THE IMPACT OF THE COVID-19 PANDEMIC AND ASSOCIATED LOCKDOWNS ON UNEMPLOYMENT IN MALAYSIA

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Abstract. The current public health crisis, namely the COVID-19 pandemic, is not confined to a single region but is a worldwide occurrence. A nationwide lockdown is the only viable option for containing and mitigating the effects of this pandemic. However, the after-effects of the lockdown, namely unemployment, have disturbed and destroyed the labor market. Malaysia has experienced three outbreaks of the COVID-19 pandemic and four lockdowns with high stringency. Hence, this paper examines the impact of the COVID-19 pandemic outbreaks and associated lockdowns on unemployment in Malaysia, and it is important to understand the power of each outbreak and lockdown on unemployment. This paper refers to the monthly unemployment rate from January 2016 to December 2021. The ARIMA-Intervention is adopted using the three outbreaks of COVID-19 and four types of Movement Control Order (MCO). The findings indicate that the second COVID-19 outbreak significantly impacted unemployment compared to the other two outbreaks. Additionally, among the four rounds of Movement Control Order (MCO), MCO 1.0 had a notable and significant effect on unemployment. Unemployment is exacerbated when a containment policy is implemented unexpectedly. It is suggested that the government establishes a policy to prepare for the future pandemic.
Keywords: *unemployment, COVID-19, lockdown, ARIMA-intervention*

Introduction

Unemployment is a crucial macroeconomic issue that occurs because of an economic shock to a country. When a shock happens, employers reduce labor demand, which causes some workers to lose their jobs. In this context, unemployment becomes the source of other economic and social issues. For instance, poverty, reduced economic growth, and loss of skills are possible economic problems, while social topics include depression, suicide, and divorce. As a result, most governments aim to maintain unemployment below a rate known as the "full employment rate" to indicate that the unemployment issue is under control within the nation. However, the global economy is undergoing another shock, specifically in public health. The '2019-nCoV' or SARS-CoV-2 (COVID-19) is a public health crisis with a high infection but a low death rate. The entire world has been affected by COVID-19, with the number of affected countries at 223, higher than previous epidemics, such as SARS, MERS, and H1N1 (WHO, 2022). A nationwide lockdown has been the only effective method in curbing the spread

and infection of the virus. During this period, people are advised to stay at home, adopt a working-from-home environment, and close facilities and workplaces to reduce the spread of the virus. As most countries implement the lockdown for the first time, the lack of experience jeopardizes the economy, especially causing unemployment or job loss. The International Labor Organization (ILO, 2021) claimed that the world had suffered a working hour loss of 8.8 percent, equivalent to a job loss of 255 million. This figure is higher from the impact of the economic crisis on unemployment, as this public health crisis impacts more sectors (Roy et al., 2021).

Malaysia has undergone three waves of the COVID-19 pandemic (Rampal and Liew, 2021). The first outbreak was from January 2020 to February 2020, the second was from February 2020 to September 2020, and the third was from September 2020 to the present. Like other countries, the Malaysian government implemented a lockdown policy known as Movement Control Order (MCO). From *Figure 1*, a series of MCOs, including MCO, Conditional Movement Control Order (CMCO), Recovery Movement Control Order (RMCO), a targeted series of MCOs, Full MCO (FMCO), and the National Recovery Plan was announced to control the pandemic (Tang, 2021). Different forms of MCOs had various Standard Operating Procedures (SOPs), including the allowed operating times of a sector, the permitted capacity of employees, and the social distancing requirements. MCO 1.0 lasted 56 days, MCO 2.0 lasted 42 days, and MCO 3.0 lasted 20 days. FMCO was enforced for 28 days. Additionally, the government went as far as to declare a state of emergency to accelerate curbing the pandemic.

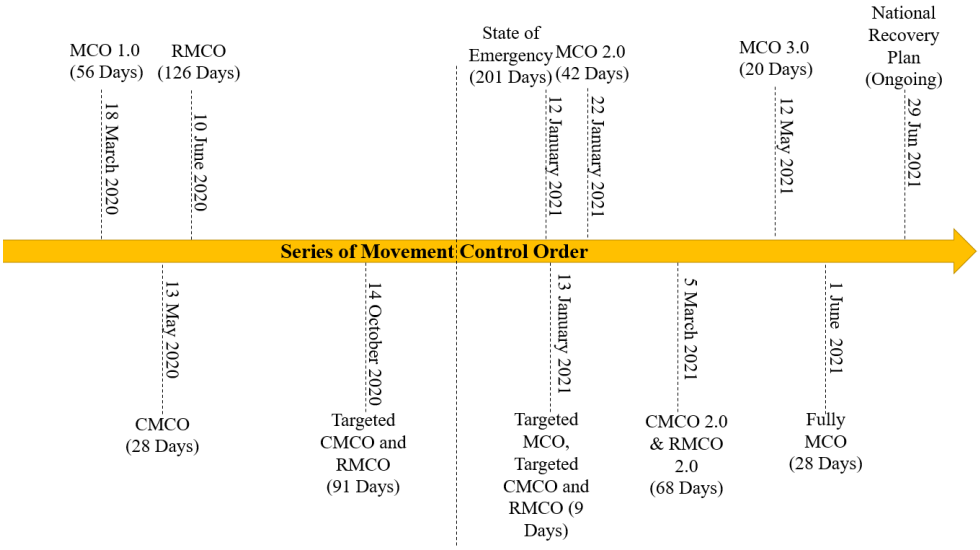


Figure 1. *The Timelines of Movement Control Orders (MCOs) in Malaysia, 2020-2021. Source: Samsudin et al (2025).*

