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SARIMA-Intervention Analysis: The Impact of SARS and COVID-19 Outbreak on Export in Malaysia

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ABSTRACT

International trade is important for a country which enables it to export excess goods and import goods which are in shortage. Meanwhile, exports are the main components that generate income for a country. However, there are some disturbances that influence exports, such as financial crises, disease outbreaks, wars, and others. Malaysia, with a high degree of economic openness, also receives the impact of these disturbances. The objective of this paper is to study the impact of the SARS and COVID-19 outbreaks on the exports of Malaysia. The monthly time series data from January 2000 to December 2024 are adopted from Bank Negara Malaysia. In this study, a Seasonal Autoregressive Integrated Moving Average (SARIMA) intervention model is applied. The results show that SARS has an insignificant negative impact, while the COVID-19 pandemic has a significant positive impact on the exports of Malaysia. Therefore, exports in Malaysia still remain strong even during public health crises. The COVID-19 pandemic, despite its disruptions, has created an opportunity for Malaysia's export sector to accelerate growth and play a pivotal role in revitalizing the national economy.

1. Introduction

Every country has different natural resources, levels of technology, levels of skills and others. Therefore, the absolute advantage and the comparative advantage in trade are different among countries. When a country has an absolute advantage or comparative advantages in a certain product, it should implement specialisation in that particular product with the intention of increasing output. Therefore, each country will export the excess product and import the products which it cannot produce due to a lack of resources or techniques. Hence, most countries in the world have already opened their economies because the importance of international trade is undeniable. An obvious example can be seen from China, which opened its economy in December 1978 with its open-door economic policy (Lin, 2011). International trade plays an important role, especially in generating income for Malaysia. Economists have also stated that

Malaysia has a high dependence on the external sector (NST, 2019). Besides that, this high dependence can also be proved by the trade openness index, which is shown in Figure 1. Although the index shows a downward trend, it is still more than 100% when compared to GDP over these 20 years (2000 – 2024), even during the COVID-19 pandemic, a global public health crisis.

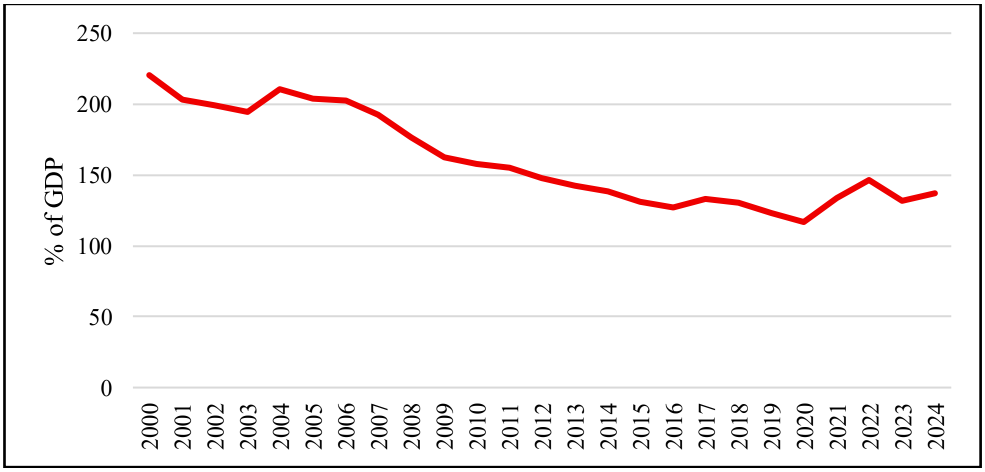


Figure 1. Trade Openness of Malaysia, 2000-2024
Sources: World Bank, 2025

Dependence on the external sector will lead to highly accelerated economic growth, but it is fraught with risk. Global circumstances such as the global financial crisis, the plunge in global crude oil prices, and the US-China trade war will impact Malaysia's trade. Therefore, there are many uncertainties if a country is heavily reliant on the external sector. However, the external sector is key to enabling Malaysia to achieve high-income status. Malaysia needs global demand in order to help boost its economy. Hence, Malaysia has focused on exports to generate the Gross Domestic Product (GDP). Figure 2 demonstrates Malaysia's exports from the year 2000 to 2024. Over these 20 years, Malaysia's exports reached their highest point in 2022 (RM 1,550,009 million). Additionally, Malaysia’s exports show an increasing trend except in the years 2001, 2009, 2019, 2020, and 2023, which were influenced by uncertainties such as the 2008/2009 global financial crisis and the trade war between the United States and China during 2018-2019. Meanwhile, the contribution of exports to Malaysia's GDP over the last five years (2015-2019) has been more than 60%, which is considered very high. Therefore, exports are of paramount importance for generating cash flow into the country.

