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EU-ERA DP 1/2021

How Do Various Lockdown Measures Cause Loss of Employment in Malaysia? Empirical Evidence Using Employment Insurance System's (EIS) Administrative Data

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EIS
EMPLOYMENT INSURANCE SYSTEM
Employment Insurance System

EU ERA
EIS-UPMCS Centre for
Future Labour Market Studies

ISSN 2785-9096
9 772785 909007

ISSN 2785-9096

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June 2021

Abstract

Motivation and aim: Finding appropriate equilibrium in balancing the costs of health and economics are the most challenging aspects experienced by many countries nowadays, including Malaysia. Various lockdown measures impacted countries differently demonstrate the magnitude and spread of the coronavirus disease (COVID-19) on the labour market, in which the trade-off between these two components is unlikely to be avoided. This paper provides novel evidence about the uneven impacts of lockdown measures on the loss of employment (LOE).

Method and material: This is the first application of daily administrative labour market data modelled in Malaysian literature. The model provides a meaningful policy application when eight different lockdown measures: domestic travel restriction, gathering restriction, international travel restriction, cancellation of public events, public transport restriction, school closure, stay at home and workforce closure, are individually tested and analysed to determine their impacts on LOE.

Key findings: Restrictions on mass gatherings, international travel, banning public events, school closures, and workplace closures have increased LOE. The magnitude of each lockdown measure impacting the LOE is distinctly different, with banning public events disrupting most areas of employment and school closures having the least impact.

Policy implications: This paper provides useful and meaningful information for policymakers in understanding the magnitude of the lockdown measures and preparing economic "rescue" programmes. The unequal impacts of each lockdown measure imply that better outcomes depend on what lockdown measures have been initiated.

JEL Classifications
I18, H30, J64

Keywords:
COVID-19; Lockdown; Loss of employment; Cointegration; Malaysia

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1. INTRODUCTION

In 2020, the world's population was shocked by two unprecedented events relating to health and economic downturn originating from China. First, the origination of the Coronavirus disease (COVID-19) from Wuhan, China. This was initially reported to the World Health Organisation (WHO) on December 31, 2019, given the spread of the virus throughout China in January 2020 (Lu, 2020). By the end of January 2020, the virus had quickly spread to more than 20 countries worldwide (Oxford Economics, 2020), and on March 11 of the same year, the WHO declared COVID-19 a global pandemic (Alam et al., 2020). Nonetheless, by March and April 2020, the virus had spread globally, creating fear and uncertainty (Zellweger, 2020). Second, total lockdown as a measure induced through social distancing in Wuhan helped to flatten the COVID-19 curve though becoming an unprecedented economic disruption at the same time (Matrajt & Leung, 2020; Balasa, 2020: Musinguzi & Asamoah, 2020). This measure was seen as a new benchmark for epidemic prevention policy (Yuan et al., 2020). Moreover, the nationwide traffic restrictions and self-isolation measures introduced in Wuhan (later Beijing and Shanghai) managed to mitigate the spread of COVID-19 across China (Yuan et al., 2020; Oxford Economics, 2020).

Similarly, almost all countries worldwide have taken the necessary steps and measures to mitigate the impact of the COVID-19 outbreak (Atalan, 2020). Learning from China, the lockdown policy has been adopted as an important measure and approach to contain the spread of COVID-19. During the lockdown period, domestic and international travel is not allowed, schools are closed, business activities are restricted, workplaces are closed, workers to work from home, mass gatherings and public events are prohibited, and public transport is closed (Moosa, 2020; De Vos, 2020). These measures allow people to "social distance" themselves, and wearing face masks and washing hands frequently will help to reduce the spread of the virus, which is

transmitted by air droplets (Qian & Jiang, 2020). Studies have shown that despite the success of lockdowns and social distancing measures in reducing the spread of the virus, it has also had positive effects on health. However, in the long-run, reducing physical activities will ultimately increase the likelihood of people having diabetes, obesity and cardiovascular disease (De Vos, 2020).

