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# Lockdown 2.0 In Malaysia: Evaluating Forecast Performance of Goods Export with Box-Jenkins Methodology and ARIMA Model

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**ABSTRACT**

The purpose of this study is to model the forecast of Malaysia's export of goods using Autoregressive Integrated Moving Average Model (ARIMA) modelling with Box-Jenkins method. The time-series concerned is from the first quarter of 2015 to the first quarter of 2021 based on the Department of Statistics Malaysia (DOSM) data. The empirical analysis focuses on the five criteria for consideration towards the best model: high significant coefficient, high adjusted R-squared value, low sigma squared value, low Akaike Information Criterion (AIC) and low Schwarz Information Criterion (SIC). The study showed that ARIMA (2,1,2) would be the best model to forecast Malaysian export of goods from the second quarter of 2021 to the fourth quarter of 2022. The quarterly forecast opined the performance rate of Malaysian goods export to be at a stable positive rate of 4.9% throughout 2022, indicating the economic recovery progress that Malaysia would acquire from its vaccination programme and Movement Control Order (MCO) done in the previous year. The annual forecast showed a more precise value after comparing the actual and forecast growth value of exports in 2021. This finding is further supported with qualitative analysis about the validity of the forecast values via reports released by sources such as World Bank and Focus Economics.

## 1. Introduction

According to Corporate Finance Institute (2021), the current account is "the country's trade balance, or the balance of imports and exports of goods and services, plus earnings on foreign investments minus payments to foreign investors." The current account is one of the components – besides the financial account and capital account – forming the balance of payment for a particular country. This component itself consists of four sub-constituents: net income, asset income, payment transfer and trade of goods and services. Among those sources, it is obvious that trade is the most influential factor since some economists tend to abbreviate the interpretation of the current account of a particular nation with its export performance, such as a study done by Bogdan et al. (2017) upon European Union members to evaluate the effect of exchange rate policies adopted towards export rate and consequently the current account.

Organization for Economic Co-operation and Development (2001) defines exports of goods and services as "merchandise trade comprising goods leaving a country's statistical territory." Although this is quite confusing at first, considering the definition only mentions *goods* and does not include services, it is implicitly understood that the exports of services would be included during the production or transportation of the goods. Nevertheless, it is clear that the export of goods is the general understanding because of its tangible nature. The definition of goods reinforces this by United Nations Statistics Division (1998) as "physical objects for which a demand exists, over which ownership rights can be established and whose ownership can be transferred from one institutional unit to another by engaging in transactions on markets." The scope for the export of goods is clearly defined by the Central Bank of Malaysia (BNM) for their foreign exchange policy (2021):

- Any movement or transfer of goods by land, sea or air from Malaysia to any territory outside of Malaysia; or

- Any transfer of ownership in goods originated from Malaysia by a resident to a non-resident abroad or a Labuan entity which the Bank declared as a non-resident.

Since the emergence of COVID-19 and thus the first lockdown in Malaysia around March 2020, the global economy has been affected and the uncertainty persists. We can see the impact of the COVID-19 pandemic upon the export of goods as Malaysia External Trade Development Corporation (MATRADE) extracted the values as shown in Fig 1.0 and Fig 1.1 below.

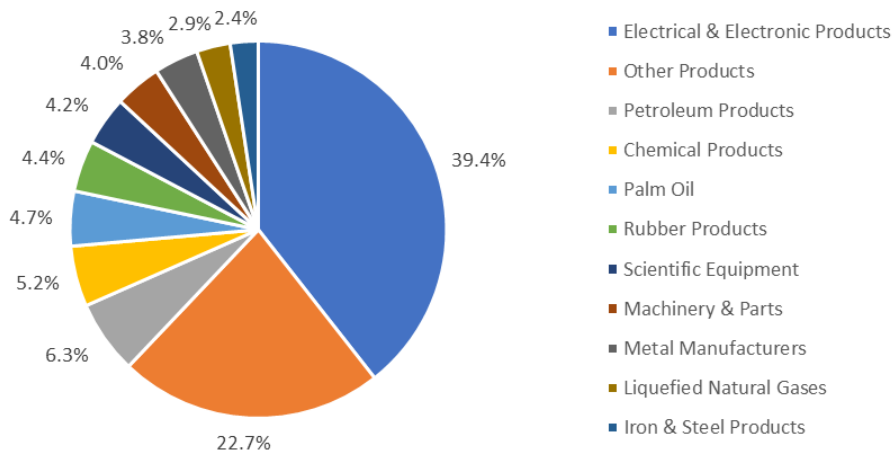



Figure 1.0 Top 10 Export Products in 2020
(Source: MATRADE)

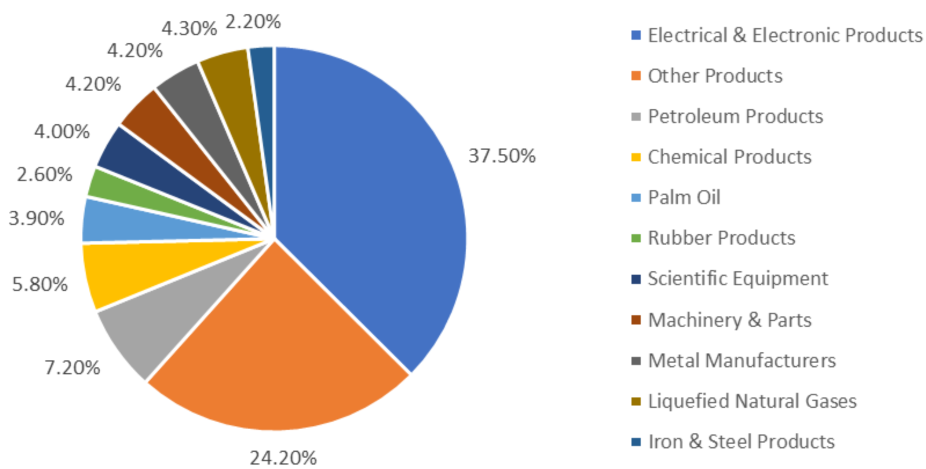



Figure 1.1 Top 10 Export Products in 2019
(Source: MATRADE)

The total exports in 2019 is RM995.07 billion, whereas the value is RM980.98 billion in 2020. This means there is a reduction of RM14.09 billion of exports due to sudden policies about closing international borders and intra-national movement restrictions. Based on both figures above, the top 3 particular export products in both years remain the same – electrical and electronic products, petroleum and chemical products. However, it is also noted that some export products experience downside trend in 2020 compared to the previous year, such as petroleum (-0.9%), chemical products (-0.6%), machinery and parts (-0.2%), metal manufacturers (-0.4%), liquefied natural gases (LNG) (-1.4%) and also miscellaneous products (-1.5%). This is because these products are primarily involved with the manufacturing sector, and thus the lockdown would significantly reduce or even halt the production of these goods. However, several other products thrived during the turbulent time compared to 2019 as they are able to improve the export rate, particularly electrical and electronic products (1.9%), palm oil (0.8%), rubber products (1.8%), scientific equipment (0.2%) as well as iron and steel products (0.2%). Electrical and electronic products increased the most among those products due to a soar in demand for gadgets initiated by the changing norm of Working From Home (WFH) and online learning for students. Rubber products and scientific equipment also prevailed due to the COVID-19 pandemic itself, with the rising demand for personal protective equipment (PPE) and scientific apparatus to conduct intensive research on the virus with the hope of securing a cure. However, economists also realize the rise in palm oil exports rate amidst the pandemic. New