According to MATRADE (2020), the top 10 major export products in 2019 are electric and electronic products (37.8%), followed by petroleum products (7.2%). The chemicals and chemical products contributed 5.8%. This is followed by machinery, equipment and parts, manufactures of metal, and LNG, with each of these three products contributing 4.2% to the total export. Meanwhile, the agricultural output, including palm oil and rubber products, contributes 3.9% and 2.6% to GDP, respectively. The contribution of crude petroleum is 2.7%, while optical and scientific equipment accounts for 3.9% of the total export of Malaysia. In terms of countries, the major export destinations for Malaysia during 2019 are China (14.2%), followed by Singapore (13.9%), the United States (9.7%), Hong Kong (6.7%), Japan (6.6%), Thailand (5.7%), India (3.8%), Taiwan (3.7%), Vietnam (3.5%), and the Republic of Korea (3.4%) (MATRADE, 2020).

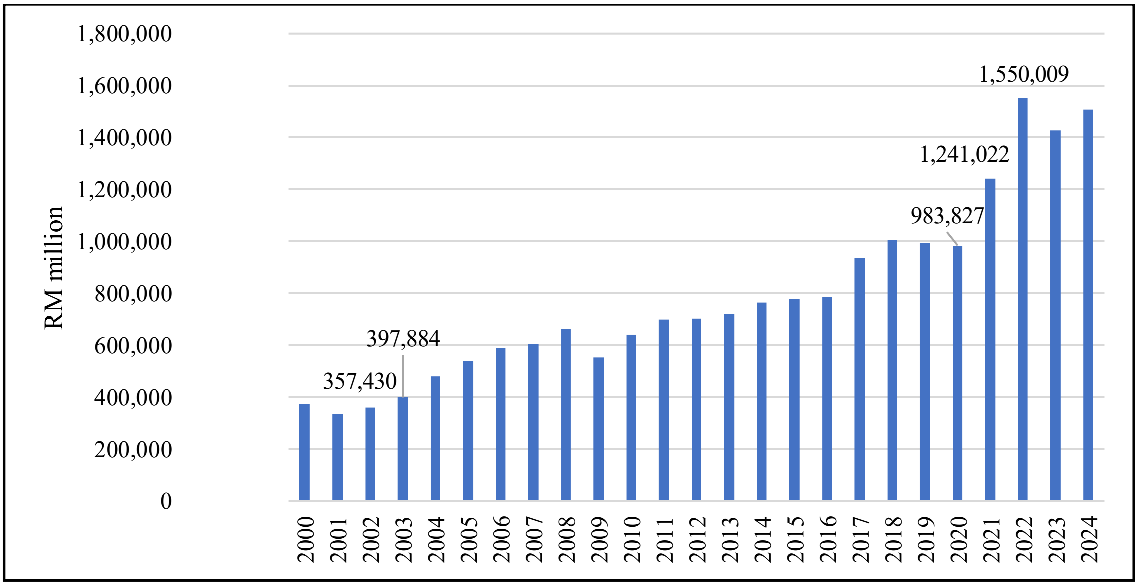


Figure 2. Export of Malaysia, 2000-2024
Source: Bank Negara Malaysia, 2025

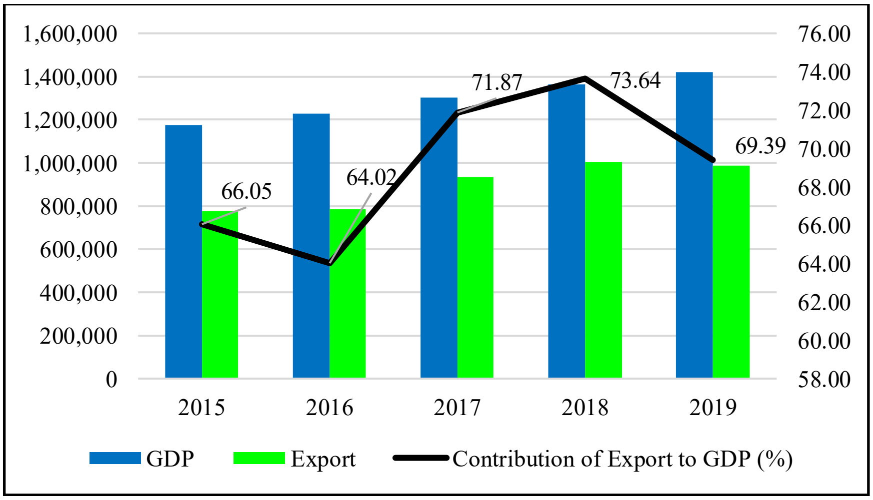


Figure 3. Contribution of Export to GDP in Malaysia, 2015-2019
Source: Calculation from the author

However, there are many uncertainties or disturbances which will influence international trade in Malaysia. Therefore, exports are one of the components of international trade that cannot be excluded from the impact of global circumstances. This study will focus on two global circumstances: the severe acute respiratory syndrome (SARS) and Coronavirus Disease 2019 (COVID-19). The SARS pandemic occurred from November 2002 until September 2003, involving 29 countries. The confirmed cases of SARS exceeded 8,000, resulting in more than 700 deaths, with a death rate of 9.56% (WHO, 2003). Meanwhile, COVID-19 began in December 2019 and continues to the present day, involving more than 220 countries. The Malaysian government reopened the national borders starting from 1 April 2022, indicating that Malaysia is undergoing the endemic period (Ng et al., 2023). From Table 1, the percentage of the death rate during the COVID-19 outbreak in Malaysia is much lower, but the number of confirmed cases has been far higher when compared to the SARS outbreak. In this context, the impact of COVID-19 is significantly greater than the impact of SARS. As of 31 December 2023, the number of confirmed cases has already exceeded 700 million, with deaths surpassing 6 million (WHO, 2020). Malaysia, as a major exporting country in the world, was also involved in both pandemics.