From *Figure 2*, the number of confirmed cases positively correlates with unemployment. As a result, the increase in confirmed cases exacerbated the unemployment rate because COVID-19 increased employee job insecurity (Khan et al., 2021; Almeida and Santos, 2020). Moreover, the increase in the confirmed case caused the government to tighten the containment policy. In terms of the lockdown policy, the MCOs effectively reduced the number of confirmed cases. However, it caused the unemployment rate in Malaysia to no longer be maintained at the total unemployment rate, which is four percent. Briefly, unemployment increased significantly after the announcement of MCOs by the government. In particular, the unemployment rate was

beyond five percent after the implementation of MCO 1.0. Unlike an economic crisis, a public health crisis complemented by the lockdown policy impacted both the demand and supply of labor. The situation was worsened as MCOs were Malaysia's first encounter with a containment policy. Unsurprisingly, balancing protecting public health while maintaining the economy is challenging, especially with unemployment.

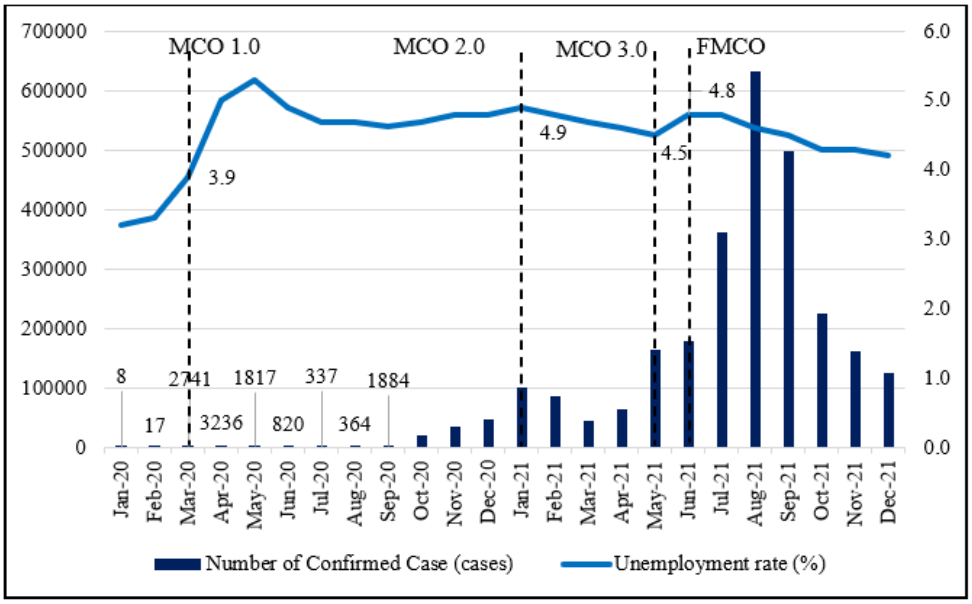


Figure 2. *COVID-19 and Unemployment in Malaysia, January 2020 – July 2021.*

As mentioned, the lockdown policy impacts unemployment, which has increased since MCO 1.0. Nonetheless, MCO 2.0, MCO 3.0, and FMCO were implemented after Malaysia gained experience from MCO 1.0. Some of the questions need to be answered from the COVID-19 pandemic: Which outbreak of the COVID-19 pandemic significantly increased unemployment? Were the MCOs after MCO 1.0 conducive to the decline of unemployment? What was the impact of MCO 1.0 on unemployment? Recent literature has only descriptively analyzed the impact of COVID-19 and lockdown policies but has not conducted an empirical analysis. To fill this gap, this study intends to empirically investigate the impact of the COVID-19 pandemic and lockdown policies on unemployment in Malaysia. The paper can provide evidence regarding the impact of the COVID-19 pandemic and lockdown policies on unemployment in the existing literature. Hence, it will give indications to the government in preparation for a similar crisis or issue in the future.

Literature review

Most literature proved the impact of the public health crisis on unemployment, particularly COVID-19. For epidemics before COVID-19, such as SARS and MERS, scholars claimed that adverse demand and supply exacerbated the unemployment issue, especially in the tourism-related sectors (Joo et al., 2019; Lee and Warner, 2005a; 2005b). However, the impact of COVID-19 is more significant than these epidemics as it affected not only the tourism-related sectors but other sectors as well. These sectors comprised agriculture, manufacturing, construction, and other service-related industries (Biswas et al., 2021; Brioscú et al., 2021; Bartik et al., 2020). Generally, the confirmed

COVID-19 cases and the nationwide lockdowns were the sources of impact. When the number of cases increased, the government tightened the containment policy to reduce virus transmission. Hence, the non-essential economic sectors were shut down, and this had a negative economic effect. The low ability to sustain the business during the lockdowns caused the layoff of workers or complete shutdown of companies and thus increased unemployment.