Other devastating effects of these lockdown measures in containing the spread of the virus are its adverse effects on the economy. Ayittey et al. (2020) assert that COVID-19 has interrupted global trade, disrupted supply chains, depressing financial markets, and curtailed business activities. According to Nicola et al. (2020), COVID-19 adversely affects all industries and sectors of the economy, namely: agriculture, petroleum and oil, manufacturing, education, finance, healthcare, pharmaceutical, hospitality, tourism, aviation, real estate and housing, sports, information technology, media, research and development, and food sectors. On the other hand, Atalan et al. (2020) held that COVID-19 had disastrous and destructive effects on the economy. Atalan et al. (2020) also point out the adverse effects of the virus on mental health, although the lockdown measures may bring about an increase in air and water quality. Adam et al. (2020) reiterated that apart from the negative shocks from the domestic sector, the situation will be aggravated further with shock from the external sector, in which exports and tourism are paused, fall in remittances flow from migrants and the 'sudden stop' in foreign direct investment and portfolio private capital flows.

The COVID-19 pandemic has led to a global health crisis and a downturn in economic and labour markets. Many governments worldwide have adopted lockdown measures to mitigate the spread of the virus, however, at the expense of dampening economic growth (World Bank, 2020). The International Labour Organisation (ILO, 2020a) asserts that lockdowns and related business disruptions, travel restrictions, school closures, and other containment measures have dramatically impacted workers and enterprises. In fact, ILO (2020b) preliminary estimates indicate that global unemployment could reach as high as 24.7 million from a base level of 188 million in 2019. On the other hand, the estimates of labour income losses suggest a global decline of 10.7% during the first three quarters of 2020 (compared with the corresponding

period in 2019). This amounts to US$3.5 trillion, or 5.5% of global gross domestic product (GDP) for the first three quarters of 2019 (ILO, 2020c).

Like many other countries, Malaysia was not "immune" from the aftermath of the COVID-19 outbreak. It was reported that the first positive case of COVID-19 in Malaysia was reported on January 25, 2020, and by the end of February, the total number of COVID-19 cases reached 25. By March 16, 2020, the total number of affected people rose to 428, with the number of new cases on March 16 was 190. In fact, this was the first three-digit number of COVID-19 new cases reported since January 2020. Realising how fatal the COVID-19 coronavirus and the speed at which it spread among the population, the Malaysian government implemented the Movement Control Order (MCO) on March 18, 2020 (Shah et al., 2020). To "flatten the curve", a total lockdown was imposed on the entire nation (Azizi et al., 2020; Tang, 2020). During the lockdown period, all airports were closed with domestic and international flights prohibited, schools and workplaces were closed, implementing a work from home policy, stay at home order, mass gatherings and public events were restricted, travelling between states prohibited, and travelling within the state was restricted to certain kilometres.

In response to the lockdown and social distancing measures that have had a severe impact on the economy, the Malaysian government launched a series of unprecedented economic stimulus programmes to lessen the adverse economic impact of COVID-19 (Shah et al., 2020; Lee et al., 2020; Ferlito & Perone, 2020). In 2020, four economic stimulus packages were announced, the largest in Malaysian history since the nation's independence in 1957. This health-related crisis clearly demanded active government intervention to ensure the stability and recovery of the economy.

The first economic stimulus package (so-called the PH stimulus package) totalling RM20 billion was announced on February 27, 2020. The purpose, to stimulate the economy, particularly the travel and tourism sector, given the international travel restrictions. The stimulus package is also meant to boost domestic consumption and encourage quality investment. The second economic stimulus package of RM230 billion was launched on March 27, 2020. The so-called Prihatin Rakyat stimulus package provides income

support for the B40 and M40 families1, a wage subsidy programme2 for unemployed workers, and financial support to business, including small and medium enterprises (SMEs). On April 6, 2020, the third Prihatin Package worth RM10 billion was announced, specifically catering for SMEs. On June 9, 2020, the government issued its fourth economic stimulus package totalling RM35 billion, *Pelan Jana Semula Ekonomi Negara* (PENJANA), aimed at helping businesses recover from the impact of COVID-19. This brings the total value of the country's economic stimulus packages to over RM290 billion.

Accordingly, the purpose of this study is to provide empirical evidence on the impact of various lockdown measures on the Malaysian labour market using loss of employment (LOE) as a proxy for the labour market reaction indicator. In assessing the reaction of the labour market to the various lockdown measures, daily data on the number of LOE compiled by the Employment Insurance System (EIS), Social Security Organisation (SOCSO) is used. The EIS centre reports LOE statistics daily and weekly. There are two novelties offered in this paper. First, this is the first application of daily administrative labour market data modelled in the Malaysian literature. Second, it provides a meaningful policy application when eight different lockdown measures, namely, domestic travel restriction, gathering restriction, international travel restriction, cancellation of public events, public transport restriction, school closure, stay at home and workforce closure, are individually tested, analysing the impacts on LOE.

