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The impacts of coronavirus pandemic on the global economy and the looming recession: Evidence from United States of America, European Union and China

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Abstract

This research analyzes the impact of COVID-19 on the global economy with a case study of the USA, Europe and China. This study uses the secondary data obtained from WHO and the World Trade Organization (WTO) among other recognized research institutes. The data analysis approach is based on hypothesis testing, where ANOVA is used for the hypothesis testing. Time series analysis of the Gross Domestic Product (GDP) of the US, Europe and China is also done. The GDPs for the periods before and during the pandemic were forecasted using Autoregressive Moving Average (ARIMA Model). Analysis of the percentage change in GDP and the forecasts showed a clear trend of countries having a stagnating GDP from 2020 to 2022. The pandemic impacts on the GDP negatively. Closure of industries has also served a big blow to the global economy due to unemployment. Many nations across the globe have also suffered economically by restructuring their budgets and diverting reasonable amount of money towards combating the virus.

Keywords: WTO, GDP, coronavirus pandemic, looming recession, global economy

1. Introduction

1.1 Background Information

The outbreak of the COVID-19 was first announced by the World Health Organization (WHO) on December 31, 2019. The impacts of COVID-19 are primarily connected to deaths, the shutdown of the economies, and occupational difficulties. For example, on February 3rd 2020, the Chinese stock market dropped 9.1% in a single day (Farrer, 2020) [7]. This was the largest drop China had seen in the past five years. By February 9th 2020, global companies like Apple, Microsoft, Samsung, Google, and Tesla and others that had plants in China had shut down or announced their plans to send all employees home. The province of Hubei, with over 50 million people, was placed on total lockdown for 76 days, where no one could enter or leave. The lockdowns were not constrained to China alone. By April 7th 2020, the BBC provided a list of countries that had ordered either a lockdown or restricted movements. In Asia, Australia, and New Zealand, the report listed 32 countries. In Europe, there were 43 nations; America had 38 countries, and Africa, there were 45 countries (BBC News, 2020a).

1.2 Purpose of the Study

The purpose of this study is to provide elaborate impacts of coronavirus on the economies of the Europe Union, China and the United States. The European Union is an integration of several countries within Europe that share economic, political and social policies. The countries offer integrated policies that guide how trade activities are conducted within the region. This research will provide authentic details on how the European Union has been affected based on economic issues and how it has countered the coronavirus during this period. The purpose of this study will also compare the European Union to the United States and China.

It will provide elaborate analysis of how the economies have countered the pandemic situation and the expected recession to affect the economies. Therefore, the study will provide details on economic impacts of coronavirus on the European Union and compare it to the United States and China.

1.3 Aims and Objectives

- To determine the economic impacts of coronavirus on economies of USA, European countries and China
- To demonstrate the industries affected by the coronavirus in USA, Europe and China
- To identify the economic measures by countries against coronavirus pandemic
- To demonstrate the future recommendations for countries amid the coronavirus pandemic.

2. Research Methods

2.1 Introduction

This chapter outlines the research methods to be employed by the study. It entails the sources and type of data to be used, the sampling procedure and the methods of data analysis. The rationale for the data chosen is also explained.

2.2 Sampling Procedure

Sampling is an essential procedure when conducting a research to identify the population being dealt with as well as the kind of data being researched by the study. This study employs a quantitative research, therefore has to use sampling procedures for quantitative approach. During the sampling, a range of secondary sources were selected for the study. The sources had primary secondary sources which were the World Trade Organization and World Health Organization websites where data obtained were based on the current coronavirus pandemic and increasing effect on the global economy.

2.3 Data Collection

This study uses secondary data. A secondary research method involves the use of already researched, collected and stored data. The secondary sources are available in different forms and are available for different time periods. The selection of secondary data collection sources in this aspect used books, articles, journals, and news and audio files where applicable. The sources always have to be timely, which means they will have to be published or released in the current generation not dating many years back since data changes overtimes and due to the dynamism of the research topic being analyzed. In addition to that, the data sources were obtained from public libraries whereas some were obtained from the online libraries. The rationale for the selection of this method for collection of data is determined as follows. The data collected related to the coronavirus pandemic and historic pandemic as well as their effects to the global economy, especially on China, Euro area and the United States. The data collected was then integrated for analysis as follows.