A new and more significant public health crisis arose with the surge in unemployment during the COVID-19 pandemic. Groshen (2020) emphasized that 22 million payroll jobs were lost in the United States, especially during March and April 2020. The same situation happened in South Korea and South Africa. Nam and Lee (2021) mentioned that this job loss in South Korea was more significant than the Great Recession in 2008. This statement was supported by Bartik et al. (2020), who stated that the job loss during the pandemic was not only 60 percent larger than during the Great Recession, but it also comprehensively affected high-paid and low-paid jobs. In South Africa, almost one out of three employees faced job loss in April 2020 (Ranchhod and Daniels, 2021). The layoff issue also occurred in Malaysia, especially in the agriculture (Shaharudin, 2020), manufacturing (Ibrahim et al., 2021), mining (Ramdoo, 2021), and service sectors (Zubair and Shamsudin, 2021).

Most of the studies suggest that the lockdown policies increased unemployment. With the lockdown policies, many economic activities were restricted, which induced the labor market to collapse (Morales et al., 2022). Vyas (2020) emphasized that there was a loss of 17.7 million jobs in India due to the April lockdown. In addition, Hoehn-Velasco et al. (2021) asserted that a lockdown created a job loss in the Mexican labor market by more than 5 percent. Karabarbounis et al. (2020) found a positive correlation between unemployment and lockdown measures in the United States. This positive result was in line with the findings using the Oxford Government Response Stringency Index in the United States (Verick et al., 2022) and the Organisation for Economic Co-operation and Development (OECD) countries (Khachatryan and Losjö Dahlström, 2021) and even Malaysia (Habibullah et al., 2021). These studies evidenced that increased unemployment is associated with the tight lockdown policy.

The present study adopts the ARIMA intervention analysis proposed by Box and Tiao (1975) to investigate the impact of COVID-19 and lockdown policies on unemployment in Malaysia. Most empirical studies use this method to analyze policy changes or incidents, including shocks. For instance, public health crises such as SARS, economic crises such as the Asian Financial Crisis, incidents such as terrorist attacks, and policy changes such as a new tax. The ARIMA intervention analysis was utilized to investigate SARS' impact on the tourism demand in Taiwan (Min et al., 2011) and Thailand (Song et al., 2003). Besides that, the Asian Financial Crisis and the Subprime Mortgage Crisis of 2008, as indicators of economic crisis, could be manipulated as an intervention in the number of tourists in a country (Rezeki et al., 2013). Regarding unemployment, the ARIMA intervention analysis was applied using the two major flooding events in 1993 and 2008, respectively, in the Midwest of Unites States (Xiao et al., 2013). Meanwhile, Rezeki et al. (2013) also utilized the terrorist attacks in Bali in their study in Indonesia. Moreover, the impact of a new levy tax, such as the Goods and Services Tax (GST), on inflation in Malaysia was investigated by Abu Bakar (2018). In short, this study investigates the impact of the COVID-19 pandemic and lockdowns on unemployment in Malaysia using the ARIMA intervention analysis.

Materials and Methods

Data

This study obtained monthly data from January 2016 to December 2021. These data include the unemployment rate, the period of each COVID-19 outbreak, and the period of the associated containment policy in Malaysia. The data were obtained from the Bank Negara Malaysia (BNM), the Ministry of Health (MOH), and the Malaysia Prime Minister's office (PMO), respectively. The present data represent the outbreaks and MCOs in dummy forms (*Table 1*).

Table 1. *Source and construction of variable.*

Label	Variable	Proxy	Frequency	Duration	Source
Ue	Unemployment	Unemployment rate	Monthly	Jan 2016 – Dec 2021	BNM
$D_{1\ First}$	First outbreak of the COVID-19 pandemic	Dummy	Monthly	Jan 2020 and Feb 2020	MOH
$D_{1\ Second}$	Second outbreak of the COVID-19 pandemic	Dummy	Monthly	Feb 2020 – Sep 2020	MOH
$D_{1\ Third}$	Third outbreak of the COVID-19 pandemic	Dummy	Monthly	Sep 2020 – Dec 2021	MOH
$D_{2\ MCO1}$	Movement Control Order 1.0	Dummy	Monthly	Mar – May 2020	PMO
$D_{2\ MCO2}$	Movement Control Order 2.0	Dummy	Monthly	Jan – Mar 2021	PMO
$D_{2\ MCO3}$	Movement Control Order 3.0	Dummy	Monthly	May 2021	PMO
$D_{2\ MCO4}$	Full Movement Control Order	Dummy	Monthly	June 2021	PMO
GDP	Gross Domestic Product	Real GDP	Monthly	Jan 2016 – Dec 2021	BNM
INF	Inflation	Consumer Price Index	Monthly	Jan 2016 – Dec 2021	BNM

Model specification

Autoregressive Integrated Moving Average (ARIMA) model

In the Autoregressive Integrated Moving Average (ARIMA) model, "AR" is autoregressive, "I" is integrated, and "MA" is the moving average (Box and Jenkins, 1970). The model follows the box and Jenkins procedure. This procedure has three stages: identification, estimation, and diagnosis.