Straits Times (2020) cited the Malaysian Palm Oil Board (MPOB) director-general, Dr. Ahmad Parveez Ghulam Kadir, regarding the reasons for such a situation as the palm oil market's swift adaptability with the palm oil market the new norm. Meanwhile, iron and steel products also experienced an increasing trend due to their quick adaptability with the trade measures such as tariffs and anti-dumping tariffs, as nations seek to safeguard their battered economy. Even more so, weaker currencies have sometimes allowed nations such as Turkey and Russia to compete in areas outside their usual export markets (S&P Global, 2020).

With this sudden shift in international trade, the overall balance of trade is bound to major disruptions. We can see the data below in Table 1.0 from the Department of Statistics Malaysia (DOSM) to comprehend the overall impact of COVID-19 upon the export performance from January 2020 till May 2021.

Table 1.0 Monthly Trade from January 2020 – May 2021 (Data Source: DOSM)
*Figures are in RM billion

| Month, Year | Total Exports | Total Imports | Total Trade | Balance of Trade |
|---|---|---|---|---|
| January, 2020 | 84.11 | 72.08 | 156.20 | 12.03 |
| February, 2020 | 74.45 | 61.83 | 136.28 | 12.62 |
| March, 2020 | 80.12 | 67.80 | 147.92 | 12.31 |
| April, 2020 | 64.79 | 68.42 | 133.21 | -3.63 |
| May, 2020 | 62.65 | 52.26 | 114.91 | 10.39 |
| June, 2020 | 82.82 | 61.97 | 144.79 | 20.85 |
| July, 2020 | 92.56 | 67.38 | 159.94 | 25.18 |
| August, 2020 | 79.13 | 65.91 | 145.04 | 13.22 |
| September, 2020 | 88.91 | 66.96 | 155.86 | 21.95 |
| October, 2020 | 91.05 | 68.93 | 159.98 | 22.12 |
| November, 2020 | 84.66 | 67.61 | 152.27 | 17.05 |
| December, 2020 | 95.73 | 75.04 | 170.77 | 20.69 |
| January, 2021 | 89.63 | 73.02 | 162.65 | 16.60 |
| February, 2021 | 87.57 | 69.69 | 157.26 | 17.88 |
| March, 2021 | 105.00 | 80.79 | 185.79 | 24.20 |
| April, 2021 | 105.59 | 85.23 | 190.82 | 20.36 |
| May, 2021 | 92.31 | 78.57 | 170.88 | 13.74 |

Based on the table above, the Malaysian economy had stable progress of having approximately RM 12 billion for the balance of trade (BOT) at the start of 2020 before stumbling upon the sudden lockdown in March 2020, resulting in a plummeting BOT value of RM3.63 billion during the subsequent month as Malaysia imported more than what it exported at that time. Another notable month is in May 2021, since it had a declining BOT value of RM6.62 billion compared to the previous month. This is the expected result from the surge in the COVID-19 pandemic leading to the highest daily cases recorded at the end of the month with 6,999 cases, ultimately causing the government to initiate the second complete lockdown in June 2021.

With the development of COVID-19, a new virus in humans that causes respiratory disease that may be transmitted from person to person and its rapidly evolving mechanism to counter vaccines, many nations worldwide have implemented economic, social, industrial, communication, and tourism limitations, among others. This situation inevitably affects the export of goods, showing its pivotal role in the economy of any country via current account. Exports are critical to emerging markets and developing economies (EMDEs) because they provide individuals and businesses with access to a broader market for their products. One of the primary objectives of diplomacy and foreign policy between governments is to promote economic commerce by promoting exports and imports to the mutual advantage of all trading partners. Therefore, all parties need to be adaptive to this uncertain situation and one of them is to make accurate forecasting.

**2. Literature Review**

There are several attempts by econometricians to illustrate the forecasting performance for national exports. One of the research includes a study by Alam (2019) utilized Artificial Neural Network (ANN) and Autoregressive Integrated Moving Average (ARIMA) models to make forecasts for the total annual exports and imports of the Kingdom of Saudi Arabia from 1968 till 2017 with the help of statistical software XLSTAT. The applied models are used to predict some future values of total annual exports and imports of the Kingdom of Saudi Arabia. It is found that the ANN and ARIMA (1, 1, 2) and ARIMA (0, 1, 1) models are suitable for predicting the total annual exports and imports of the Kingdom of Saudi Arabia during the aforementioned period. Although the researcher used the ARIMA model as one of the models, Box-Jenkins methodology is not applied in this paper since ANN is expected to be more comprehensive and systematic than the methodology's selective style. This ANN-ARIMA comparative forecasting capability is also studied by Munira et al. (2018) to forecast USD/MYR exchange for the next five months, and Box-Jenkins methodology is applied in ARIMA model. MATLAB 2015a is used for the ANN modelling. The Box-Jenkins method determines that ARIMA (0, 1, 1) is the optimal model for the time series. After comparing forecasting methods utilising ANN and ARIMA (0, 1, 1) time series, they discover that feed-forward neural networks produce much lower Mean Squared Error (MSE) and Root Mean Squared Errors (RMSE) than ARIMA (0, 1, 1). This finding implies that, in this study, an ANN approach using a feed-forward neural network is a better appropriate forecasting technique for predicting the US Dollar exchange rate represented in Malaysian Ringgit than the ARIMA (0,1,1) time series model.

Despite the criticism by some econometricians and statisticians regarding the capability of Box-Jenkins methodology upon ARIMA models, some researchers found their study to be the opposite. Farooqi (2014) study was based on a time series model using ARIMA with a focus on the Box-Jenkins methodology for Pakistan's yearly total imports and exports from 1947 to 2013 using programming language R. The fitted model's validity is determined using conventional statistical methods. The fitted model is then used to predict future values for Pakistan's imports and exports. The ARIMA (2, 2, 2) and ARIMA (1, 2, 2) models are shown to be *appropriate* for forecasting Pakistan's yearly imports and exports, respectively. Additionally, he discovered a rising tendency in both imports and exports throughout his research. Another study by Khan and Kundu (2012) also attempted to forecast the future contribution of exports-imports towards Bangladeshi Gross Domestic Product (GDP) with the same technique. The data covered were from 1981 till 2010 and they forecasted the figures up to 2015. The projected result shows that exports will contribute about 17% of GDP during the next five years. Imported products and services will account for about 23% of GDP in each year predicted in this study. Consequently, the projected trade deficit from 2011 through 2015 will be approximately 6%, somewhat less than the 2010 figure. The projected proportion of export and import in forecasted GDP is slightly declining, as GDP volume grew faster than export and import volume.