2.4 Hypothesis

H_0 : The coronavirus pandemic has ravaging effects on the global economy hence will result in a recession

H_1 : The coronavirus pandemic has no effects on the global economy, hence will not lead to a recession

2.5 Data Analysis

The data was analyzed in the R-Software environment. The following are the major analysis which were done.

2.5.1 ANOVA Test

The data analysis approach is based on hypothesis testing, where ANOVA will be used for the hypothesis testing. The ANOVA will develop the three levels or groups for the economies being analyzed by the study. The economies include US, Euro Area, and China. The economic conditions obtained from the global statistics will be based on the economic condition before corona virus, after announcement of the pandemic, and the condition during the pandemic.

2.5.2 Time Series ARIMA Model

A time series Autoregressive Moving Average (ARIMA) model is fit on the GDP data of the US, Euro Area and China before the pandemic. The model is used to forecast the GDP values to the period during and after the pandemic with the aim of comparing with the real values and measuring the amount of economic damage caused by COVID-19.

This is a general model introduced by (Box, 1976) which includes autoregressive, moving average parameters, and differencing in the formulation of the model. The parameters are autoregressive parameters (p), the number of differencing passes (d), and

moving average parameters (q). In the notation the models are summarized as ARIMA (p, d, q).

The input series for ARIMA needs to be stationary, i.e., it should have a constant mean, variance, and autocorrelation through time. Usually the series' first needs to be differenced until it is stationary.

ARIMA (1, 0, 0) is the first-order autoregressive model: If the series is stationary and autocorrelated, the forecasting equation in this case is

$$y = \mu + \phi y_{t-1}$$

Which is Y regressed on itself lagged to period one.

The second-order autoregressive model (ARIMA (2, 0, 0)), written y_{t-2} term on the right as well, and so on. Hence, the prediction equation for this model can be written as:

$$y_t - y_{t-1} = \mu$$

Equivalently, $\hat{y}_t = \mu + y_{t-1}$ is the average period-to-period change in Y. ARIMA (1, 1, 0) is the differenced first-order autoregressive model. The prediction equation is given as follows:

$$\hat{y}_t - y_{t-1} = \mu + \phi(y_{t-1} - y_{t-2})$$

$$y_t - y_{t-1} = \mu,$$

Which can be rearranged to

$$\hat{y}_t = \mu + y_{t-1} + \phi(y_{t-1} - y_{t-2})$$

This is a first-order autoregressive model with one order of non-seasonal differencing and a constant term.

3. Findings and Discussion

3.1 Test of Hypothesis

The hypothesis was tested on whether the Economic impact of COVID-19 had similar effects on the three regions under consideration. A sample of five countries were selected. The estimated percentage change in GDP before corona, upon announcement, during and the percentage change after various measures were put in place. F-statistic was analyzed and ANOVA table finally drawn.

Table 1: Percentage change of GDP for various countries

Before	Announcement of Corona	During	Control
8	2	3	2
9	4	5	2
6	3	4	-1
7	5	2	0
3	1	3	3

- Step 1. Set up hypotheses and determine level of significance
- $H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$ H_1 : Means are not all equal $\alpha=0.05$
- Step 2. Select the appropriate test statistic.
- The test statistic is the F statistic for ANOVA, $F=MSB/MSE$
- Step 3. Set up decision rule.
- The appropriate critical value can be found in a table of probabilities for the F distribution (see "Other Resources"). In order to determine the critical value of F we need degrees of freedom, $df_1=k-1$ and $df_2=N-k$. In this example, $df_1=k-1=4-1=3$ and $df_2=N-k=20-4=16$. The critical value is 3.24 and the decision rule is as follows: Reject H_0 if $F > 3.24$.
- Step 4. Compute the test statistic.
- To organize our computations, we complete the ANOVA table. In order to compute the sums of squares we must first compute the sample means for each group and the overall mean based on the total sample.