Identification

The identification stage intends to examine the model, either stationary or not. The unit root test will be implemented for this stage. Meanwhile, The Augmented Dickey-Fuller (ADF) test is conducted to identify the existence of the "unit root" problem in the model. Hence, the null hypothesis is built in which the model is not stationary over time. When the P-value is larger than 0.05 for the ADF test, the null hypothesis fails to be rejected, indicating a "unit root" problem is present. The model is not stationary over time and exists with a spurious regression problem. Thus, it should undergo the first difference process before moving to the estimation. The first different model is as below:

$$\varphi_p(L)(1-L)^d Y_t = \Theta_q(L)\varepsilon_t \qquad \text{Eq. (1)}$$

Where, $(1-L)^d Y_t$ is the stationary of Y_t. Subsequently, the process determines p and q orders for ARIMA via the correlogram. It is observing the significant spike in the autocorrelation function (ACF) for autoregression (AR) terms or in the partial autocorrelation function (PACF) for moving average (MA) terms. These spikes represented the presence of significant correlations at specific lags. After identifying the

number of lags required for the combination of the autoregressive moving average (ARMA) model, it continuous to the estimation stage.

Estimation

As a result, the estimation process will adopt the determined lags. Hence, several models were developed and preceded with trial and error. The Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion (SC) will be applied to compare the models. The adequate model should be fulfilled with the lowest AIC and SC (Abu Bakar, 2018; Asteriou and Hall, 2007). The equation is stated as Eq. (2).

$$Y_t = \emptyset_1 Y_{t-1} + \emptyset_2 Y_{t-2} + ... + \emptyset_p Y_{t-p} + u_t + \theta_1 u_{t-1} + \theta_2 u_{t-2} + \ldots + \theta_q u_{t-1-q} \quad \text{Eq. (2)}$$

Where; Yt is Unemployment; u is Error or residuals; ∅ is Polynomial function of unemployment; and θ is Polynomial function of error.

Diagnostic

The diagnostic stage is rechecked to ensure that all the spikes are within the bounds of the stationarity for the AR and MA coefficients. This stage will use the correlogram to get the particular intention.

Intervention analysis model

After an adequate ARIMA model was chosen, the intervention analysis was utilized to check the impact of COVID-19 and the lockdown on unemployment. The intervention analysis can examine the effect of a shock or policy for a certain period (Pankratz, 1991). As such, the COVID-19 pandemic is a shock event, while the MCO or lockdown is a policy. Two dummy variables are used to identify the impact of the COVID pandemic following the outbreak and lockdown. Meanwhile, two variables, namely Gross Domestic Product and inflation are added to the model in order to strengthen the model. There are three model are constructed for the intervention analysis as follows.

Model 1

$$\varphi_p(L)(1-L)^d Y_t = \Theta_q(L)\varepsilon_t + \beta D_{1t} + lnGDP + lnINF, D_t^T \begin{cases} 0, & t < T \\ 1, & T \geq T \end{cases} \quad \text{Eq. (3)}$$

Where, D_{1First}=1 was the period of first COVID-19 outbreak, while 0 was otherwise; $D_{1Second}$=1 was the period of second COVID-19 outbreak, while 0 was otherwise; D_{1Third}=1 was the period of third COVID-19 outbreak, while 0 was otherwise; *ln*GDP=Log Gross Domestic Product; *ln*INF=Log inflation.

Model 2

$$\varphi_p(L)(1-L)^d Y_t = \Theta_q(L)\varepsilon_t + \beta D_{2t} + lnGDP + lnINF, D_t^T \begin{cases} 0, & t < T \\ 1, & T \geq T \end{cases} \quad \text{Eq. (4)}$$

Where, D_{2MCO1}=1 was the period of MCO 1.0, while 0 was otherwise, D_{2MCO2}=1 was the period of MCO 2.0, while 0 was otherwise, D_{2MCO3}=1 was the period of MCO 3.0, while 0 was otherwise, D_{2MCO4}=1 was the period of FMCO, while 0 was otherwise, *ln*GDP=Log Gross Domestic Product, and *ln*INF=Log inflation.

Model 3

$$\varphi_p(L)(1-L)^d Y_t = \Theta_q(L)\varepsilon_t + \beta D_{1t} + \beta D_{2t} + lnGDP + lnINF, D_t^T \begin{cases} 0, & t < T \\ 1, & T \geq T \end{cases} \quad \text{Eq. (5)}$$

Where, D_{1First}=1 was the period of first COVID-19 outbreak, while 0 was otherwise, $D_{1Second}$=1 was the period of second COVID-19 outbreak, while 0 was otherwise, D_{1Third}=1 was the period of third COVID-19 outbreak, while 0 was otherwise, D_{2MCO1}=1 was the period of MCO 1.0, while 0 was otherwise, D_{2MCO2}=1 was the period of MCO 2.0, while 0 was otherwise, D_{2MCO3}=1 was the period of MCO 3.0, while 0 was otherwise, D_{2MCO4}=1 was the period of FMCO, while 0 was otherwise, *ln*GDP=Log Gross Domestic Product, and *ln*INF=Log inflation. Hence, Model 1, Model 2, and Model 3 are constructed for the intervention analysis. The first model explains the intervention of each outbreak of the COVID-19 pandemic. The second model discusses the intervention of each lockdown policy, while the third model analyses the intervention of both the shock and lockdown.