Some researchers prefer to zoom in the scope towards specific exports and imports of a particular product to enable more accurate forecasting, even more so that some involve agricultural products. A study by Ersen et al. (2019) also made comprehensive forecasting on both the exports and imports of Turkish paper-related products using the Box-Jenkins methodology. The monthly data are covered from January 2003 to December 2014 and the researchers forecasted up to December 2020. Sum of Squared Errors (SSE) and MSE criteria were considered when choosing appropriate Box-Jenkins models. Performance evaluation criteria such as Mean Absolute Percentage Error (MAPE), Mean Absolute Error (MAE) and RMSE were considered to ascertain a successful forecast. It was found that the ARIMA (2,1,0) (0,0,1) was found to be the best model for predicting paper products exports, whereas ARIMA (3,1,2) (1,0,1) was shown to be the best model for predicting imports. Another study upon forecasting monthly soybean production and exports from January 2013 to December 2020 was done by Tanong et al. (2021) using the Seasonal ARIMA model instead. Econometric analysis was used to determine if the time series was stationary using the ADF unit root technique and whether the import demand for soybean meal in Thailand could be predicted using the Box-Jenkins method or the Seasonal ARIMA(p,d,q) (P,D,Q)s model. The empirical findings indicated that the time series of Thailand's import demand for soybean meal was non-seasonal and seasonal in nature at the level stage and first differencing order, respectively. Seasonal ARIMA (0,0,1) (0,1,1) was the best appropriate model for forecasting the import demand for soybean meal in Thailand, based on the lowest Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) data. According to the projected demand for soybean meal in Thailand, the amount imported in 2021 should rise by 1.71 percent above 2020 levels. The government and other relevant stakeholders should continue to encourage and support local soybean production in order to reduce reliance on imported soybeans.

We conclude that Box-Jenkins methodology is still relevant for forecasting and academic research based on the previous research. Some studies often cover both exports and imports of the whole country or a particular product. Therefore, this paper attempts to fill in the literature gap by studying the exports of Malaysian goods and give another perspective on the export performance.

## 3. Data

This research analysed time-series data from the DOSM's quarterly economic evaluation https://www.dosm.gov.my/v1/index.php. During the period 2015Q1 – 2020Q1, there are 25 observations with no missing values. DOSM provides significant macroeconomic data in Malaysia, particularly the external trade indices. The 25 quarterly observations of Malaysia's goods exports performance meet the Box-Jenkins method's criterion of at least 24 observations opined by Hanke and Wichern (2009). The data was gathered in Malaysia's currency unit, the Ringgit Malaysia (MYR), which is denominated in millions.

## 4. Methodology

The forecast is conducted by following the Box-Jenkins forecasting method's four stages: identification, estimation and selection, checking and model use.

Step 1 (identification) entails establishing the model's necessary order (p, d, and q) in order to capture the data's most prominent dynamic characteristics. This mostly results in the employment of graphical techniques such as plotting the ACF and PACF. Step 2 (parameter estimation and choosing) begins with the parameter estimate of the various models derived from Step 1 using maximum likelihood techniques, backcasting etc., before progressing to the first model selection. Step 3 (verification) entails evaluating if the stated and estimated model(s) are sufficient as one takes advantage of residual diagnostics. The goodness-of-fit tests would be performed to verify that the model adequately represents the data. Residuals should be unequally distributed, homoscedastic, and distributed normally with constant mean and variance. This is to uphold the concept of BLUE – Best Linear Unbiased Estimator to ensure the econometric assumptions still hold in this case. The final step involves selecting a model and validating its fit and forecasting capability - the model may be used to predict across a future time horizon. The flow of the Box-Jenkins methodology is illustrated in Fig 4.0 below.