Table 1. The number of confirmed cases, number of deaths, percentage of death of SARS outbreak and COVID-19 outbreak in Malaysia

Title/outbreak	SARS outbreak	COVID-19 outbreak
Number of confirmed case (case)	5	701,370,544 (until 31 December 2023)
Number of death (case)	2	6,982,594 (until 31 December 2023)
Percentage of death (%)	40	1.00 (until 31 December 2023)

Source: World Health Organization, 2003; Ministry of Health Malaysia, 2025

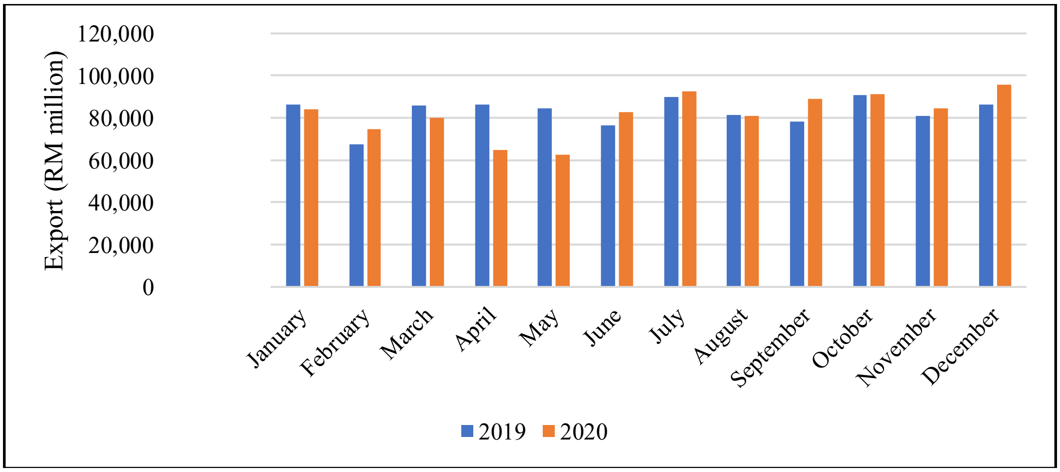


Figure 4. Total of Export, 2019 and 2020
Source: MATRADE, 2020

Therefore, most of the countries implemented the Movement Control Order (MCO) or the lockdown policy to restrict the spread of the virus. Hence, the production of the firms was affected, and thus it impacted exports. The Malaysian government announced the implementation of the MCO phases I to III, the Conditional Movement Control Order (CMCO), and the Recovery Movement Control Order (RMCO) from 18 March 2020 until 31 August 2020. During the MCO, all economic activities, except for the strategic sector, were prohibited. Hence, the output produced was reduced, making Malaysia's exports also lower compared to last year. This can be seen from Figure 4. In Figure 4, the export during April 2020 was RM 64.91 billion, which is 24.77% less than the export during April 2019. Meanwhile, the export for May 2020 (RM 62.8 billion) is 25.83% less compared to May 2019 (RM 84.67 billion). In terms of the year 2020, the export during the COVID-19 period demonstrates a downward trend, starting from March 2020 to May 2020.

However, when compared with Figure 2, the information shows that exports were increasing even during the SARS period. During the COVID-19 pandemic, Figure 2 portrayed a downward trend for the yearly export data. Interestingly, in Figure 4, it was found that monthly export data during the COVID-19 pandemic was upside down. However, it was noted that some export data (2020) were even higher than pre-pandemic export data (2019), for instance, in February 2020, June 2020, July 2020, September 2020, November 2020, and December 2020. From the descriptive analysis, there was a dilemma regarding whether the COVID-19 pandemic reduced or increased exports. For example, Menhat et al. (2021) and Waiho et al. (2020). Therefore, an empirical study is important to determine the pandemic's impact on exports. Additionally, descriptive analyses could only show the basic relationship between two variables and did not provide details such as significance, strength, and direction of causality. Empirical studies, on the other hand, could overcome this weakness. Furthermore, several studies have been conducted to investigate the impact of macroeconomic shocks, such as the Global Financial Crisis 2008 (Bekhet & Yasmin, 2014), oil price shock (Ahmed & Wadud, 2011), and commodity shock (Ziaei & Ali, 2021) on export, but there is no empirical evidence of a public health crisis on export.