Procedure of modelling

A step-by-step to complete the ARIMA intervention analysis for this study was applied as follows: (1) The stability of the unemployment rate was examined by using the ADF test. If unemployment was not stationary at the level, the study proceeded with the difference to achieve stationarity. The number of the difference was recorded as symbol d. (2) The values of p and q for the lags were identified through the correlogram. (3) The parameter was estimated to determine the values of p and q based on the lowest AIC and SIC. (4) The selected model was rechecked with the significance and residual diagnostic tests. (5) After identifying the ARIMA model, the intervention variables in this study, the COVID-19 pandemic and lockdown were taken and entered into the model. (6) The model was run and estimated to capture the impact of the COVID-19 pandemic and associated lockdown policies on unemployment.

Results and Discussion

Identification

The ADF test was used to conduct the stationary test. Based on *Table 2*, the result shows that unemployment in Malaysia was not significant for levels either in the intercept or trend and intercept. Hence, the “unit root" problem existed, and the model was non-stationary. As a result, the first difference model was applied. Unemployment became stationary in the first difference with the significance of ADF statistics.

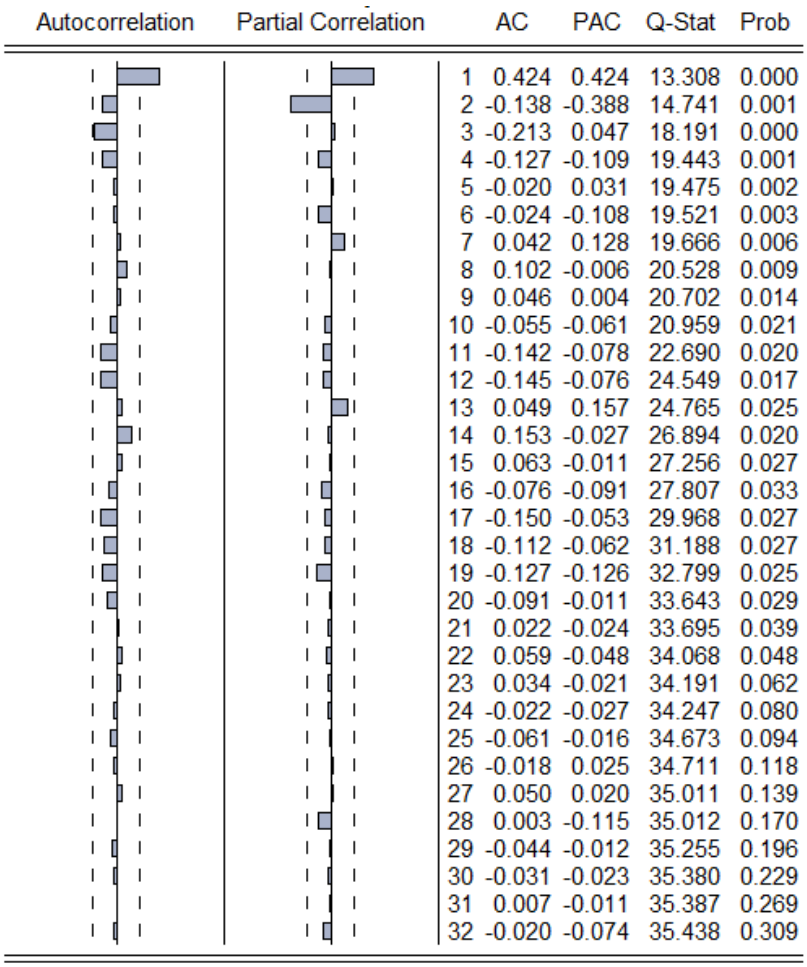
***Table 2**. The results of the ADF test.*

Variable	Level		First difference	
	Intercept	Trend and intercept	Intercept	Trend and intercept

Unemployment (UE)	-1.2420	-1.9987	-6.5687***	-6.5225***

Note: (***), (**), and (*) denoted that the significance level at 1%, 5%, and 10%.
Source: Result from Eview-12.

Before estimating, the values of p and q for the lags were determined through the correlogram. *Figure 3* shows that the spike of autocorrelation (ACF) and partial autocorrelation (PACF) exceeded the bounds at the first lags. Meanwhile, the spike of PACF for the second lags was also beyond the bounds. As a result, the values of the p and q for the lags were taken from 1 or 2 to run the estimation of ARIMA.



	AC	PAC	Q-Stat	Prob
1	0.424	0.424	13.308	0.000
2	-0.138	-0.388	14.741	0.001
3	-0.213	0.047	18.191	0.000
4	-0.127	-0.109	19.443	0.001
5	-0.020	0.031	19.475	0.002
6	-0.024	-0.108	19.521	0.003
7	0.042	0.128	19.666	0.006
8	0.102	-0.006	20.528	0.009
9	0.046	0.004	20.702	0.014
10	-0.055	-0.061	20.959	0.021
11	-0.142	-0.078	22.690	0.020
12	-0.145	-0.076	24.549	0.017
13	0.049	0.157	24.765	0.025
14	0.153	-0.027	26.894	0.020
15	0.063	-0.011	27.256	0.027
16	-0.076	-0.091	27.807	0.033
17	-0.150	-0.053	29.968	0.027
18	-0.112	-0.062	31.188	0.027
19	-0.127	-0.126	32.799	0.025
20	-0.091	-0.011	33.643	0.029
21	0.022	-0.024	33.695	0.039
22	0.059	-0.048	34.068	0.048
23	0.034	-0.021	34.191	0.062
24	-0.022	-0.027	34.247	0.080
25	-0.061	-0.016	34.673	0.094
26	-0.018	0.025	34.711	0.118
27	0.050	0.020	35.011	0.139
28	0.003	-0.115	35.012	0.170
29	-0.044	-0.012	35.255	0.196
30	-0.031	-0.023	35.380	0.229
31	0.007	-0.011	35.387	0.269
32	-0.020	-0.074	35.438	0.309