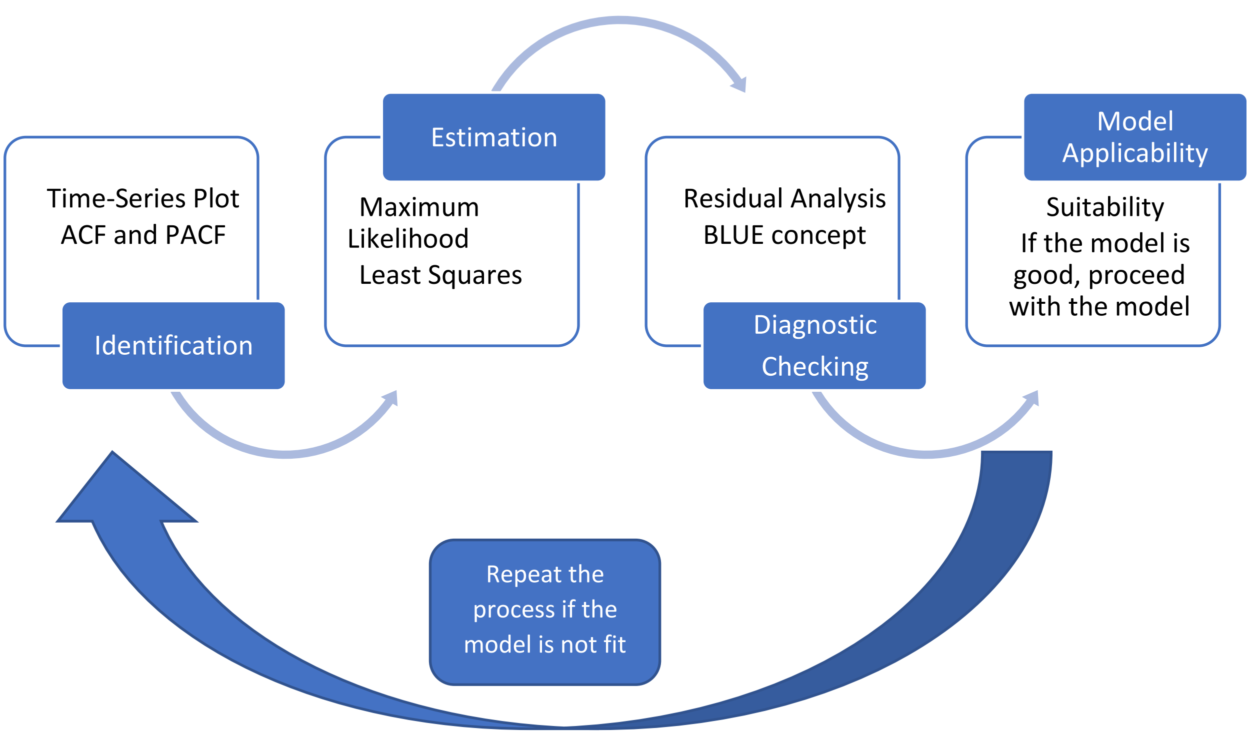



Figure 4.0 Flow Chart for The Box-Jenkins Methodology

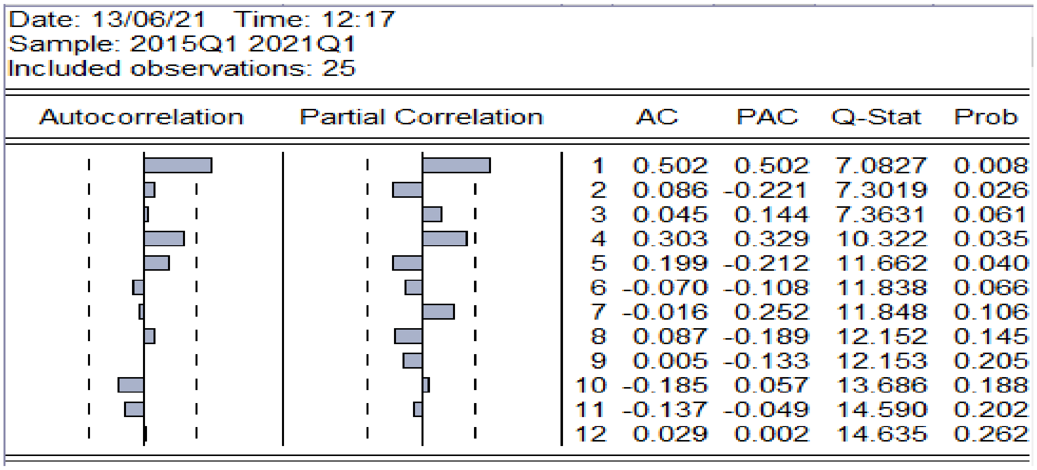
The analysis will also be fortified with qualitative forecasting based on economic reports and opinions by academicians regarding the prospects of export performance. The complete analysis will be shown in the following section.

## 5. Analysis

There are many methods to choose to forecast from time series data, such as exponential smoothing methods, single-equation regression models, simultaneous-equation regression models, vector autoregression (VAR) models, and the autoregressive integrated moving average (ARIMA) models or also known as the BJ methodology. We will be using Box-Jenkins (BJ) methodology to develop our forecasting model. In ARIMA models or the BJ methodology, there are four steps: identification, estimation, diagnostic checking, and forecasting.

### 5.1 Identification

In the first step, we need to check if the time series is stationary by looking at the correlogram of the autocorrelation function (ACF) and the partial autocorrelation function (PACF) for the series. Figure 5.1 below is the correlogram of the LEXG.



Date: 13/06/21 Time: 12:17
Sample: 2015Q1 2021Q1
Included observations: 25

| | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|
| 1 | 0.502 | 0.502 | 7.0827 | 0.008 |
| 2 | 0.086 | -0.221 | 7.3019 | 0.026 |
| 3 | 0.045 | 0.144 | 7.3631 | 0.061 |
| 4 | 0.303 | 0.329 | 10.322 | 0.035 |
| 5 | 0.199 | -0.212 | 11.662 | 0.040 |
| 6 | -0.070 | -0.108 | 11.838 | 0.066 |
| 7 | -0.016 | 0.252 | 11.848 | 0.106 |
| 8 | 0.087 | -0.189 | 12.152 | 0.145 |
| 9 | 0.005 | -0.133 | 12.153 | 0.205 |
| 10 | -0.185 | 0.057 | 13.686 | 0.188 |
| 11 | -0.137 | -0.049 | 14.590 | 0.202 |
| 12 | 0.029 | 0.002 | 14.635 | 0.262 |



Figure 5.1 Correlogram of LEXG, 2015Q1-2021Q1

From the figure above, we can conclude that the coefficients of autocorrelation (ACF) pattern changes with a sine wave-like pattern and the ACF shows that 8 from 12 lags are individually statistically significantly different from zero, for they all are outside the 95 percent confidence bounds or we can say that it has a probability value higher than 0.05. Also, the Q-statistic of Ljung-Box (1978) at the 5th lag has a probability value which is smaller than 0.05. Thus, it seems that the series is nonstationary and must be configured in the first difference.

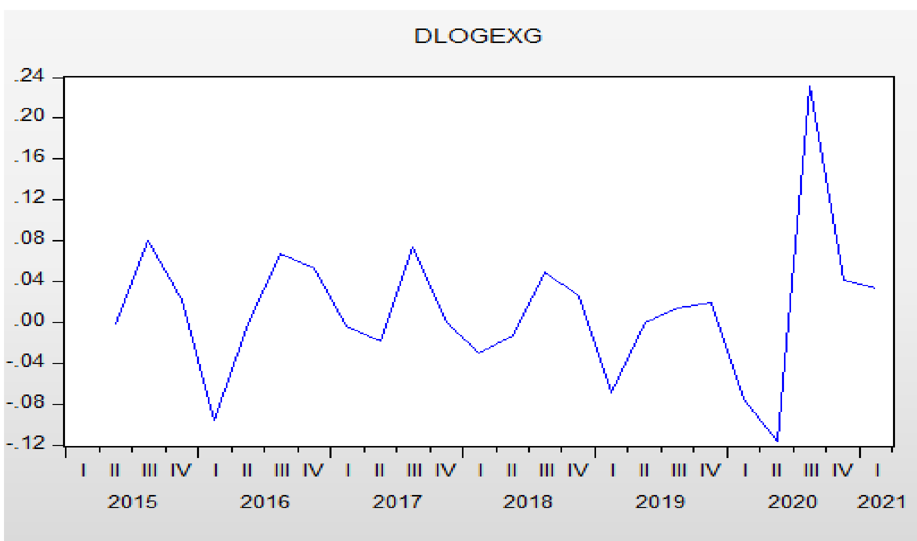
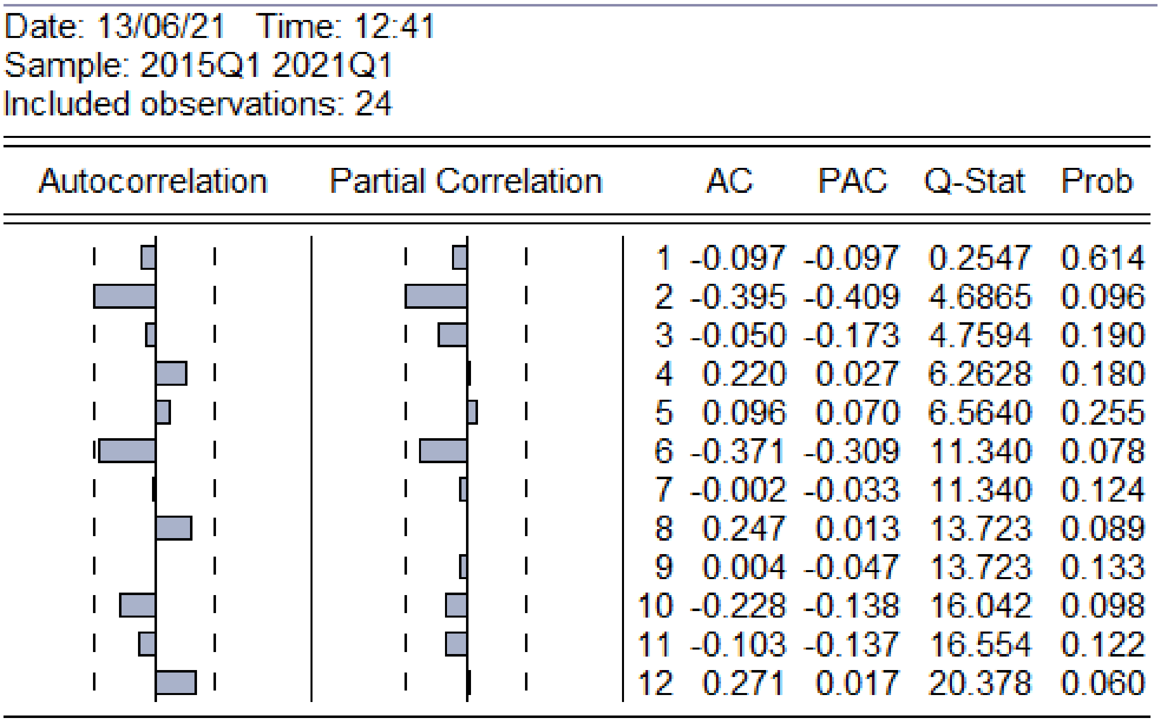



