy, which will have a greater impact on the UK stock market in the short term. habit and the basic fact that the Covid-19 epidemic will persist for a long time, the UK stock market will stabilize and coexist with the Covid-19 epidemic in the long-term.

The content of this article is divided as follows: The second part is a literature review, including the economic consequences of the Covid-19 and how it affects financial markets, and finally summarizes the literature review. This is followed by the third part, which will design research based on data from FTSE 100, new outbreaks in the UK, and new global outbreaks, and introduce the VAR model settings and ARMA-GARCHX model settings. The fourth part will then rank and analyze the

VAR and ARMA-GARCHX models and evaluate the estimation results of the ARMA-GARCHX models. The results of the empirical analysis are used to demonstrate the degree of correlation between the development of the Covid-19 and the UK stock market. Finally, draw conclusions and predictions and discuss the similarities and differences between this paper and other related literatures and how investors should use the research findings of this paper.

2. Literature Review

2.1. Studies of the Economic Phenomenon of the Covid-19

The impact of the coronavirus on the global economy is worse than the Great Depression brought on by the 2008 economic crisis, Roubini pointed out that under the influence of the Covid-19, the US stock market to fall into a bear market just by 15 days, which was the fastest decline in history, and the market fell by 35% [2]. Meanwhile, U.S. Treasury Secretary Steven Mnuchin has warned that unemployment could soar to more than 20%, which would be double the peak during the financial crisis. or the socio-economic field, Abodunrin, Oloye and Adesola believe that the Covid-19 pandemic has the following impacts:

Lack of labor force and high costs, Katie Bach reported that in June 2022, the U.S. Census Bureau released a report showing that today, about 16 million working-age Americans (ages 18 to 65) suffer from chronic disease. There is Covid. Of these, between 2 million and 4 million have lost their jobs due to prolonged Covid-19. Lost costs due to unemployment amount to \$170 billion a year (possibly as high as \$230 billion) [3].

Reduces productivity and negatively affects economic growth. The Bank of England's Monetary Policy Committee point out the ways Covid-19 could affect the economy. The spread of Covid-19 and the precautionary ways against its (increasing public safety distances) have reduced the normal consumption behavior of businesses and households. A sluggish world economy has exacerbated these impacts, which not only dampen demand for exports, but also disrupt international supply chains and lower incomes for businesses and households [4].

More poverty due to falling family pillars. The UNICEF report claims that two years after the COVID-19 pandemic, the social and economic devastation is bearing the greatest burden on children, especially the poorest and most marginalized. At least 68% of households with children can no longer afford household expenses due to Covid-19, according to UNICEF and the World Bank. Nearly half of adults in households with children say they skip meals due to lack of money. One in four adults living with children reported being without food for a day or more [5].

Canuto sees a post-coronavirus global economy marked by rising public and private debt levels, accelerated digitalization and reduced globalization [6].

2.2. The negative results of the economic consequences of the Covid-19 on financial markets

The bad economic consequences of the Covid-19 are also affecting the stock market. According to the British BBC broadcast, Britain's FTSE 100 closed down 3.3 percent, its biggest drop since January 2016. In Italy, the worst-hit country in Europe, the Milan stock market tumbled nearly 6% [7]. At the same time, the OECD also declared that Covid-19 has caused huge turbulence in global stock markets, and the negative economic results caused by the global spread of Covid-19 has intensified market risk aversion in an unprecedented way [8]. The stock fell by more than 30%; The implied volatility of stocks and oil has soared to crisis level; As investors reduce risk, the credit spread of non-investment grade debt expands sharply. Although many countries have taken corresponding countermeasures after the turmoil in the financial market, the effect is still not significant. Zhang, Hu and Qi believe that although the Fed has a zero interest rate policy and a quantitative easing (QE) plan of at least US\$700 billion in the market Unrestricted quantitative easing announced after negative reaction, but there is still a lot of uncertainty as the pandemic continues [9]. Similarly, not only the United States, but also central banks around the world have taken measures to intervene, hoping to reduce influences of the Covid-19 on financial markets. For example, the Fed cut rates by