This paper is structured into six sections. Section 2 provides an overview of the cross-country empirical assessments on the impact of lockdown measures on the labour market in the context of Malaysia. Section 3 presents the econometric model along with the data requirements, followed by Section 4

1In the current policy target on income, Malaysian households are categorised into three different income groups: Top 20% (T20), Middle 40% (M40) and Bottom 40% (B40). These categorisations are made based on the Household Income and Basic Amenities survey.

2 Wage subsidy programme is designed to subsidize worker's salaries for certain periods depending on the economic packages.

that presents the most important findings obtained from the econometric model. Section 5 supports the findings by providing robustness checks to the estimation. Finally, Section 6 concludes by offering policy implications drawn from the study.

2. HETEROGENEOUS IMPACTS OF COVID-19 ON LABOUR MARKETS

The literature survey undertaken in this study indicates that the various lockdown measures adopted by many countries to contain the spread of COVID-19 have a severe impact on the labour market. Many of the studies have shown that lockdown measures strongly impact employment, with variable impacts depending on the country's economic structure and position. For example, Kong and Prinz (2020) found that in the United States (US), the closure of schools, bars and restaurants, non-essential businesses, stay at home requirements, banned from mass gatherings contribute less than a 13% increase in unemployment. In Japan, Kikuchi et al. (2020) found that apart from the regular, young, and female workers working in the social and non-flexible job environment hit by the pandemic, the hardest hit was the contingent workers. Studies on the MENA countries (Hassan et al., 2020), US, Germany and Singapore (Reichelt et al., 2020) and in Asia (Awad & Konn, 2020) found that the COVID-19 pandemic has severely affected women more than men. In India, the economic shutdown caused 32 million regular informal workers, 89 million casual workers, and 107 million self-employed workers to lose their jobs; most of these workers were poor and with a low-education background (Ghose, 2020).

Nevertheless, different lockdown measures affect different groups and socio-demographics of employment. Juranek et al. (2020) asserted that lockdown measures come at a cost in terms of labour market performance in the short run. Their study on Nordic countries found that beginning in the early weeks of 2020, the number of unemployed people rose sharply in Norway, Denmark and Finland. Shuai et al. (2020) found that COVID-19 resulted in a decline labour demand, with the worst affected being young workers working in the leisure and hospitality sectors (Gould & Kassa, 2020). In another study,

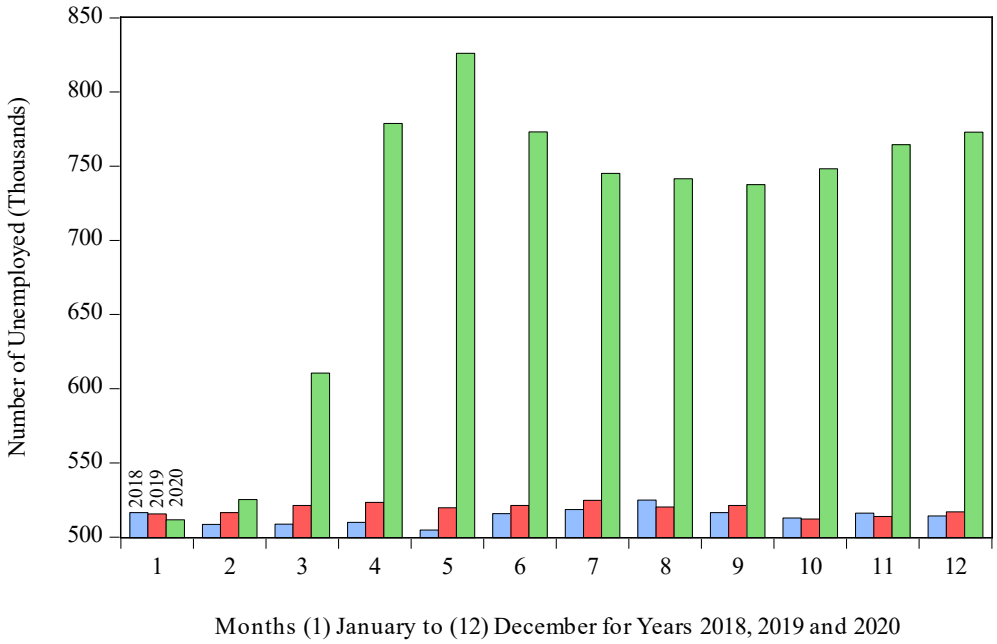
Beland et al. (2020) asserted that the negative impact of the COVID-19 pandemic was more significant for men, younger workers, Hispanic and less-educated workers. In European Union (EU) countries, Pouliakas and Branka (2020) and Fana et al. (2020) indicated that the most vulnerable groups in the labour market affected by the pandemic included women, non-natives, self-employed and temporary workers, the lower educated and low-wage workers in the micro-enterprises. In contrast, a study of G20 countries by ILO and OECD (2020) found that COVID-19 and the lockdown measures caused an unprecedented fall in employment in the G20. For example, between December 2019 and April 2020, employment declined by 40% in Mexico and 8-9% in Japan and Korea; total hours worked declined by 46% in Mexico and 10% in Australia, and the unemployment rate increased substantially in Canada and the US markets, more than during the global financial crisis (GFC) in 2008.