Figure 5.2: Graph of first-differentiated LEXG

To proceed with the ARIMA model, we must make sure that the series is stationary first. Therefore, we need to differentiate the log series to a certain number of times to make it stationary. We differentiate the LEXG series one time (first difference) and it is plotted as Figure 5.2.



Date: 13/06/21 Time: 12:41
Sample: 2015Q1 2021Q1
Included observations: 24

| | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|
| 1 | -0.097 | -0.097 | 0.2547 | 0.614 |
| 2 | -0.395 | -0.409 | 4.6865 | 0.096 |
| 3 | -0.050 | -0.173 | 4.7594 | 0.190 |
| 4 | 0.220 | 0.027 | 6.2628 | 0.180 |
| 5 | 0.096 | 0.070 | 6.5640 | 0.255 |
| 6 | -0.371 | -0.309 | 11.340 | 0.078 |
| 7 | -0.002 | -0.033 | 11.340 | 0.124 |
| 8 | 0.247 | 0.013 | 13.723 | 0.089 |
| 9 | 0.004 | -0.047 | 13.723 | 0.133 |
| 10 | -0.228 | -0.138 | 16.042 | 0.098 |
| 11 | -0.103 | -0.137 | 16.554 | 0.122 |
| 12 | 0.271 | 0.017 | 20.378 | 0.060 |

Figure 5.3: Correlogram of the first differenced DLOGEXG

In Figure 5.3 above is the correlogram of the first difference of the LEXG (DLOGEXG). As we can see, the ACFs and PACFs for the first-differenced series show a few spikes in lag 2 and the rest are not statistically different from zero. The Q-statistic of Ljung-Box at the 12th lag has a probability value larger than 0.05. This shows that the DLOGEXG series is perhaps stationary. We further checked it using the Augmented Dickey-Fuller (ADF) unit root test, proving it so (Figure 5.4).

**Augmented Dickey-Fuller Unit Root Test on D(LEXG)**

Null Hypothesis: D(LEXG) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on AIC, maxlag=5)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -2.448816 | 0.3456 |
| Test critical values: | 1% level | -4.571559 | |
| | 5% level | -3.690814 | |
| | 10% level | -3.286909 | |

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18

Figure 5.4: ADF unit root test on DLEXG

Once the series is confirmed as stationary, we can use the BJ methodology to develop our model. From Figure 5.3, it seems that both the ACF and PACF spike significantly at lags 2. We only consider lag 5 using the rule of thumb because the EXG data is collected quarterly. As the model is stationary on first differences, i.e. (d=1) our ARIMA model will be ARIMA (2,1,2), ARIMA (0,1,2) and ARIMA (2,1,0). We have obtained appropriate values for p and q for the next step, that is, estimation.

### 5.2 Estimation

With the values of p and q obtained, we combined them to estimate the parameters of the autoregressive and moving average terms in the model. There are a few indicators to help in choosing the best model: [1] number of significant coefficients, [2] volatility (Sigma square), [3] adjusted R-squared value, [4] Akaike Info. criterion (AIC) and [5] Schwarz criterion (SBIC). Table 5.1 below shows the ARIMA model estimated by using the appropriate p, d and q values.

Table 5.1: Comparison of the indicators between the ARIMA models.

| Indicator | ARIMA (2,1,2) | ARIMA (0,1,2) | ARIMA (2,1,0) |
|---|---|---|---|
| Significant coefficients (number) | 2 | 1 | 1 |
| Sigma square (vitality) | 0.002504 | 0.003713 | 0.003859 |
| Adjusted R squared | 0.377191 | 0.120214 | 0.085651 |
| AIC | -2.61789 | -2.471363 | -2.45586 |
| SBIC | -2.421554 | -2.324106 | -2.308609 |

The best model to be chosen is ARIMA (2,1,2) because it has the highest number of coefficients and Adjusted R-squared, lowest volatility (Sigma square), AIC and SBIC, among the other models. Thus, the ARIMA (2,1,2) model will be chosen to continue the next BJ methodology step.

### 5.3 Diagnostic Checking

The third step of the BJ methodology is to do the diagnostic checking. After choosing the particular ARIMA model and estimating its parameter, we will see whether the chosen model fits the data reasonably well. If the residuals estimated from this model are white noise, then we can accept the particular fit, and if not, we must start over again. So, the BJ methodology is an iterative process. The most appropriate model that we have chosen is ARIMA (2,1,2). To know whether this model is a reasonable fit to the data, we have done a diagnostic to obtain residuals from ARIMA (2,1,2) and obtain the ACF and PACF of these residuals up to lag 5.