50 basis points, which puts rates in the 1% to 1.25% range. But Japan and England declared that they would closely monitor financial markets and keep them stable. At the same time, the central banks of some Gulf countries have also made corresponding measures to cut interest rates by 0.5%. As for the International Monetary Fund and the World Bank, they also issued a statement claiming that they are willing to work with the world to face the economic challenges and human threats posed by Covid-19. And the European Central Bank has also prepared pigs for an economic slowdown. and the Chinese government has approved 500 billion yuan (\$71 billion) in financing to issue low-interest rate payments to small businesses that have been affected by the outbreak. loan. The moves by central banks and regulators around the world to reassure investors have not really reassured investors. Financial markets, while rebounding on March 2, fell again the next day [10].

2.3. Review of the literature

All in all, the world has a preliminary understanding of the short-term economic consequences of the Covid-19 and the impact on the financial market, but the long-term impact of the Covid-19 is still unconfirmed. Therefore, this paper intends to analyze the data and build a financial model and use empirical evidence. The data fills research gaps in this area and makes predictions about the direction of the economy after the Covid-19.

3. Research design

3.1. Data Sources

This article uses the choice financial terminal to obtain the closing price of FTSE 100, the global daily increase (except for the United Kingdom) and the daily increase of the United Kingdom and other data, and uses Excel and Stata to calculate the rate of return and establish a time series [11]. This is used as the data basis for studying the impact of the Covid-19 on the UK stock market.

3.2. ADF test

After completing the construction of the model, this part performs a unit root test (smoothness test) on the model, and sets the null hypothesis that the model is not smooth. Next, put the data (closing price, yield, the number of new confirmed daily in the UK, and the number of new confirmed daily in the world) into Stata for ADF test (table 1). It can be seen from Table 1 that the P-values of these four sets of data are all less than 0.1, indicating that the null hypothesis is rejected and the time series are stable.

Table 1. ADF test

Variables	t-statistic	p-value
Price		
FTSE 100	-4.871	0.0004***
Yield		
FTSE 100	-18.538	0.0000***
New confirmed cases		
UK	-10.229	0.0000***
Global	-9.391	0.0000***

3.3. VAR model

$$Y_t = c + A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + e_t \quad (1)$$

A VAR model exhibits k endogenous variables in the same sample period, and can also be a linear function of the past values of these k endogenous variables. The VAR(p) model is shown in the above formula (1).

In this article, put the closing price of the FTSE 100 and the daily new diagnoses in the world and the closing price of the FTSE 100 and the daily new diagnoses in the UK respectively into the stata, and use the VAR model to predict the future.

3.4. ARMA-GARCHX model settings

$$x_t = \phi_0 + \sum_{i=1}^p \phi_i x_{t-i} + \alpha_i - \sum_{i=1}^q \phi_i a_{t-i} \tag{2}$$

From equation (2) above, it can be seen that $\sum_{i=1}^p \phi_i x_{t-i}$ represents the AR(p) part, which uses the historical returns of the UK stock market to predict the future; similarly, $\sum_{i=1}^q \phi_i a_{t-i}$ represents the MA part, which uses past volatility to estimate the future.

Next, this paper constructs an ARMA-GARCH model for the return and volatility of the UK stock market. On this basis, this paper also uses the time point of the Covid-19 from January 24, 2020 to today as a dummy variable, and adds it to the model calculation. Therefore, this paper can assess the correlation between returns and volatility in the UK stock market.