In Malaysia, the MCO severely impacted the Malaysian labour market, increasing unemployed from 3.2% in the fourth quarter of 2019 to 3.5% in the first quarter of 2020 and reaching 5.1% in the second quarter of 2020 (DOSM 2020). The number of unemployed people increased from 512 thousand in the fourth quarter of 2019 to 547 thousand in the first quarter of 2020, to 792 thousand in the second quarter of 2020. To illustrate the impacts, Figures 1 and 2 show the unprecedented increase in the number of unemployed persons and LOE for 2020 compared to 2018 and 2019. There is a noticeable, substantial gap between 2020 and 2018-2019, beginning from March to December.

Like many other countries, the COVID-19 pandemic and MCO measures are disproportionate regarding the impact among the Malaysian population. Among unemployed workers, the number of women affected by COVID-19 and lockdown measures is more significant than men. Similarly, the disproportionate impact of COVID-19 is more severe on younger workers (aged between 15-24 years) than older workers (aged between 35-33 years) (DOSM 2020). Cheng (2020) and Rahman et al. (2020) highlighted that women and young low-educated workers had been severely affected by the pandemic. Similarly, foreign workers were also severely affected by the pandemic and lockdown measures (Wahab, 2020) despite their significant

contribution to the Malaysian economy (Ismail, 2003). During the MCO, foreign workers were allowed to work for a limited number of days each month; some were not permitted to work at all (Wahab, 2020). At the sectoral level, an ILO study conducted by Lin (2020) found that job losses were mainly concentrated in the agriculture sector, with 21.9% representing total job losses from a survey of 168,182 respondents; and 33.3% of workers in the agriculture sector subject to reduced working hours.

Figure 1: The number of unemployed for 2018, 2019 and 2020 from January to December



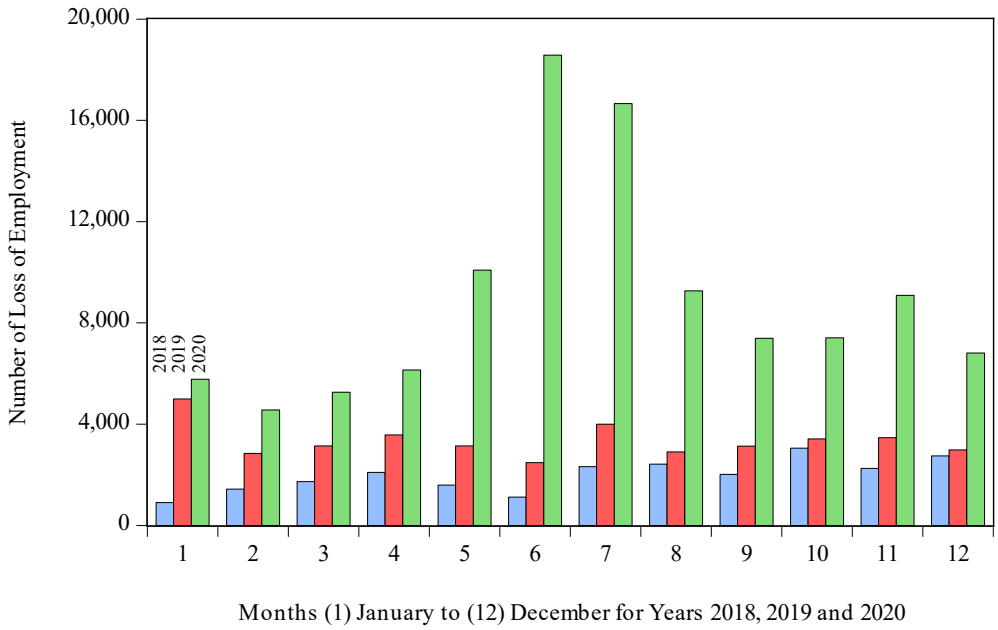
3. MODELLING LOCKDOWN MEASURES AND LOSS OF EMPLOYMENT (LOE)