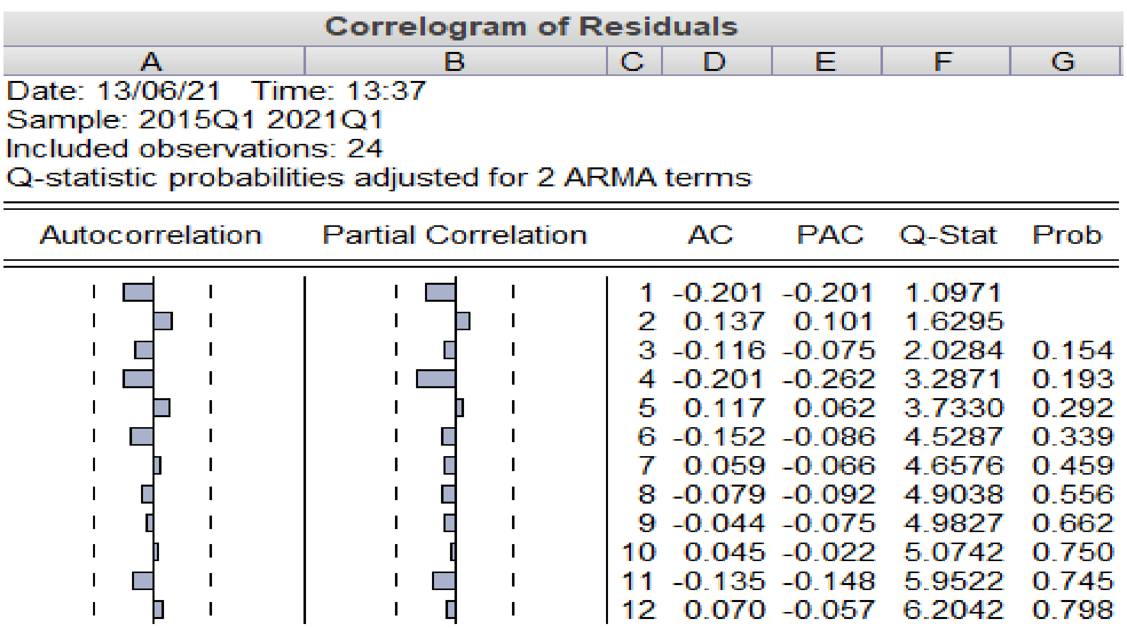


Figure 5.5: Correlogram of residuals for ARIMA (2,1,2)

The correlogram of the residuals is flat which indicates that all information has been captured. So, there is no need for re-estimation and the forecast will be based on this model.

**Correlogram of Residuals Squared**

| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|

Date: 13/06/21 Time: 13:37
Sample: 2015Q1 2021Q1
Included observations: 24

| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|---|---|
| | | 1 | 0.261 | 0.261 | 1.8416 | 0.175 |
| | | 2 | 0.129 | 0.066 | 2.3135 | 0.315 |
| | | 3 | 0.046 | -0.003 | 2.3758 | 0.498 |
| | | 4 | 0.037 | 0.019 | 2.4183 | 0.659 |
| | | 5 | -0.041 | -0.061 | 2.4732 | 0.781 |
| | | 6 | -0.011 | 0.009 | 2.4778 | 0.871 |
| | | 7 | -0.060 | -0.054 | 2.6114 | 0.918 |
| | | 8 | -0.056 | -0.030 | 2.7324 | 0.950 |
| | | 9 | -0.067 | -0.036 | 2.9173 | 0.967 |
| | | 10 | -0.066 | -0.038 | 3.1109 | 0.979 |
| | | 11 | -0.059 | -0.023 | 3.2775 | 0.987 |
| | | 12 | -0.080 | -0.059 | 3.6137 | 0.989 |

Figure 5.6: Correlogram of residuals squared for ARIMA (2,1,2)

Next, we also performed the Q-statistic of Ljung-Box (LB) statistics to test the autocorrelation. As we can see, from lag 1 until lag 12, the probability values here are higher than 5%, which indicates that there is no autocorrelation in this model. Thus, we will use this model to do forecasting. As we know, there cannot be an exact or perfect ARIMA model because it is more "of an art than of a science".

**5.4 Forecast**

The final and most important stage of the Box-Jenkins process is forecasting. The forecast is done by using a statistical package (EViews).

**5.4.1 In Sample Forecast**

The National Account (Export of goods) from 2015Q1 to 2021Q1 was used to predict the export of goods by using MA (2) and AR (2) model as indicated in Figure 5.8.

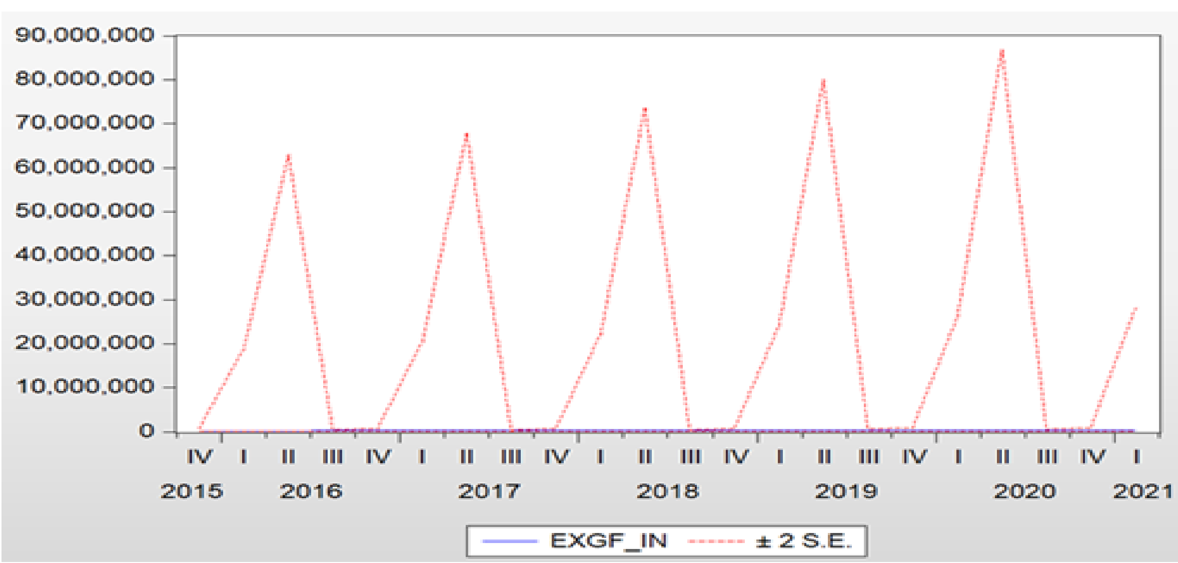



Figure 5.7: The quarterly exports of goods in sample forecast.

Besides that, a comparison has been done between the actual and the in sample forecast of the growth of export of goods as shown in Figure 5.8.