The model GARCH (p, q) is set as follows:

$$\alpha_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \dots + \alpha_q \varepsilon_{t-q}^2 + \gamma_1 \sigma_{t-1}^2 + \dots + \gamma_p \sigma_{t-p}^2 + \beta_1 D_1 \tag{3}$$

In equation (3) above, the term $\alpha_1 \varepsilon_{t-1}^2 + \dots + \alpha_q \varepsilon_{t-q}^2$ is ARCH part, σ_t^2 is the conditional variance of the disturbance term ε_t , the subscript “t” indicates that variance changes over time. σ_t^2 depends on the square of the disturbance term in the previous p periods. And the last part of the model $\beta_1 D_1$ represents the impact of external variable, i.e., daily confirmed cases.

GARCH model is set up based on the ARCH model, with the addition of autoregression of σ_t^2 . In (3), the term is $\gamma_1 \sigma_{t-1}^2 + \dots + \gamma_p \sigma_{t-p}^2$ GARCH part.

4. Empirical Results and Analysis

After introducing the model settings of this article, this part begins to introduce the order determination of the model in this article.

4.1. VAR model identification

Table 2. VAR model identification

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-605.087				0.002426	2.46216	2.50228	2.51792
1	-461.787	286.6	9	0.000	0.001399	1.94175	1.98223	2.04479
2	-405.34	112.89	9	0.000	0.001152	1.7473	1.81813	1.92762
3	-364.087	82.507	9	0.000	0.001009	1.61511	1.7163	1.87271
4	-339.395	49.383	9	0.000	0.000946	1.5508	1.68234	1.88568
5	-225.602	227.59	9	0.000	0.000616	1.12132	1.28322	1.53348*
6	-207.149	36.906	9	0.000	0.000593	1.08258	1.27483*	1.57202
7	-195.624	23.05	9	0.006	0.000587	1.07223	1.29484	1.63895
8	-187.511	16.227	9	0.062	0.000589	1.07586	1.32883	1.71987
9	-182.641	9.7396	9	0.372	0.000599	1.09279	1.37611	1.81408
10	-160.928	43.426*	9	0.000	0.000569*	1.04069*	1.35437	1.83925
11	-157.336	7.1843	9	0.618	0.000581	1.06285	1.40689	1.9387
12	-154.424	5.8238	9	0.757	0.000596	1.0878	1.4622	2.04093

In Table 2, LL represents the log-likelihood function, and LR represents the likelihood ratio test, that is, the likelihood ratio test for the joint significance of the last-order coefficients. Next, this part needs to price the VAR model. Usually, selecting the row number of the minimum value as the order from the asterisked data in the four columns of FPE, AIC, HQIC and SBIC, but this part can also use

the LR likelihood method, The AIC statistic and the SC statistic are used to determine the maximum lag order.

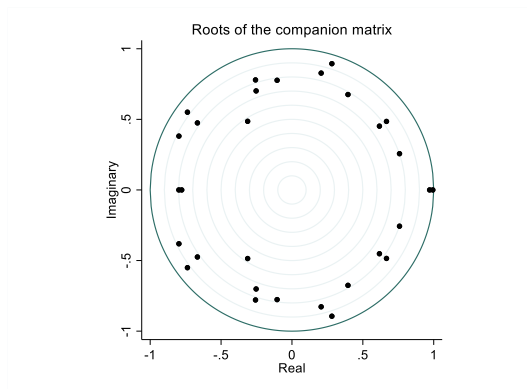


Figure 1. VAR stability (Photo credit: Original)

In this article, choosing the order of the VAR model as 10, and then use Stata to run the var stationarity test to test the stationarity of the selected order. If all the points in the graph that appear are within the circle, it means that the VAR model is sufficiently stable. Figure 1 shows that order 10 is stable enough.

4.2. Impulse response

In order to understand the mutual influence relationship between variables and the degree of influence, this part needs to do further pulse images. This paper first set the impulse variable and the response variable to be global log new and FT log returns, respectively, and then draw an impulse image, and then this paper sets the impulse and response variables to be UK log new and rich, respectively. When the logarithmic rate of return is obtained, draw a pulse image, and the two pulse images are shown below.