To examine the impact of lockdown on the LOE, the following simple bi-variate model is presented:

$$log\ y_t = \alpha_0 + \alpha_1 log\ x_t + \mu_t \quad (1)$$

where y_t is the Loss of Employment (LOE) and x_t represents the lockdown measures; while parameter μ_t is the error term assumed to have zero mean and constant variance. It is expected *a priori* that $\alpha_1 > 0$; implying that an increase in lockdown intensity will increase the number of job losses.

Figure 2: Number of LOE for 2018, 2019 and 2020 from January to December



In this paper, Ordinary Least Squares (OLS) with robust standard error due to Newey-West (Newey & West, 1987) heteroscedasticity and autocorrelation consistent (HAC) estimates of the standard error in the estimation of Equation (1). Nevertheless, we are aware that estimating Equation (1) consisting of non-stationary variables will result in a spurious regression problem. Thus, we

needed to determine the order of integration of each of the variables involved. In doing this, we employed the conventional augmented Dickey-Fuller (ADF, Dickey & Fuller, 1981) unit root test. By employing the ADF unit root test procedure, the null hypothesis is the unit root against the alternative hypothesis of stationary. Rejection of the null hypothesis of the unit root would suggest that the series is stationary. The work by Nelson and Plosser (1982), Perron (1988) and Malliaris (1990) demonstrates that most macroeconomic time series are non-stationary; that is, they are I(1) in levels and I(0) after first-differencing.

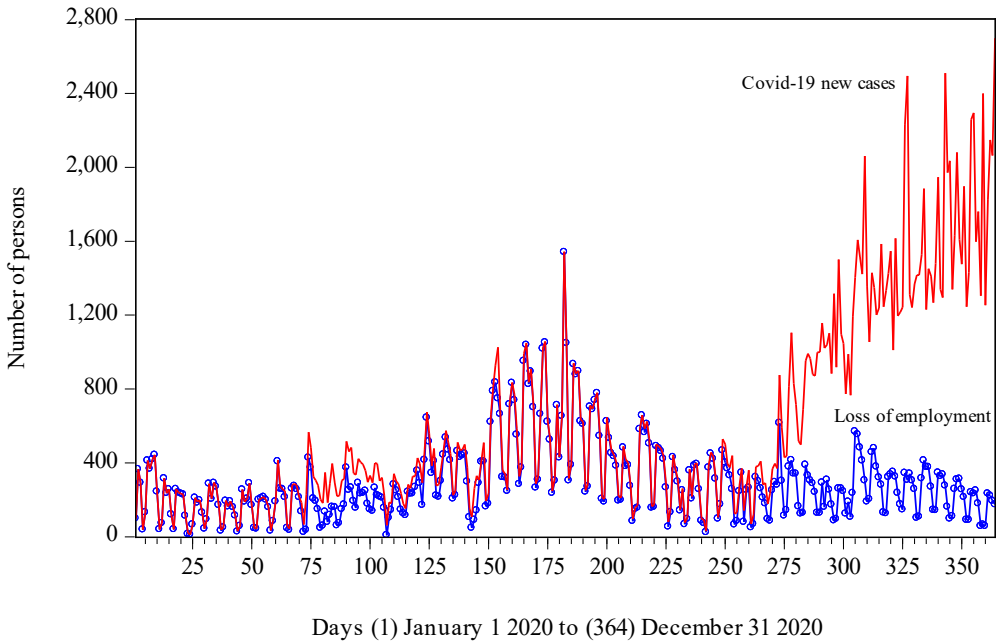
The regression results by running Equation (1) with non-stationary I(1) variables will be spurious unless the variables are cointegrated (Granger & Newbold, 1974). To determine the validity of Equation (1), we tested for cointegration. A simple test for cointegration was conducted using the Engle and Granger (1987) two-step procedure. Following this procedure, we saved the residuals on estimating Equation (1) in the first step and then proceeded with the second step by testing the residuals for unit root using the conventional Dickey and Fuller (1981) unit root test. The rejection of the null hypothesis of unit root suggested that the residuals are stationary, implying that the variables are cointegrated – such that there is a long-run relationship between y_t and x_t. A cointegrated regression also signifies that the estimated regression is a non-spurious, stable, and valid long-run model.