Figure 3. *Correlogram unemployment at first difference.*

Estimation

To identify the adequate model, the trial-and-error process constructed four models, comprising ARIMA (1,1,1), ARIMA (1,1,2), ARIMA (2,1,1), and ARIMA (2,1,2). The diagnostic result shows that ARIMA (1,1,2) was the most suitable model due to having the lowest AIC (-0.8624) and SC (-0.7349) (*Table 3*). Additionally, its adjusted R2 (0.2988) and SIGMASQ (0.0218) were the highest and lowest compared to others. From *Table 4*, ARIMA (1,1,2) model was significant in both AR and MA.

Table 3*. Result of ARIMA estimation.*

Measurement	1,1,1	1,1,2	2,1,1	2,1,2

Adjusted R^2	0.2861	0.2988	0.2877	0.0869
Akaike info criterion	-0.8451	-0.8624	-0.8477	-0.5599
Schwarz criterion	-0.7176	-0.7349	-0.7203	-0.4324
SIGMASQ	0.0222	0.0218	0.0222	0.0284

Table 4. *Model of ARIMA (1,1,2).*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.0111	0.0307	0.3606	0.7195
AR(1)	0.6339	0.1225	5.1753	0.0000
MA(2)	-0.5676	0.1461	-3.8851	0.0002

Diagnostic

Besides that, the diagnostic result from *Figure 4* portrays that the P-value for autocorrelation and partial autocorrelation coefficients were more than 0.05, which means all lags were insignificant. This condition indicates that the model was suitable for the intervention analysis.

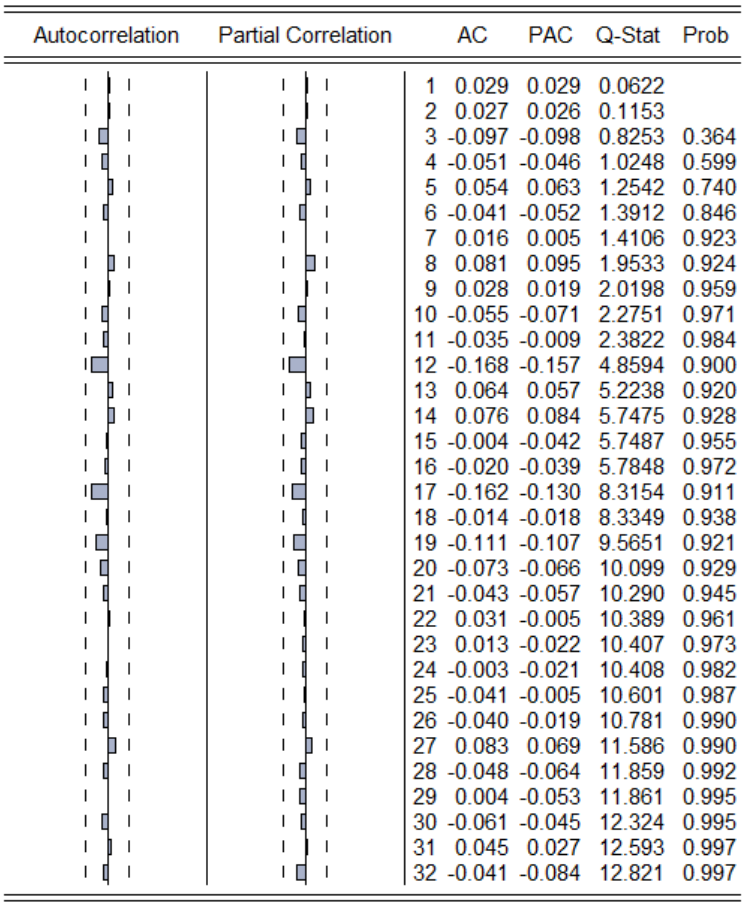


Figure 4. *Diagnostic residuals' autocorrelation test.*

ARIMA intervention analysis result

After determining the adequate model, the model ARIMA (1,1,2) was used by inserting the intervention variables, the COVID-19 pandemic, and the lockdown. In *Table 5*, the first model explains the intervention of the COVID-19 outbreak without the

lockdown policy. From this model, unemployment decreased by 0.2590 percent during the first outbreak of COVID-19 in Malaysia. During the second outbreak of COVID-19, unemployment increased by 0.1868 percent, significantly associated with this outbreak. However, unemployment portrayed a significant negative relationship during the third outbreak, which reduced by 0.0421 percent.