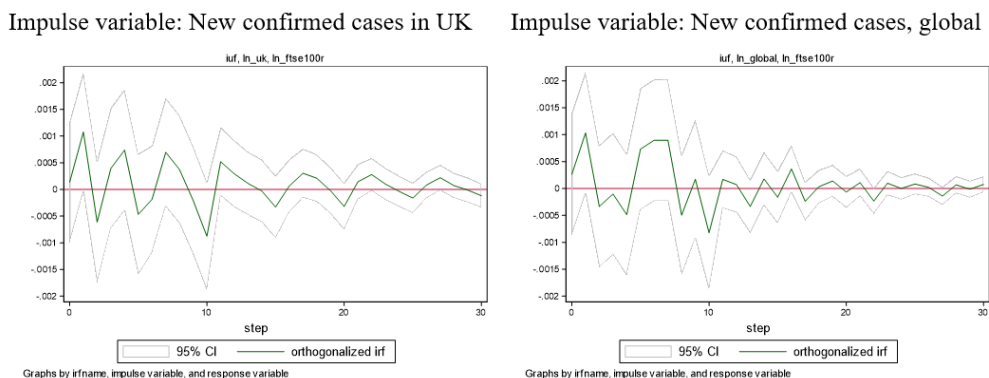


Figure 2. Impulse and response (Photo credit: Original)

From Figure 2, it can be seen that from a fundamental point of view, The massive spread of Covid-19 at the beginning of 2020 caused a great hindrance to the normal operation of the world economy. In the short period of time after the outbreak of the epidemic, major financial markets around the world fell sharply, and the British stock market was no exception.

Obviously, the new crown pneumonia epidemic has impacted investor confidence in the short term, causing funds to flee the market for safe haven, and the rapid outflow of funds caused the decline. On the other hand, the shutdown caused by the Covid-19 has triggered the operation of the real economy, which has also strengthened the impact.

Over time, both cumulative diagnoses and new diagnoses are still growing at a faster rate, but the UK stock market has not shown any more drastic adjustments (it is recommended to use EXCEL to draw a time series diagram of FTSE 100, which can be more clearly illustrate).

According to the impulse response function derived from the VAR model in this paper, it can be found that in the case of normalized epidemics, the factors that continue to affect the operation of the

stock market depend more on fundamentals, and investors seem to have accepted the basic fact that the epidemic will exist for a long time.

Specifically, during the period of $t=0$, the number of newly diagnosed cases in the UK increased by 1%, and the yield sequence of the FTSE 100 index fluctuated around 0 in the short term in the future, and the maximum amplitude did not exceed 0.1%.

It can be found that although the new crown pneumonia epidemic has a long-term impact on the UK stock market, the effect is small. Based on this, this article argues that the UK's financial markets and the Covid-19 pandemic have coexisted.

4.3. ARMA model identification

As with the VAR model, this part also needs to order the ARMA model, and this part needs to determine the order of the AR part and the order of the MA part by ordering the FTSE log-return series using PACF and ACF. The resulting PACF and ACF graphs are shown below:

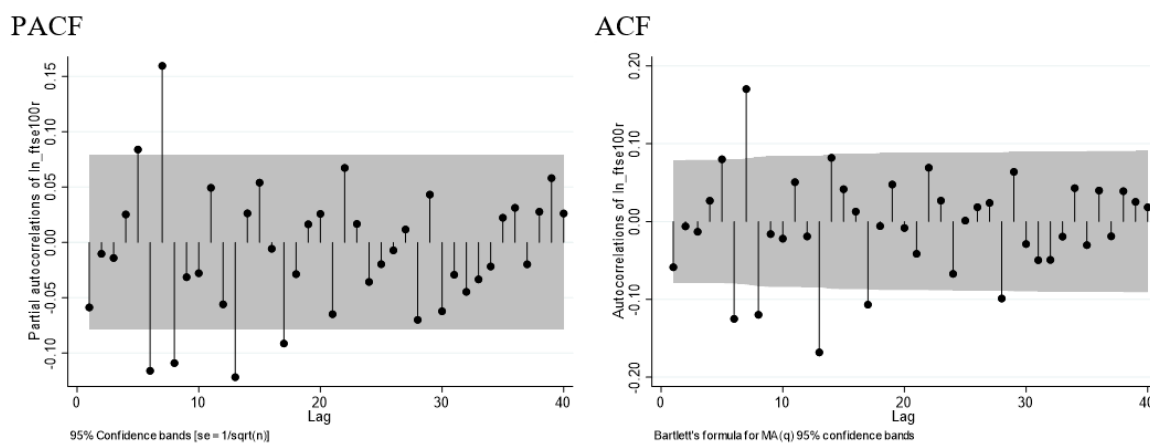


Figure 3. PACF and ACF (Photo credit: Original)

In this paper, the order of the AR and MA models is selected as 6, and the method of order determination is to select the minimum X-axis value corresponding to the point beyond the shadow part in the image (Figure 3). Then substitute the selected order into the formula of ARMA-GARCH.

4.4. ARMA-GARCHX estimation results

By determining the order of AR and MA, this part can use the ARMA-GARCH model to calculate the order just obtained through Stata. The estimated results are shown in Table 3:

Table 3. ARMA-GARCHX estimation results

	(1)			(2)		
	Coef.	Std. err	$p > Z $	Coef.	Std. err	$p > Z $
Mean equation						
AR, L6	0.9032	0.0727	0.000	0.8675	0.1152	0.000
MA, L6	-0.9432	0.0586	0.000	-0.9073	0.0976	0.000
Constant	0.0004	0.0003	0.204	0.0003	0.0003	0.352
Variance equation						
New daily confirmed cases						
UK	0.1077	0.0797686	0.177			
Global				-0.3575	0.0511	0.000
GARCH (1, 1)						
ARCH, L1	0.1701	0.0301	0.000	0.7897	0.0127	0.000
GARCH, L1	0.7706	0.0407	0.000	0.8730	0.0205	0.000
Constant	-12.5184	0.9576	0.000	-7.4971	0.5717	0.000

From the estimation results of the ARMA-GARCH model, the ARCH and GARCH terms in columns (1) and (2) are both significant, indicating that the FTSE 100 return series have statistically significant conditional heteroscedasticity, and GARCH can be performed modeling. This paper further uses external explanatory variables to examine the impact of the Covid-19 outbreak on FTSE 100-day volatility in the long run. Judging from the coefficient of new confirmed cases in the UK, although the coefficient is positive, it is not significant, and the coefficient of new confirmed cases globally is negative and significant. The above results all indicate that in the long run, the new crown pneumonia epidemic will no longer have a significant impact on the UK stock market.

5. Conclusion

There are also many existing literatures that analyze the economic impact of the Covid-19, but this article starts from the time series, and analyzes the correlation between the Covid-19 and the British stock market more based on the construction of two models. Similarly, this paper draws the same conclusions as much of the existing literature that the Covid-19 pandemic will co-exist with financial markets. Financial institutions and government agencies can choose appropriate time nodes to launch corresponding economic policies to boost the economy according to the time series listed in this article. Investors can also choose appropriate nodes to invest in stocks and various financial derivatives according to this article. Based on the conclusions drawn in this article, this paper suggests that investors should not have low expectations for the future financial market. The Covid-19 will coexist with the financial market, and investors can still invest at the right time.

This article analyzes and predicts the returns and volatility of the British stock market by using the FTSE 100 index, the global daily increase and the UK daily increase, combined with stata and the VAR and ARMA-GARCH models, and finally believes that in the short term The Covid-19 has indeed caused a great impact on the UK stock market, but as time goes on, consumers will acquiesce to the basic fact that the Covid-19 and the financial market will coexist for a long time, and the financial market will stabilize.

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