In this study, a Seasonal Autoregressive Integrated Moving Average (SARIMA) intervention model is employed. Since exports are inherently time-dependent and strongly influenced by their historical values, SARIMA provides an appropriate framework for capturing both autocorrelation and long-term trends in economic time series. Unlike the standard ARIMA model, SARIMA extends the analysis by explicitly incorporating seasonal autoregressive and moving average components. These additional terms help account for recurring seasonal patterns such as regular upswings and downturns by introducing extra lags into the model (Davidescu et al., 2021). Within this framework, major events such as the SARS outbreak in 2003 and the COVID-19 pandemic in 2020 are treated as exogenous shocks to the Malaysian economy. The intervention analysis enables an assessment of whether, and to what extent, these shocks significantly altered the trajectory of Malaysia's exports.

The objective of this paper is to study the impact of the SARS and COVID-19 outbreaks on the export of Malaysia. The impact of the outbreaks is very important for the planning of policies to overcome the effects of the public health crisis, as exports are vital to our nation's economy.

2. Literature Review

The public health crisis generated simultaneous shocks to the economy. During the COVID-19 pandemic, according to Bekaert et al. (2020), it acted as a negative demand shock by dampening consumption and investment. At the same time, Brinca et al. (2020) highlight the presence of supply shocks, as lockdown measures restricted the operations of non-essential businesses and curtailed production capacity. Lee and Warner (2006) also proved these shocks happened during the SARS period, which resulted in AD and AS shocks. Together, these studies demonstrate that the pandemic disrupted exports through the combined effect of demand and supply shocks.

Lee and McKibbin (2004) in their paper, which investigates the global economic impacts of SARS, claimed that the pandemic strongly affected the trade of trade-dependent countries, especially Hong Kong, China, and Singapore. They also illustrated that the temporary shock from SARS caused Hong Kong's exports to fall sharply, but the persistent effect of SARS was less significant. Siu and Richard Wong (2004) suggested that the transitory impact from the SARS outbreak had given a shock to Hong Kong's exports. This is because Hong Kong's exports are predominantly dominated by re-exports from mainland China. Emma Fan (2003) described that the SARS pandemic had a significant negative impact on service exports, particularly tourism-related exports. This negative impact influenced foreign exchange, which reduced demand for the domestic currency, especially in the infected countries. According to Bank Negara Malaysia (2003), the export of goods and services from Malaysia only grew by 0.2% during the second quarter of 2003 compared to the first quarter of 2003 (1.9%). Bank Negara Malaysia claimed that this was supported by strong demand for rubber products (11.5%), chemicals, and chemical products (23.3%).

Ozili and Arun (2020) stated that the coronavirus pandemic will affect import-dependent countries due to the global supply chain being heavily affected. Besides that, there is a shortage of supplies from exporters, and this impacts global trade. The low-price pressure will lessen the interest of countries to increase exports because there is low demand for the commodity. Thus, the coronavirus reduces exports. Apart from that, Baldwin and Weder (2020) emphasised that COVID-19 leads to demand shocks and supply shocks in the world, which impact global trade. The work-from-home culture encouraged by each government leads to a decrease in supply, while the lockdown policy encouraging people to stay at home leads to a decrease in demand. Hence, the plunge in crude oil prices due to the shortage of demand leads to a reduction in commodity prices. Therefore, the supply shock and the demand shock have had a significant impact on global trade. Furthermore, Rajamoorthy (2020) conducted research investigating the impact of the coronavirus outbreak on Malaysia's trade. The research used export and import data from December 2019 to January 2020. From the results and findings, the export of crude oil and the manufacture of metal declined. The declining trend is also shown in the total export to China from Malaysia.

In Malaysia, descriptive analysis has been adopted by Menhat et al. (2021) and Waiho et al. (2020) to study the impact of the COVID-19 pandemic on exports in Malaysia. They claimed that the COVID-19 pandemic seriously reduced the export of some products, especially maritime and aquaculture, as global demand dropped significantly. Zainuddin et al. (2022) found that a rise in COVID-19 cases among trading partners is associated with higher exports of both capital and consumption goods. However, when trading partners impose stricter containment measures, as reflected by the stringency index, it adversely affects the export of capital goods. The AIS data clearly reflect both forward propagation to Malaysia, seen through reduced imports from China, occurring at the point when China cuts its exports (with a noticeable time lag in Malaysia’s case) (Verschuur et al., 2021).

Chung Roy et al. (2009) applied the ARIMA-intervention analysis in terms of studying the impact of the financial crisis on China’s manufacturing industry. They adopted monthly time series data from March 2005 to November 2008. The results showed that the financial crisis had a significant negative impact on the output of the manufacturing industry in China, which led to a reduction in exports. Moreover, Min, Lim and Kung (2010) described the impact of severe acute respiratory syndrome (SARS) on Japanese tourism demand for Taiwan. They used the SARIMA with an intervention model and found that SARS had a significant impact on tourism demand that lasted for about a year, which reduced the export of services in Taiwan. Hence, this study is analysing the impact of the SARS and COVID-19 outbreaks on the export of Malaysia. The impact will be examined using SARIMA-Intervention analysis.

3. Methodology

3.1 *Data*

The data on the export is employed. The monthly export data from January 2000 to December 2024 are obtained from the website of Bank Negara Malaysia. Hence, there are 300 observations used in this study.