Table 2: Group Statistics

	Before	Announcement of Corona	During	Control
N	5	5	5	5
Group mean	6.6	3	3.4	1.2

If we pool all $N=20$ observations, the overall mean is $\bar{X} = 3.6$
We can now compute

$$SSB = \sum n_j (\bar{X}_j - \bar{X})^2$$

So, in this case,
 $SSB = 5(6.6 - 3.6)^2 + 5(3.0 - 3.6)^2 + 5(3.4 - 3.6)^2 + 5(1.2 - 3.6)^2$
 $SSB = 45.0 + 1.8 + 0.2 + 28.8 = 75.8$

Next we compute

$$SSE = \sum \sum (X - \bar{X}_j)^2$$

SSE requires computing the squared differences between each observation and its group mean. We will compute SSE in parts. For the countries before coronavirus pandemic:

Table 3: Squared differences of percentage change in GDP before corona

Before	X 6.6	(X-6.6) ²
8	1.4	2
9	2.4	5.8
6	-0.6	0.4
7	0.4	0.2
3	-3.6	13
Totals	0	21.4

Thus $\sum(X - \bar{X}_1)^2 = 21.4$

For the countries during announcement of corona pandemic:

Table 4: Squared differences of percentage change in GDP during corona announcement

Announcement of Corona Pandemic	X-3.0	(X-3.0) ²
2	-1	1
4	1	1
3	0	0
5	2	4
1	-2	4
Totals	0	10

Thus $\sum(X - \bar{X}_2)^2 = 10.0$

For the countries after announcement during the corona pandemic:

Table 5: Squared differences of percentage change in GDP during corona

During Corona Pandemic	X-3.0	(X-3.4) ²
3	-0.4	0.2
5	1.6	2.6
4	0.6	0.4
2	-1.4	2
3	-0.4	0.2
Totals	0	5.4

Thus $\sum(X - \bar{X}_3)^2 = 5.4$

For the control group:

Table 6: Squared differences of percentage change in GDP before corona

Control	X-3.0	(X-1.2) ²
2	0.8	0.6
2	0.8	0.6
-1	-2.2	4.8
0	-1.2	1.4
3	1.8	3.2
Totals	0	10.6

Thus $\sum(X - \bar{X}_4)^2 = 10.6$

Therefore $SSE = \sum \sum (X - \bar{X}_j)^2 = 21.4 + 10.0 + 5.4 + 10.6 = 47.4$

We can now construct the ANOVA table

Table 7: ANOVA

Source of Variation	Sum of Squares	Degrees of Freedom (DF)	Mean Squares (MS)
Economic effects	75.8	4-1 = 3	75.8/3 = 25.3
Error/Residuals	47.4	20-4 = 16	47.4/16 = 3.0
Totals	123.2	20-1 = 19	

Step 5. Conclusion

We reject H_0 because $8.43 > 3.24$. We have statistically significant evidence at $\alpha=0.05$ (95% confidence interval) to show that there is a difference in economic situations among the three countries, before the corona pandemic and during the coronavirus pandemic.

3.2 Analysis of World Bank Data on GDP

The quarterly GDP data from the last quarter of 2018 to the first quarter of 2020 was analyzed. The data was sourced from World Bank. The analysis was narrowed down to the US, Euro Area and China.

3.2.1 GDP Analysis of the US and its economic outlook

Year	Qtr 1	Qtr 2	Qtr 3	Qtr 4
2018				2.5
2019	2.7	2.3	2.1	2.3
2020	0.3			

The quarterly GDP data of the US were analyzed using R statistical package. The parameters of interest are the percentage change of the GDP in comparison with the

previous period. The US percentage change of the GDP from 2018 to 2020 is given as follows.

> US_Quarterly_GDP

The average quarterly percentage change of the US GDP from the last quarter of 2018 to the last quarter of 2019 is 2.38%. Adding the percentage change for the first quarter of 2020 lowers the average to 2.033%. The results of a time plot are given as follows.