Concerning the data, we used novel administrative data that records the daily LOE, extracted from the Employment Insurance System (EIS), SOCSO database ranging from January 1, 2020, to December 31, 2020. Figure 3 demonstrates the daily trend of LOE and new cases of COVID-19. It can be seen that the two variables are closely related throughout the year until early October where the two variables diverge.

In addition to LOE, the daily data of lockdown measures were taken from the COVID-19 Government Response Tracker (OxCGRT) database compiled by Hale et al. (2020). The OxCGRT database provides several lockdown measures: school closing, workplace closing, public events cancellation, gathering restrictions, stay at home, transportation restrictions, internal movement restrictions and international travel controls. According to the

OxCGRT database, the eight lockdown policy variables were given ordinal values from 0 to 4 (see Appendix). In Figure 4, we plotted each of the lockdown measures with LOE for January to December 2020. The stringency of the lockdown measures range from 0 to 1 for restrictions on public transport; 0 to 2 for restrictions on domestic travel, banning of public events and stay at home requirements; 0 to 3 for school and workplace closures; and 0 to 4 for restrictions on mass gathering and international travel. In this study, we employed the formula $\log y_t = \log [y_t + \sqrt{(y_t^2 + 1)}]$ to transform the series into a logarithm (Busse & Hefeker, 2007). By employing this method, we maintained the sign of y_t.

Figure 3: Daily number of loss of employment (LOE) and number of COVID-19 new cases, January-December 2020