Table 2. Source and Construction of Variable

Label	Variable	Proxy	Frequency	Duration	Source
X	Export	Total Export (RM million)	Monthly	January 2000 – December 2024	BNM
D_1	SARS	Dummy	Monthly	November 2002 - September 2003	WHO

D_2	COVID-19 pandemic	Dummy	Monthly	January 2020 – March 2022*	MOH

*Malaysia reopened the border starting from 1 April 2022

3.2 *The ARIMA Model*

The Box–Jenkins methodology consists of three main stages: identification, estimation, and diagnostic checking (Box & Jenkins, 1976). In the identification stage, the first step is to assess whether the model is stationary. This study applies the Augmented Dickey-Fuller (ADF) test to examine the presence of a unit root. If the test produces a p-value below 5%, the null hypothesis of a unit root is rejected, indicating that the series is stationary. Conversely, if the p-value is greater than 5%, the null hypothesis cannot be rejected, suggesting the series is non-stationary. In such cases, the data should be transformed, either by logarithms or first differencing, before reapplying the unit root test.

After establishing stationarity, the autocorrelation function (ACF) and partial autocorrelation function (PACF) of the pre-intervention series are analysed to identify suitable autoregressive (AR) and moving average (MA) orders, denoted as AR(p) and MA(q). The next stage involves parameter estimation to calculate the coefficients of the model. Diagnostic checking then follows, ensuring that the estimated coefficients are statistically significant and that the AR and MA terms remain within the stationarity bounds.

Subsequently, candidate models are compared using criteria such as the Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC), with preference given to models with the lowest values. Additionally, the overall goodness of fit is evaluated (Dimitrios & Stephen, 2010). The final selected model undergoes another round of diagnostic checking to verify that the AR and MA coefficients remain stable and within acceptable limits.

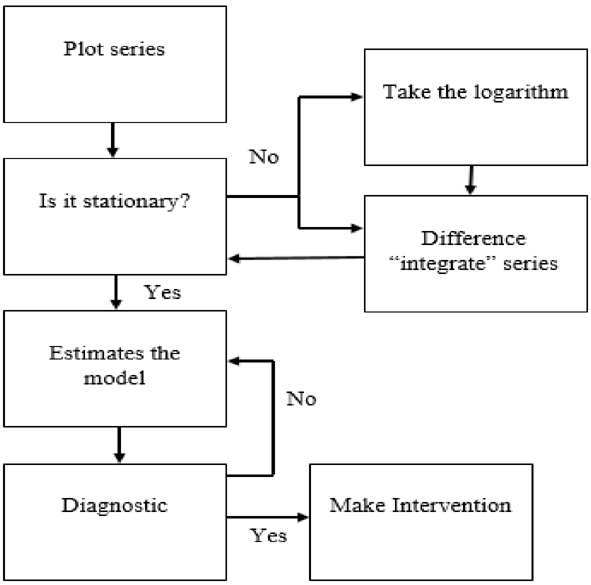


Figure 5. Procedure of Box-Jenkins Procedure
Sources: Ng et al. (2023)

3.3 The SARIMA Model

$$\Delta_S^d y_t = (1 - L^S)^{\mathrm{D}} y_t \quad (1)$$

Where:
Δ_S^d = Δ order difference
L^S = The lag operator, which demonstrated periodic seasonal behaviour.

Afterwards, the seasonal ARMA (p,q) model for every s is rewritten into:

$$\emptyset(L^S) y_t = \theta(L^S) u_t \quad (2)$$

Where:
u_t = White noise
θ = Seasonal lag parameter, u_{t-12}

Following the ARMA (p,q) model, Equation (2) is considered in the form of Equation (3).

$$\mathrm{A(L)} u_t = \Theta(L)\varepsilon_t \quad (3)$$

Where:
A(L) = Polynomial for p;
$\Theta(L)\varepsilon_t$ = Polynomial for q.

The seasonal ARMA model $(p,q)(p,q)_s$ formed as a result of the replacement of Equation (3) substitutes Equation (4).

$$\mathrm{A(L)}\emptyset(L^S) y_t = \theta(L)\Theta(L)\varepsilon_t \quad (4)$$

Lastly, Equation (5) will be modified to suit ARIMA $(p,d,q)(P,D,Q)_s$, in which the p,d,q in front stand for ARIMA while the P,D,Q at the back represent the additional seasonal components.

$$\mathrm{A(L)}\emptyset(L^S)(1-L)^d(1-L^S)^D y_t = \theta(L)\Theta(L)\varepsilon_t \quad (5)$$

3.4 *Intervention Model Approach*

The model which examines the impact of events can be used for intervention analysis (Box and Tiao, 1975). The ARIMA model is utilised to test the effects of an exogenous intervention upon the level of a time series before the intervention analysis. Different intervention models can be established for this context. The level of the pre-intervention series is compared with the level of the time series that follows the intervention. The significance of the intervention can also be computed to measure the importance of the impact of the events on the dependent variable. Therefore, this paper will apply the intervention analysis of the impact of the SARS and the COVID-19 outbreaks on exports in Malaysia. After examining the characteristics of the series itself, the export comparison is conducted with the period before the intervention. Furthermore, the noise has also been considered in the model, and thus the results of the comparison are more valid.