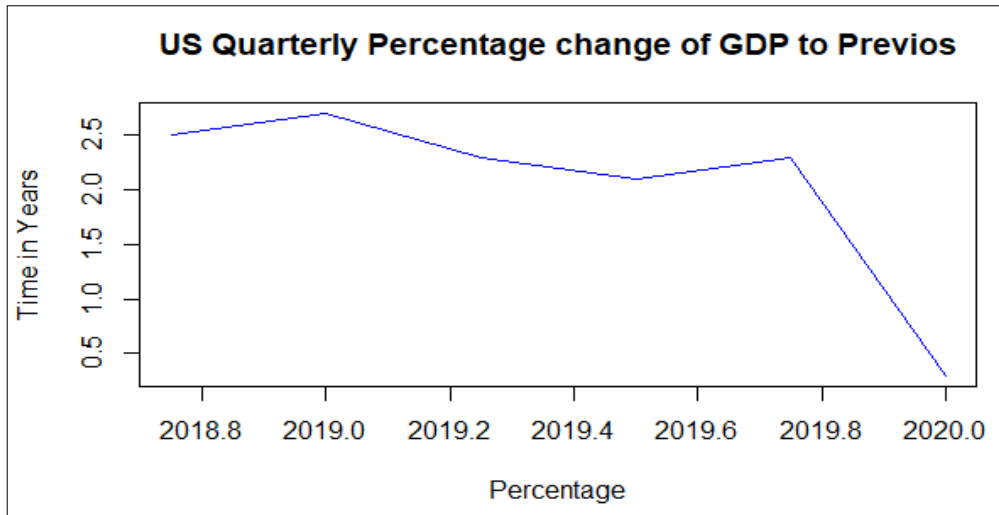


Fig 1: US Quarterly percentage change of GDP

From the time plot, it is evident that the GDP has been rising and dropping within the mean of 2.033%. Of great significance to note is that the GDP percentage dropped drastically from the last quarter of 2019 to the first quarter of

2020. An autoregressive integrated moving average (ARIMA) model was fit to the US data and a forecast going to 2022 was projected. The forecast was also plotted.

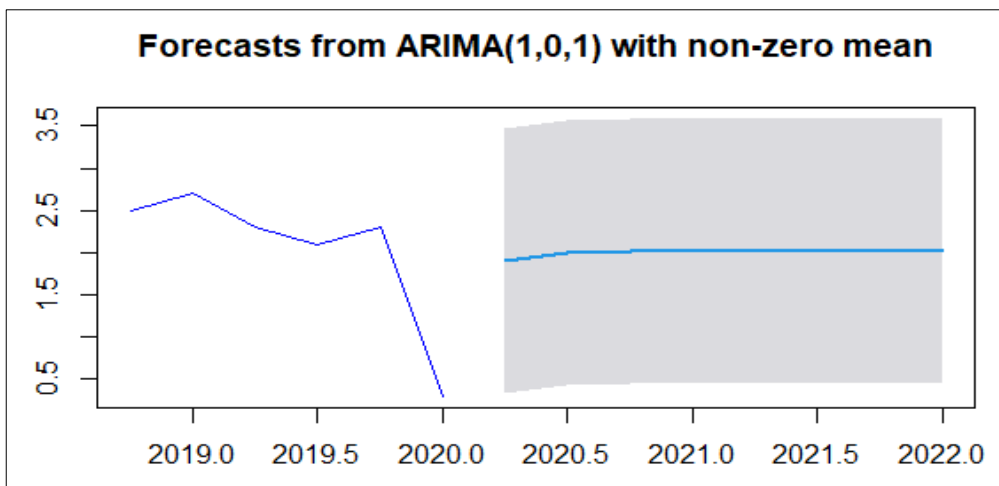


Fig 2: US GDP Forecast

From the figure, it is evident that the percentage change of GDP dropped drastically from 2019 to 2020 and stagnated all through to 2022. The projection shows the devastating effects of COVID-19 to the US GDP. This shows that the pandemic has paused a threat to the US economy.

The United States is currently the center of coronavirus infections globally. The economy has lost several jobs as it has also shut down operations of a high number of institutions. The global pandemic has caused infection of more than one million people in the United States alone with over two hundred thousand deaths. Additionally, the country

has experienced several institutions laying off their employees, as a response to controlling the number of people attending work. Also, this is due to the increasing effects on the economy by the prevailing coronavirus pandemic. The United States is affected as majority of its institutions have collapsed. Small scale businesses have been affected as majority has been closed down. The United States is experiencing a looming recession period as more people have fallen out of income bracket and more institution are facing decline in revenue. This will cause inflation and more ravaging effects on the economy of the nation.