Table 5. *Result of ARIMA intervention.*

Variable	Model 1	Model 2	Model 3
C	0.0332***	0.0088	0.0217***
	(0.0099)	(0.0107)	(0.0097)
$D_{1\ First}$	-0.2590*	-	-0.1832***
	(0.1328)		(0.0780)
$D_{1\ Second}$	0.1868***	-	-0.0020
	(0.0285)		(0.0430)
$D_{1\ Third}$	-0.0421***	-	-0.0390*
	(0.0194)		(0.0222)
$D_{2\ MCO1}$	-	0.4662***	0.4834***
		(0.0492)	(0.0858)
$D_{2\ MCO2}$	-	0.0068	0.0197
		(0.0378)	(0.0478)
$D_{2\ MCO3}$	-	-0.1533	-0.1443
		(0.9257)	(8.5771)
$D_{2\ MCO4}$	-	0.2557	0.2901
		(0.2469)	(2.5597)
D(*ln*GDP)	-3.5756***	-1.870***	-2.5461***
	(0.9617)	(0.3790)	(0.5226)
D(*ln*INF)	-13.1961***	-10.8841***	-9.5640***
	(2.0184)	(2.0581)	(2.2603)
p(1)	0.1146	-0.1225	-0.2975*
	(0.1151)	(0.1647)	(0.1693)
q(2)	-0.5598***	-0.1253	-0.1778
	(0.1381)	(0.1390)	0.1827

Note: (***), (**), and (*) denoted that the significance level at 1%, 5%, and 10%.

From the second model, it explains the intervention of lockdown without the COVID-19 outbreak. MCO 1.0 significantly impacted unemployment. From the coefficient, unemployment increased to 0.4662 percent during MCO 1.0. Meanwhile, during MCO 3.0, unemployment experienced a downturn but was insignificant. Nonetheless, unemployment showed an upward trend during the MCO 2.0 and FMCO period. Same as before, this trend was negligible. In the third model, the impact of the COVID-19 pandemic was examined in the presence of the impact lockdown. This result revealed that the outbreak of the COVID-19 pandemic decreased unemployment. However, only the inverse impact from the first outbreak was significant at 5 percent. Unemployment was reduced by 0.1832 percent when the first outbreak of COVID-19 began. For the lockdown policy, unemployment surged during MCO 1.0, MCO 2.0 and FMCO but declined during MCO 3.0. It was only found that the impact of the first MCO was significant at 5 percent. Hence, MCO 1.0 increased unemployment by 0.4834 percent. An inverse relationship was found between the GDP and inflation variables with unemployment. For instance, in the first model, when the GDP and inflation increased by 1 percent, unemployment decreased significantly by 0.0358 percent and

0.1320 percent, respectively. Meanwhile, the same result also happened in the second model. For example, a 1 percent increase in the GDP significantly reduced unemployment by 0.0187 percent, while unemployment decreased by 0.1088 percent, significantly associated with the increase of 1 percent in inflation. Meanwhile, GDP reduced unemployment by 0.0255 percent on average in the third model. The same trend was also found for inflation, which declined unemployment by 0.0956 percent on average.

This study discussed three models of the intervention, which first model comprised of COVID-19 outbreak only (equation 3), second model included associated lockdown only (equation 4), while third model encompassed of combination between the COVID-19 outbreak and associated lockdown (equation 5). From the result of first model, the first outbreak and third outbreaks reduced unemployment, as supported by stronger economic growth. In this token, the economy was still open during the first outbreak of COVID-19. Besides that, almost all the sectors in Malaysia were permitted to be fully operated during the third outbreak of COVID-19. Meanwhile, the third outbreak influenced unemployment insignificantly because most citizens were vaccinated (Ramlan, 2021; Tang, 2021). The vaccine's protection reduced the infection rate, and workers could return to the workplace. In contrast, the second outbreak of the COVID-19 deterioted the unemployment significantly. The significance is caused by the fear of infection causing work absenteeism and destruction and job insecurity increasing among employees, especially in the service sector (Morales et al., 2022; Lee et al., 2021). Since China announced its lockdown policy in January, Chinese tourists visiting Malaysia have reduced significantly, exacerbating unemployment in the service sector (Ajmal et al., 2023). It was also affected by the lockdown policy, which was announced during this outbreak. Workers' mobility and operation size were restricted and causing an increasing in unemployment. Moreover, the result from the second model shows the considerable impact of the lockdown on unemployment during MCO 1.0. As Malaysia was the first to conduct a national lockdown, strict SOPs restricted the operation of non-essential sectors (Hashim et al., 2021). Some firms had a limited budget to face these changes during the lockdown period as the lockdown announcement was sudden (Tajudin et al., 2021). The limited savings and absence of a sufficient precautionary budget impacted the firms' survival. Without sales, businesses could only survive for three to six months (Che Omar et al., 2020). Hence, the firms underwent cash flow restrictions, and laying off their staff was one way to downsize to sustain the business. MCO 1.0 exacerbated unemployment in this context. MCO 2.0, MCO 3.0, and FMCO were conducted based on the experience of MCO 1.0. Unlike MCO 1.0, more sectors, especially manufacturing industries, were allowed to operate during the following MCOs to prevent considerable economic damage. Additionally, the employer and employee were prepared financially and psychologically and had alternative methods to sustain the lockdown period (Kuriakose et al., 2021).