Hence, the model of the intervention analysis can be written as below:

$$Y_t = f(I_{1t,}, I_{2t}) + N_t \quad (6)$$

Where,
Y_t = Export

I_{1t} = The intervention of SARS
I_{2t} = The intervention of COVID-19
N_t = Noice component

In other way, the intervention model also can be written as Equation (7).

$$\varphi_p(L)(1-L)^d Y_t = \Theta_q(L)\varepsilon_t + \beta D_{1t} + \beta D_{2t} \tag{7}$$

Where,

$$D_t^T = \begin{cases} 0, & t < T \\ 1, & T \geq T \end{cases}$$

D_1 = 1 was the period of SARS, while 0 was otherwise

D_2 = 1 was the period of COVID-19 outbreak, while 0 was otherwise

4. Result and Discussion

4.1 *Stationary Test*

The stationary test is done by using the Augmented Dickey-Fuller test. The null hypothesis (H_n) is that the model is non-stationary, while the alternative hypothesis (H_a) is that the model is stationary. Tables 3 and 4 demonstrate the results of the Augmented Dickey-Fuller test. The result reveals that the export is non-stationary in level form, either with the intercept or with the trend and intercept. However, the export is stationary in first difference form. Hence, the export data in the first difference (I=1) is used for the correlogram to find out the AR(p) and MA(q).

Table 3. The results of Augmented Dickey-Fuller test (Level)

Variable	Level			
	Intercept	Probability	Trend and intercept	Probability
Export (X)	0.7164	0.9924	-1.7252	0.7377

(***), (**), dan (*) show the significance level at 1%, 5%, and 10%.
Source: Eviews 10

Table 4. The results of Augmented Dickey-Fuller test (First Difference)

Variable	First Difference			
	Intercept	Probability	Trend and intercept	Probability
Export (X)	-5.4179***	0.0000	-5.5781***	0.0000

(***), (**), dan (*) show the significance level at 1%, 5%, and 10%.
Source: Eviews 10

4.2 Correlogram

The identification is continued with the correlogram. Figure 6 shows the correlogram of the level of export, while Figure 7 portrays the correlogram of the first difference of export. From Figure 6, the autocorrelation (ACF) tends to be high at the beginning and declines later. Thus, it indicates that the model is non-stationary.

From Figure 7, the correlogram shows that the spike of autocorrelation (ACF) exceeds the bounds at some lags, including the first, third, fourth, eighth, and eleventh. Meanwhile, the spike of the partial autocorrelation (PACF) exceeds the bounds at the first, second, third, eighth, eleventh, and twelfth lags.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.960	0.960	279.54	0.000
		2	0.948	0.324	552.54	0.000
		3	0.940	0.194	822.04	0.000
		4	0.915	-0.149	1078.4	0.000
		5	0.902	0.023	1328.3	0.000
		6	0.892	0.068	1573.5	0.000
		7	0.872	-0.056	1808.4	0.000
		8	0.859	0.002	2037.1	0.000
		9	0.856	0.166	2265.3	0.000
		10	0.831	-0.172	2481.2	0.000
		11	0.825	0.095	2694.7	0.000
		12	0.824	0.114	2908.1	0.000

Figure 6. Correlogram (Level)
Source: Eviews 10

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.447	-0.447	60.293	0.000
		2	-0.099	-0.374	63.284	0.000
		3	0.344	0.169	99.323	0.000
		4	-0.254	-0.023	118.98	0.000
		5	-0.070	-0.163	120.48	0.000
		6	0.228	0.006	136.49	0.000
		7	-0.151	0.015	143.52	0.000
		8	-0.132	-0.181	148.95	0.000
		9	0.349	0.155	186.73	0.000
		10	-0.270	-0.039	209.39	0.000
		11	-0.162	-0.290	217.54	0.000
		12	0.520	0.263	302.31	0.000

Figure 7. Correlogram (First Difference)
Source: Eviews 10

4.3 *Estimation and Diagnostic Test*

The estimation is proceeded with the AR(p) and MA(q) identified from the correlogram. The estimation process is tested with ARIMA (1,1,1), ARIMA (1,1,2), ARIMA (2,1,1), ARIMA (2,1,2), ARIMA (1,1,3), ARIMA (3,1,1), ARIMA (3,1,3), ARIMA (3,1,2), ARIMA (2,1,3), and ARIMA (3,1,3). The number of significant variables, adjusted R^2, Akaike info criterion, Schwarz criterion, and SIGMASQ are compared. The most adequate model will have the highest number of significant variables, the highest value of adjusted R^2, and the lowest values of the Akaike info criterion and Schwarz criterion. Meanwhile, the lowest value of SIGMASQ will indicate the best model.