3.2.2 China Quarterly percentage change of GDP and the outlook of economy: The China’s GDP from 2018 to 2020 was analyzed as well. It comprised the percentage change of GDP with respect to the previous period. The respective percentages of GDP are given as follows

```
> China_Quarterly_GDP
```

The average percentage of GDP change from the last quarter of 2018 to the last quarter of 2019 is 6.22%. When the

percentage change of the first quarter of 2020 added, the average drops to 4.05%. A time plot was for the percentage change in GDP was also plotted

	Qtr 1	Qtr 2	Qtr 3	Qtr 4
2018				6.5
2019	6.4	6.2	6.0	6.0
2020	-6.8			

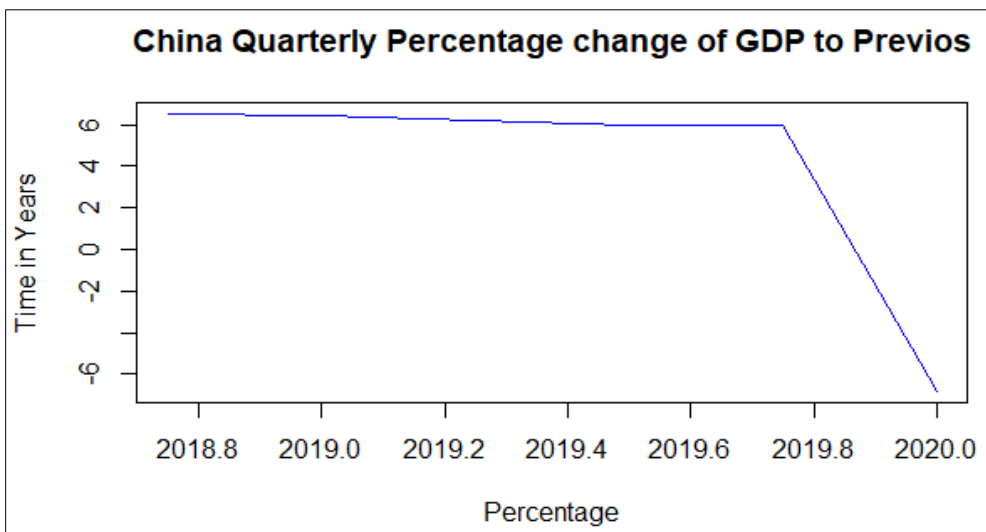


Fig 3: China time plot for percentage change in GDP

The percentage of GDP of China has been steady above 6.0% from 2018 to the end of 2019. The percentage dropped sharply from the end of 2019 to the first quarter of 2020. The

GDP dropped at a percentage 6.8%. ARIMA model was fitted to the data and a forecast projecting to 2020 plotted.

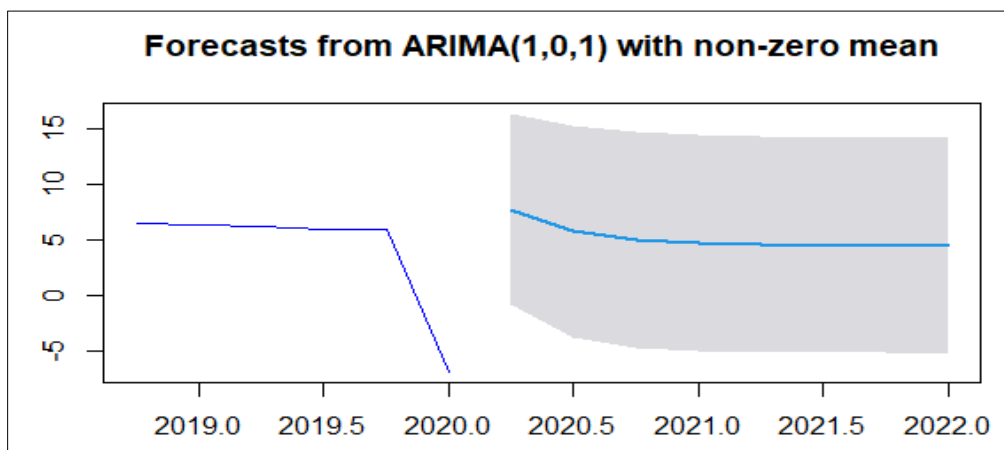


Fig 4: China GDP forecast

The forecast shows that the percentage change of China’s GDP will continue declining steadily from 2020 to 2022. This shows that China is most hit by the pandemic and it will take a significant amount of time to recover into normalcy.