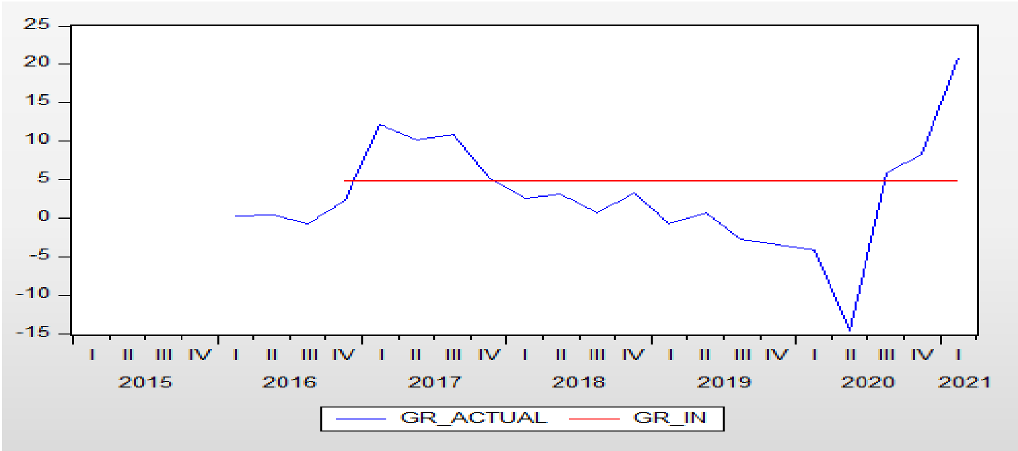



Figure 5.8: The comparison of the actual and in sample forecast growth.

Figure 5.8 shows a large discrepancy between the actual and the sample forecast of exports of goods in 2017Q1, 2020Q1 and 2021Q1. In contrast, there are also some small discrepancies between the actual and the sample forecast of goods exports in 2017Q4, 2018Q2, 2018Q4 and 2020Q3.

### 5.4.2 Forecast Error

Several measures were computed to gauge the accuracy of fitting – Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE) and Theil Inequality Coefficient. Table 5.2 presents the results of fitting accuracy measurements in which the actual values and logarized values are compared. The similarity of these forecast errors is the smaller the errors give, the better the accuracy of the forecasting model.

Table 5.2: Fitting Accuracy Measures

| Forecast Error Criterion | Actual Value | Log. Value |
|---|---|---|
| Root Mean Squared Error (RMSE) | 18187.18 | 0.09464721 |
| Mean Absolute Error (MAE) | 13332.5 | 0.06883 |
| Mean Absolute Percentage Error (MAPE) | 7.361399 | 0.56863 |
| Theil Inequality Coefficient (Theil-U) | 0.046924 | 0.00389 |

### 5.4.3 Out Sample Forecast

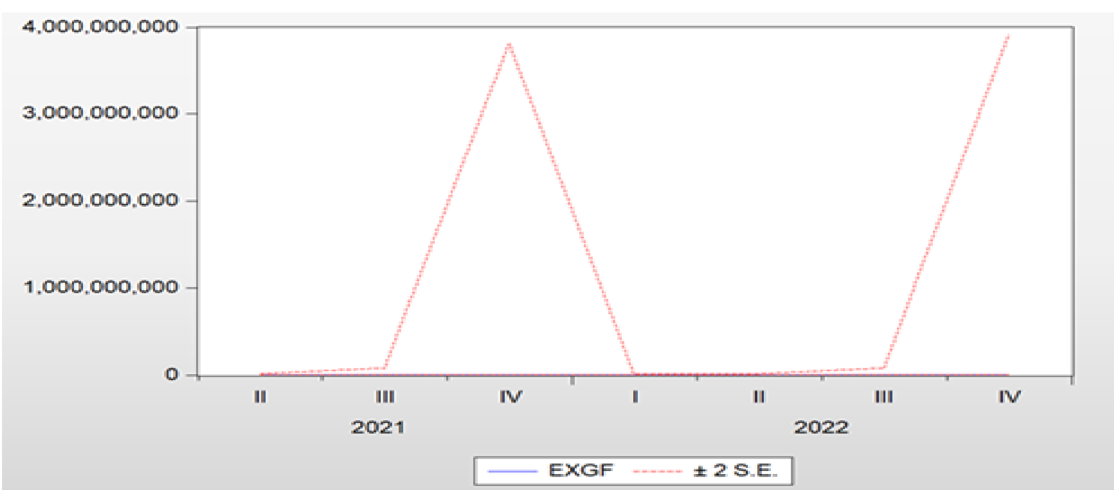



Figure 5.9: The quarterly exports of goods out sample forecast.

A comparison has been done between the actual and the out sample forecast of exports of goods for quarterly as shown in Figure 5.9 and Figure 5.10. From figure 5.10, we can see that the forecast growth of the exports of goods shows a fluctuated trend. It first decreases from 2020Q1 to 2020Q2, then it increases until 2021Q1 and is estimated to continue to increase until 2021Q2. But it was estimated to decrease starting from 2021Q2 to 2022Q1 and become unchanged until 2022Q4.

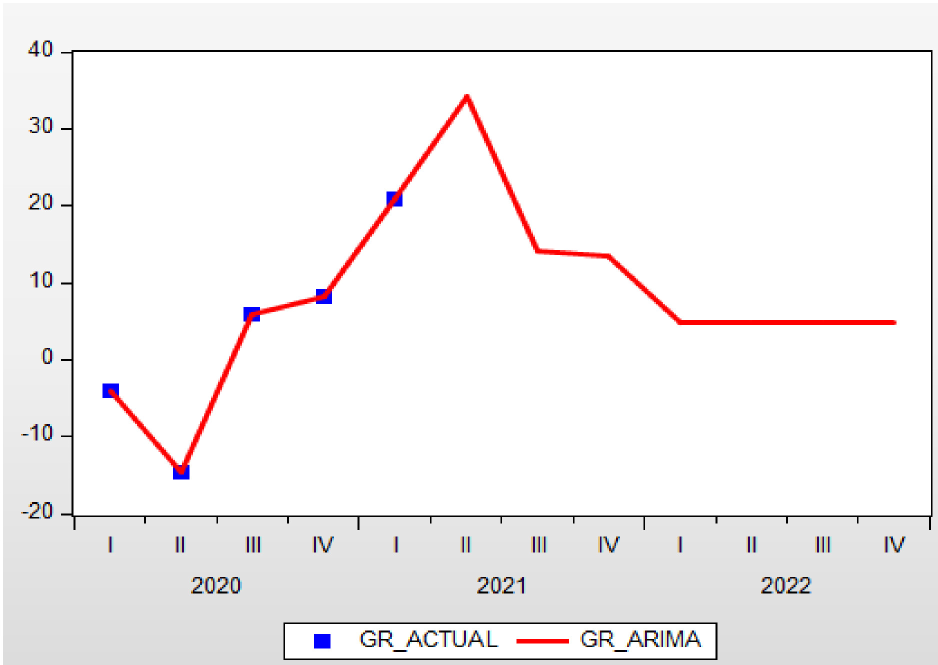



Figure 5.10: The actual growth vs the forecast growth of exports of goods (quarterly)

While in Figure 5.11, we can see that the forecast growth of the exports of goods increases from the year 2020 to the year 2021 and then decreases sharply from the year 2021 to the year 2022.