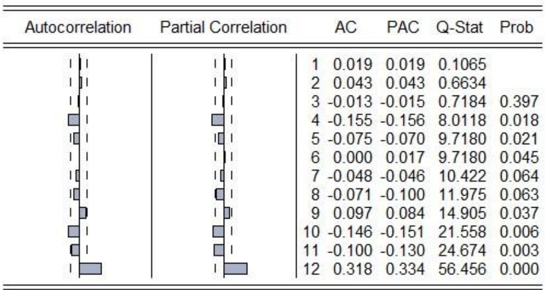
Table 5. The estimation result (ARIMA)

	ARIMA (p, q)									
	1,1,1	1,1,2	2,1,1	2,1,2	1,1,3	3,1,1	3,1,3	3,1,2	2,1,3	3,1,3
Number of significant variables	2	2	1	1	2	2	2	2	1	2
Adjusted R^2	0.2606	0.2591	0.2556	0.0234	0.2607	0.3130	0.2079	0.1198	0.0892	0.2079
Akaike info criterion	20.1417	20.1436	20.1483	20.4189	20.1415	20.0686	20.2136	20.3164	20.3498	20.2136
Schwarz criterion	20.1912	20.1931	20.1978	20.4684	20.1910	20.1181	20.2631	20.3659	20.3993	20.2631
SIGMA SQ	31824087	31885456	32038893	42029913	31818281	29568203	34092242	37883714	39200977	34092242

Source: Eviews 1

Through the result of the estimation, the ARIMA (3,1,1) model is the most adequate model because it has the highest number of significant variables (2), the highest adjusted R^2 (0.3130), the lowest Akaike Information Criterion (20.0686), and the lowest Schwarz Criterion (20.1910) when compared to other models. The SIGMASQ value of this model (29568203) is also the lowest among the models built.

Next, the adequate model undergoes the correlogram again to ensure that there are no more spikes exceeding the bounds of ACF and PACF. The result from Figure 8 shows that there are still spikes beyond the bounds at the twelfth lag.



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.019	0.019	0.1065	
		2	0.043	0.043	0.6634	
		3	-0.013	-0.015	0.7184	0.397
		4	-0.155	-0.156	8.0118	0.018
		5	-0.075	-0.070	9.7180	0.021
		6	0.000	0.017	9.7180	0.045
		7	-0.048	-0.046	10.422	0.064
		8	-0.071	-0.100	11.975	0.063
		9	0.097	0.084	14.905	0.037
		10	-0.146	-0.151	21.558	0.006
		11	-0.100	-0.130	24.674	0.003
		12	0.318	0.334	56.456	0.000

Figure 8. The Result of the Correlogram Q-Statistic
Source: Eviews 10

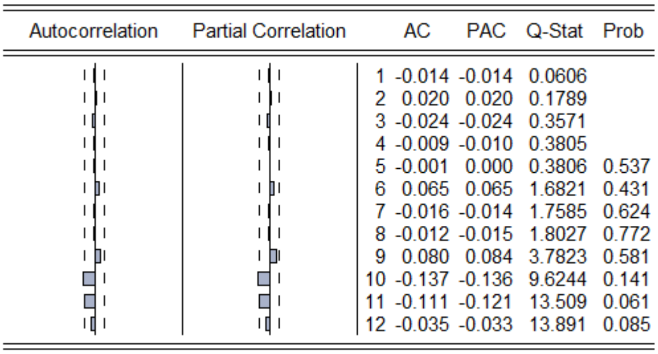
Hence, the model will be modified to eliminate the significant spike. Therefore, the model is estimated again to figure out the most adequate model. From Table 6, the SARIMA (3,1,1) $(1,1,1)_{12}$ is the most adequate model, which has the highest number of significant variables (3), highest adjusted R-squared (0.4920), lowest Akaike information criterion (19.8152), and Schwarz criterion (19.8895). Meanwhile, the SIGMASQ of the model (21714804) is the lowest among the models. Figure 9 also shows that all the spikes are within the bounds.

Table 6. Estimation Result (SARIMA)

Measurement	SARIMA Model (3,1,1)		
	SARIMA (3,1,1)$(1,1,0)_{12}$	SARIMA (3,1,1)$(0,1,1)_{12}$	**SARIMA (3,1,1)$(1,1,1)_{12}$**
Number of significant variable	3	3	3
Adjusted R^2	0.4018	0.3753	0.4920
Akaike info criterion	19.9396	19.9799	19.8152

Schwarz criterion	20.0015	20.0418	19.8895
SIGMASQ	25658469	26794069	21714804

Source: Eviews 10



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.014	-0.014	0.0606	
		2	0.020	0.020	0.1789	
		3	-0.024	-0.024	0.3571	
		4	-0.009	-0.010	0.3805	
		5	-0.001	0.000	0.3806	0.537
		6	0.065	0.065	1.6821	0.431
		7	-0.016	-0.014	1.7585	0.624
		8	-0.012	-0.015	1.8027	0.772
		9	0.080	0.084	3.7823	0.581
		10	-0.137	-0.136	9.6244	0.141
		11	-0.111	-0.121	13.509	0.061
		12	-0.035	-0.033	13.891	0.085

Figure 9. The Result of the Correlogram Q-Statistic after Modifying the Model
Source: Eviews 10

4.4 *The Intervention Analysis*

The SARIMA model applies intervention analysis by incorporating dummy variables representing SARS and COVID-19. The pre-intervention export value is estimated at RM 2,498.55 million, indicating the level of exports prior to the outbreaks of SARS and COVID-19.