Additionally, China, which was the ground zero of the coronavirus pandemic, has experienced a slight change in its economic condition. It is fortunate for the country to have experienced less extreme situation of the pandemic as compared to the United States. China has reopened its economy and is experienced slight growth. However, during the coronavirus pandemic, majority of the locations were under total lockdown as no economic activities took place. This also led to the nation using most of its revenues in treatment and research about the coronavirus pandemic. As its

focus was on the containment of the virus, it also wanted to be the country that addresses how to stop the virus from spreading globally. The economy declined during this period; however, it was not close to a recession to affect its economy.

3.2.3 Analysis of the Euro Area GDP

The percentage change in GDP of the Euro Area (as per World Bank) was analyzed using R statistical software. The Euro Area GDP from the end of 2018 to the first quarter of 2019 is given as follows

```
> EuroArea_Quarterly_GDP
Qtr1 Qtr2 Qtr3 Qtr4
```

	Qtr 1	Qtr 2	Qtr 3	Qtr 4
2018				1.2
2019	1.4	1.2	1.3	1.0
2020	-3.2			

The average percentage of GDP of the Euro Area from the last quarter of 2018 to the last quarter of 2019 is 1.22%. When the first quarter of 2020 is factored in, the average percentage change drops to 0.4833%. This is an indication of the negative impact of COVID-19 to the Euro Area GDP. The time plot of the percentage change in GDP is given as follows

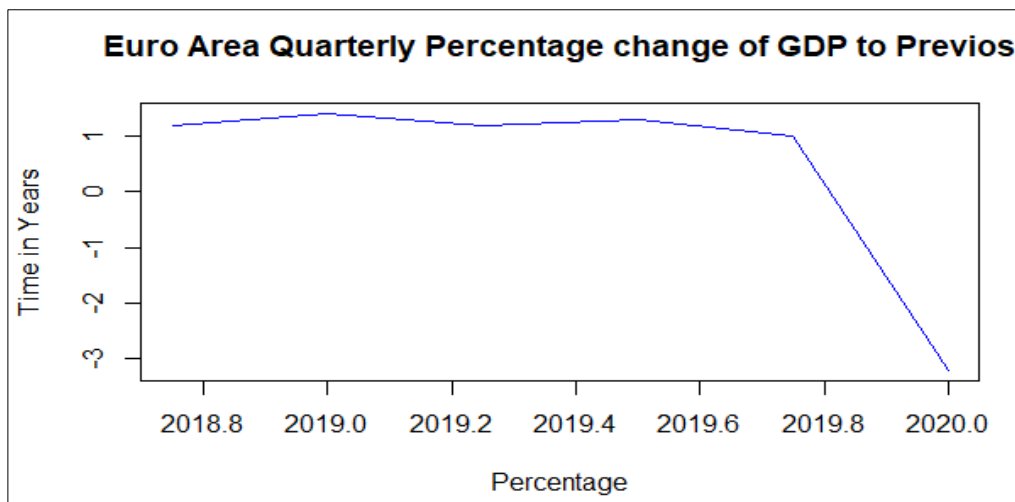


Fig 5: Euro Area Quarterly percentage change of GDP

The plot clearly shows that the GDP percentage change remained steady around the mean from the last quarter of 2018 to the last quarter of 2019 until the first quarter of 2020

when it dropped drastically to a negative figure. An ARIMA model was fit to the data and a forecast going to 2022 plotted.