Interestingly, the period of MCO 2.0 (42 days), MCO 3.0 (20 days), and FMCO (28 days) were shorter than MCO 1.0 (56 days), causing an insignificant impact on unemployment. Alamoodi et al. (2022) claimed that Malaysians were not as reciprocating to the first lockdown (MCO 1.0) compared to the second lockdown (MCO 2.0) and third lockdown (MCO 3.0). This circumstance could be observed from the negative sentiment during MCO 1.0 being higher than MCO 2.0 and MCO 3.0. Citizens' negative views exacerbated the situation, especially the economy. Moreover, Ramlan (2021) also propounded that the impact of MCO 1.0 on the economy was more

significant than MCO 2.0. Kuriakose and Tran (2020) stated that the closure of firms in Malaysia during the MCO 1.0 was 35 percent among 1500 firms. This figure was more significant than 15 percent during MCO 2.0 and 22 percent during MCO 3.0 (Kuriakose et al., 2021). Hence, the closure of the firms was linked to higher unemployment during MCO 1.0. In another analysis from the third model, we adopted the combination of the shock event with the policy in the intervention model. The lockdown's impact was more significant than the pandemic outbreak on unemployment. As a result, unemployment increased by 0.4834 percent in the first MCO period. In contrast, all the outbreaks tried to reducing the unemployment, but only the first outbreak was significant. In addition, the impact of the MCO 1.0 (0.4662 percent) was greater the second outbreak of the pandemic (0.1868 percent) in terms of unemployment. This result is in line with Goswami et al. (2021) as well as Khachatryan and Losjö Dahlström's (2021) findings, which stated that the lockdown impact was more significant than the COVID-19 pandemic.

From the first, second and third models, they claimed that the GDP and inflation play a vital role in the model. The GDP and inflation had a significant and stable trade-off relationship. Hence, this result is in line with Mussida and Zanin (2022) and Nia et al. (2022) that the GDP and inflation had negatively impacted unemployment, either in the pre-pandemic period or during the pandemic period or post-pandemic period in Malaysia. These results also supported the existence of Okun's law and the Phillip Curve in Malaysia. Hence, the results of the present study answered these questions: which outbreak of the COVID-19 pandemic significantly increased unemployment? Were the MCOs after MCO 1.0 conducive to the decline of unemployment and what the impact of MCO 1.0 on unemployment? Firstly, the second outbreak of the COVID-19 pandemic significantly increased unemployment compared to the first and third outbreaks. Secondly, the MCOs after the MCO 1.0 were conducive to declining unemployment. Thirdly, MCO 1.0 had a higher percentage impact on unemployment in Malaysia. In another word, the longer the MCO period, the unemployment tended to be increased.

Conclusion

In conclusion, this study aimed to investigate the impact of the COVID-19 pandemic and lockdowns on unemployment in Malaysia. This study stands out from previous research due to its unique approach to examining the association between the COVID-19 outbreak and lockdown measures. Unlike other studies by Habibullah et al. (2021) by using the stringency index and Su et al. (2022) by utilizing the confirmed case and death case, respectively, to study the impacts on unemployment, this research adopted a distinct perspective and considered different aspects of these phenomena. Since various COVID-19 outbreaks and lockdown measures possed varying degrees of strength in terms of their duration and impact, it became crucial to comprehend the specific characteristics of each outbreak and lockdown and their influence on unemployment. This gave valuable insight into the effectiveness of different strategies and interventions in managing the pandemic. This information helps policymakers, healthcare professionals, and the public make informed decisions and implement targeted measures to minimize the negative consequences, especially unemployment. Additionally, this study employed intervention analysis which gave additional information for the researchers to assess the impact of specific interventions or policy changes on the

observed outcomes. This provided a comprehensive and in-depth understanding of the relationship between the COVID-19 outbreak, lockdown measures, and their effects.

As a result, policymaker should prepare for medical precautions early. For example, the government can impose more budget for medical components. COVID-19 proved a great demand for vaccines, beds, and medical equipment. Considerable expense is required to deal with a public health crisis. Hence, the budget is vital in ensuring the country is well prepared. Sufficient medical staff, beds, and equipment should be on standby as a precaution for the next pandemic. A nationwide lockdown will create a trade-off that destroys the economy. The result showed that unemployment increases significantly when there is a more extended lockdown period. Hence, the government should have an alternative for citizens during a lockdown, especially for economic activities. For instance, the operation of the sectors could be allowed with limited capacity with strict, clear, and consistent SOPs during the lockdown. With the experience of the COVID-19 pandemic, it is believed that government now has guidelines and SOPs for a lockdown. Nonetheless, the implementation of these SOPs must be improved. Moreover, the government should promote a program encouraging employers and employees to have a precautionary deposit. This deposit enables the employer to sustain its business during a crisis, such as a lockdown. It will reduce the risk of shutdown and layoffs. During the COVID-19 pandemic, the Malaysian government allowed Malaysians to withdraw their savings from the Employees Provident Fund (EPF). EPF is well known for its importance in safeguarding retirement planning. As a result, withdrawing funds would jeopardize an employee's future, notably their retirement period. Therefore, employers and employees are encouraged to have alternate savings as a precaution.

This study came with certain limitations. Firstly, the data set was only applied from one country. Hence, future studies can increase observation by adopting more data. For example, ASEAN-5 countries. Secondly, this study used the dummy of the waves of the COVID-19 outbreak and lockdown in the intervention analysis. As a result, there was another indicator for COVID-19 and lockdown for future study.

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Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

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