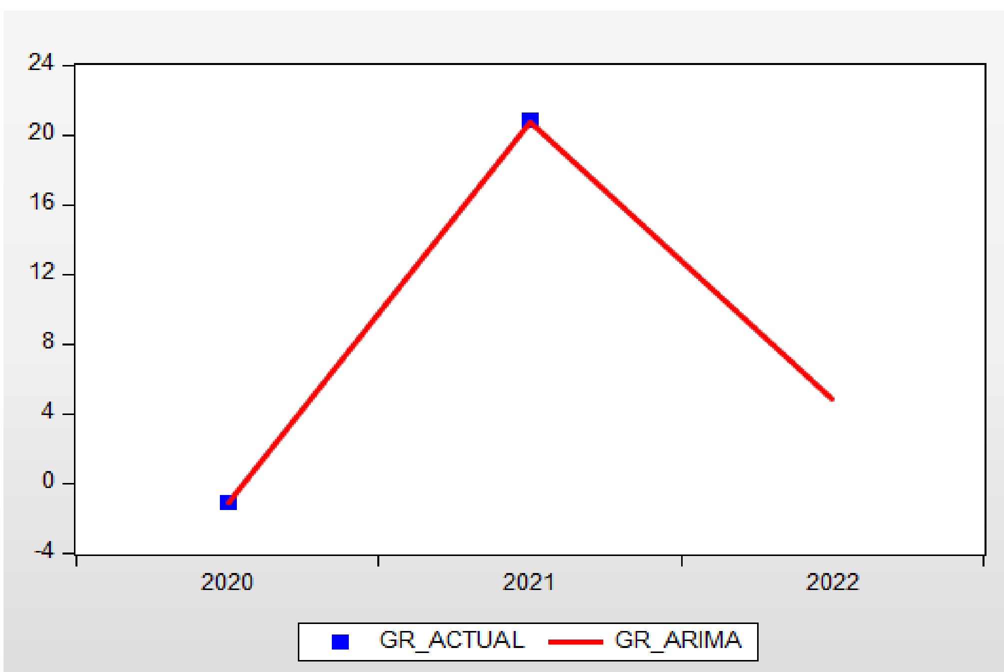



Figure 5.11: The actual growth vs. the forecast growth of exports of goods (ann)

### 5.5 Comparison with Qualitative Forecast

Based on the actual growth value of exports of goods that can be collected via the DOSM, the exports of goods dropped 4.1 per cent in 2020Q1 and dropped 14.7 per cent in 2020Q2. Starting from 2020Q3 to 2021Q1 the exports of goods begins to rise from 5.9 per cent in 2020Q3 to 8.3 per cent in 2020Q4 and lastly rose to 20.9 per cent in 2021Q1 compared to the same period of the previous year. As we compare to the forecast value of the growth of the exports of goods (q-o-q) in Table 5.3 using the ARIMA model, the growth of the exports of goods in 2020Q1 to 2021Q1 shows exactly the same amount.

Table 5.3 The actual vs. the forecast growth rate comparison of exports of goods (quarterly)

| Year, Quarter | EXG-Actual | EXG-ARIMA |
|---|---|---|
| 2020, Q1 | -4.7 | -4.7 |
| 2020, Q1 | -14.7 | -14.7 |
| 2020, Q1 | 5.9 | 5.9 |
| 2020, Q1 | 8.3 | 8.3 |
| 2021, Q1 | 20.9 | 20.9 |
| 2021, Q2 | N/A | 34.2 |
| 2021, Q3 | N/A | 14.2 |
| 2021, Q4 | N/A | 13.5 |
| 2022, Q1 | N/A | 4.9 |
| 2022, Q2 | N/A | 4.9 |
| 2022, Q3 | N/A | 4.9 |
| 2022, Q4 | N/A | 4.9 |

The actual growth value of exports of goods in 2020 dropped 1.2 per cent and then rose to 20.9 per cent in 2021. As we compare to the forecast value of the growth of the exports of goods (y-o-y) in Table 5.4 using the ARIMA model, the growth of the exports of goods in 2020 was the same which is dropped 1.2 per cent and in 2021 in rose by 20.7 per cent which the difference between actual and forecast growth rate was 0.2 per cent.

Table 5.4 The actual vs. the forecast growth rate comparison of exports of goods (y-o-y)

| Year | EXG-Actual | EXG-ARIMA |
|---|---|---|
| 2020 | -1.2 | -1.2 |
| 2021 | 20.9 | 20.7 |
| 2022 | N/A | 4.9 |

Based on World Bank Global Economic Prospects, June 2021, despite the continued pandemic-related disruption, rising oil prices and faster-than-expected recoveries in most regional economies, are supporting activity in oil exporters. Rising oil prices, and recovery in demand, are expected to return current account balances to surplus and increase inflation in many oil exporters.

According to Malaysia Economic monitor June 2021, in April 2021, headline inflation increased to 4.7%. The increase in the headline was mainly due to fuel price increases stemming from the base effect from the same period last year. Local production's Producer Price Index (PPI) recorded a marked increase of 10.6% in April 2021.

According to Malaysia Economic Monitor June 2021 as well, Malaysia's exports accelerated in 2021Q1. This was primarily driven by increased external demand due to stronger global economic activity and the low base in 2020Q1. Much momentum was driven by manufacturing exports on the back of increased global demand for E&E products and rubber gloves. Exports growth was also supported by a narrower contraction in commodities exports, mainly due to higher LNG prices.

Based on Petropoulos (2021), Malaysia merchandise exports will be an increase from 2021 until 2022 which is 12.2 per cent and 6.8 per cent, respectively. Based on our forecast, the pattern of the graph is almost the same as the forecast value by Petropoulos (2021), even though the value of the growth rate was quite different.

We can see from the qualitative forecast compared to the forecast we did that Malaysia's economy has begun to recover. The similarities of the forecast we have done and the qualitative forecasts are that there will be a rise in growth in 2021 and in 2022, the exports of goods will increase at a declining rate.

The increase of exports of goods was driven by the upward trends in commodity prices and high demand for semiconductor prices. Besides that, the increasing demand for the E&E product, rubber products and commodity products has caused the growth of the exports of goods to increase. And because of the arrival of the vaccine for covid-19, Malaysian economic activity also can be carried out and thus, production of Malaysian products will also increase.

## 6. Conclusion

As we have discussed in the earlier sections, BJ methodology requires four steps which is Identification, Estimation, Diagnostic Checking and Forecasting. These steps are required so that we can develop a more appropriate and accurate model. After trial and error and checking the indicators, we can conclude that the best model to forecast the exports of goods is ARIMA (2,1,2). Based on the result of the ARIMA model, the result of the forecast is very close to the actual growth rate values of exports of goods. We can assume that this happens due to the recovery in the market after the impacts of pandemic Covid-19 and the Movement Control Order (MCO) issued by the government.

In conclusion, we found that the BJ methodology is a perfect forecasting tool for exports of goods. It is a reliable forecasting method, considering the difference between actual and forecast results is very close. Using this model, we hope it may help stakeholders, investors, government, policymakers, and other related parties do better planning for the future.

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