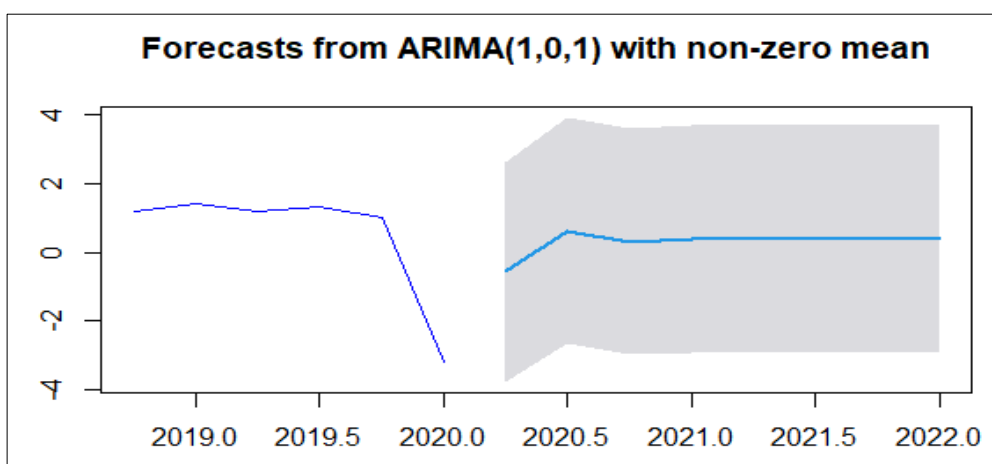


Fig 6: The euro area forecast of percentage change in GDP

The forecast shows that the percentage change is GDP will rise slightly towards the end of 2020, falls towards the first quarter of 2021 and remains constant through to 2022.

The region experienced the extreme effects of coronavirus in the European region. The region was slow to adapt to the coronavirus situation due to delayed information. However, upon the closure of the major economic activities, the country experienced a surge in the revenue collected. Additionally, more expenses were towards the fight against the coronavirus. The lockdown policy also led to more jobless people in the economy of the region and high living standards. The economy of the Euro Area was affected as companies were shut down, people were rendered jobless and the economy was declining daily.

4. Conclusion and Recommendations

It is evident that the coronavirus has had devastating effects to the global economy and continues to pause a threat as

countries battle to control the disease. Analysis of the percentage change in GDP and the forecasts showed a clear trend of countries having a stagnating GDP from 2020 to 2022. The pandemic impacts on the GDP negatively.

Closure of industries has also served a big blow to the global economy due to unemployment. Many nations across the globe have also suffered economically by restructuring their budgets and diverting reasonable amount of money towards combating the virus. COVID-19 pandemic has spread almost to every nation in the world in the past few months. Unlike past pandemics, this is a crisis with unique characteristics, which makes the prediction of the outcome confusing. Nevertheless, there is a hope given that the mechanisms that have been set in place for its control are working. Observation of hygiene such as washing hands, covering one's nose and mouth when sneezing, and avoiding contact are some of the mechanisms that are helping to minimize the spread. Another important consideration that is a sign of hope is that the rush

to find the cure or anti-drug seems to be gaining success as more drugs are on trial at the moment. Other than that, most governments have been offering food, stipend benefits, and unemployment benefits, which is something that had not been seen before. Overall, in the past few months, the world has been able to manage the outbreak in a more organized manner than what has been seen in the past crisis. With this, there is a possibility that the economy would recover from the loss once the pandemic is contained.

It is recommendable for nations to improve contact tracing approaches by applying the innovative measures by various scientists. To date, several scientists have discovered means of addressing coronavirus by implementing different approaches for contact tracing and identifying whether someone is suffering from the disease. The use of thermal temperature thermometers might not be effective to a certain extent as it is hard for the nations to take random temperature tests for everyone. However, as seen in the UAE, Dubai has implemented a system where temperature is easily recorded by the cameras all over the city. The cameras easily trace individuals from one point of movement to another, hence ensuring their contacts are also known. This will help reduce the economic impact of purchasing several thermal thermometers as well as payment for labor.

In conclusion, international organizations should sponsor any creative and innovative ideas for the fastening of identification and treatment of the novel coronavirus since this is a global pandemic. It is the collective responsibility of every nation to offer outstanding services to aid in reducing the impact or risk of further spread of the coronavirus. This has been seen by the philanthropic aid offered by nations such as Denmark to African countries by providing capital to increase the battle against coronavirus. Cuba also increased the health care workforce of Italy as it was battling the increased number of deaths that impaired its health care system. The IMF has also provided funds to countries to oversee the risks and impacts of coronavirus. Continued support will lessen any impacts that include economic and social impacts. Therefore, countries with the capability to assist others should continue doing so to help in battling the coronavirus to the end.

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