Table 7. The Intervention Analysis with SARS and COVID-19

Variable	Coefficient	Standard Error	T-statistic	Prob.
C	2498.550	1088.441	2.295532	0.0208
SARS	-38.5208	2472.685	-0.015579	0.9876
COVID	1126.946	337.4670	3.339427	0.0009
AR(3)	0.234492	0.036002	6.513364	0.0000
SAR (12)	0.987831	0.019617	50.35574	0.0000
MA(1)	-0.531568	0.035559	-14.94903	0.0000
SMA (12)	-0.889963	0.057088	-15.58939	0.0000
SIGMASQ	21471555	1325970	16.19310	0.0000

Source: Eviews 10

From Table 7, the occurrence of the COVID-19 pandemic increases exports by RM 1,126.95 million, while the occurrence of SARS decreases exports by RM 38.52 million. The positive impact of COVID-19 on exports in Malaysia is significant at the 1% level. However, the negative impact of SARS on exports in Malaysia is not significant at the 5% level. This indicates that exports amount to RM 3,625.50 million during the COVID-19 pandemic. This positive relationship result differs from the Menhat et al. (2021) and Waiho et al. (2020)'s findings, which mentioned the COVID-19 pandemic reduced the Malaysia's export.

During the COVID-19 pandemic, Malaysia's exports increased due to the rising global demand for medical and health-related products and Electronics & Electrical (E&E) products. For instance, PPE products and gloves (Mikic et al., 2020). Additionally, lockdowns globally accelerated remote work, online learning, and digitalisation. This caused a surge in demand for semiconductors, laptops, smartphones, and data servers, which are Malaysia's key export sectors. Ong and Lee (2024) highlighted that Malaysia's E&E exports surged by 45.6% in 2020, amounting to RM386.1 billion.

5. Conclusion

To sum it up, this paper intends to study the impact of SARS and COVID-19 on the export of Malaysia. The AD and AS shocks from the public health crisis led to an adverse impact on the AD and AS components. Meanwhile, exports as the AD component should drop during the public health crisis. This study provides insights that the COVID-19 pandemic significantly increased exports in Malaysia. Meanwhile, SARS has an insignificant impact on Malaysia's exports. Although Malaysia implemented a lockdown during the COVID-19 pandemic, exports remained strong, supported by global demand, especially for health-related products and Electronics & Electrical (E&E) products. During that time, the export of these two products was able to compensate for the drop in other products and boost our total exports. This circumstance is very important for resuming our economy after being impacted by the prolonged lockdown.

However, the government is suggested to increase exports to ensure the role of exports in Malaysia, especially during the post-pandemic period. The government is suggested to restore confidence in the domestic supply side to enhance export performance in the post-outbreak period. Several incentives can be introduced, such as temporary corporate tax exemptions, subsidies, and loan moratoriums, which help reduce firms' production costs, ease their financial burden, and encourage greater output for export markets. Beyond these short-term measures, the government should also promote export diversification to reduce reliance on a few products and trading partners, particularly by incentivising firms to explore emerging markets and high-growth industries such as green technology, halal-certified goods, and digital services. To remain competitive, firms must also embrace digitalisation and e-commerce, and government support in training, digital trade facilitation, and cross-border marketing will be crucial. Strengthening participation in global value chains (GVCs), particularly in high-value segments like semiconductors, medical devices, and automation, should also be prioritised, alongside continued investment in logistics infrastructure and streamlined customs procedures to improve trade efficiency.

Furthermore, incentives for research and development (R&D) can foster innovation and product upgrading, while expanded export financing facilities and export credit insurance can mitigate risks for firms, especially SMEs. Human capital development is equally important, as upskilling workers in digital trade and supply chain management will sustain Malaysia's competitiveness. Lastly, maximising opportunities from regional and multilateral trade agreements, such as the RCEP and CPTPP, will provide Malaysian exporters with greater market access and new growth opportunities.

This study limited the impact of the SARS and COVID-19 pandemics on exports in Malaysia. Future studies may include more outbreaks in the model, such as the Middle East Respiratory Syndrome (MERS), Spanish flu, and others. Additionally, other countries may be included as comparisons for the impact of the public health crisis in terms of exports. The impact of the COVID-19 pandemic may also be investigated through the several levels of lockdown, such as MCO, CMCO, and RMCO, as each lockdown policy had a different stringency level.

While the COVID-19 pandemic posed a significant global threat by causing recessions, unemployment, deflation, and disruptions to international trade, it simultaneously created opportunities for Malaysia in certain sectors. In particular, the surge in global demand for healthcare-related products and electrical and electronics (E&E) goods turned the crisis into a catalyst for Malaysia's export growth. Therefore, it is crucial for the Malaysian government to strengthen and expand the healthcare and E&E industries to sustain their contribution to exports in the post-pandemic era.

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Conflict of interest

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

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