4. RESULTS OF THE ESTIMATION

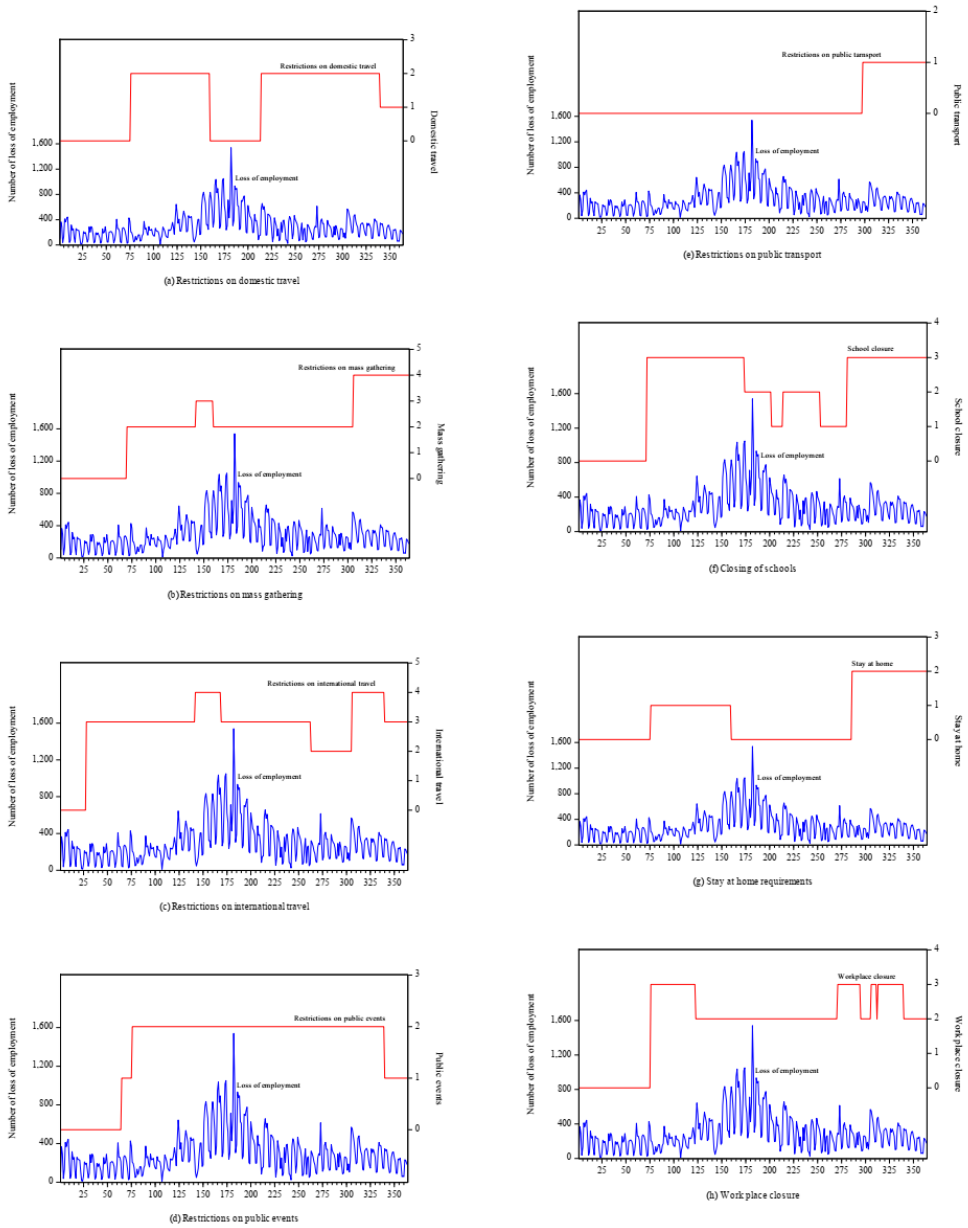
Table 1 reports the summary statistics of the variables used in the study. The mean for LOE is 294.02, and the maximum and minimum values are 1540 and 7, and the standard deviation is 211.69. The mean of all eight lockdown indicators shows positive values; while the standard deviations of the lockdown policy response variables are 0.94 for domestic travel, 1.21 for gatherings, 0.96 for international travel, 0.78 for public events, 0.39 for school closure, 1.19 for stay at home, and 0.81 for workplace closure. The positive mean implies that each lockdown indicator increased over time. The negative skewness was shown by all series, except for LOE, school and workplace closures, indicating that these series show longer or a fatter tail on the left side of the distribution.

Table 1: Descriptive Statistics

Series	Obs	Mean	Max	Min	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
Loss of employment	364	294.02	1540	7	211.69	1.71	7.47	480.73***
Domestic travel	364	1.22	2	0	0.94	-0.46	1.29	56.97***
Gatherings	364	1.99	4	0	1.21	-0.08	2.68	2.02
International travel	364	2.83	4	0	0.96	-1.66	5.99	302.20***
Public events	364	1.55	2	0	0.78	-1.30	2.93	102.99***
School closure	364	0.18	1	0	0.39	1.63	3.66	167.85***
Stay at home	364	2.01	3	0	1.19	-0.73	1.93	49.33***
Workplace closure	364	0.66	2	0	0.81	0.68	1.86	48.08***

Notes: Asterisk *** denotes statistically significant at 1% level.

Figure 4: Trend in the lockdown measure indicators, January to December 2020



Nonetheless, all variables show non-normality in the series as indicated by the Jarque-Bera tests, except for the restrictions of public gatherings. The correlation matrix in Table 2 shows the correlation between the variables used in the study. All variables in this table were transformed into a logarithm to reduce the skewness of the time series. It can be seen that the daily LOE is positively related to all lockdown variables (except for domestic travel, public transport, and the stay-at-home requirement), significant at the 1% level. Strong correlations are shown by all positive covariates with the LOE series. Table 2 also suggests that there is a strong positive correlation between the lockdown policy response variables and the LOE in Malaysia during the COVID-19 pandemic in 2020.

The results of the ADF unit root tests for the order of integration of the series presented in Table 3 suggests that all variables are I(1), indicating that the series becomes stationary after taking the first difference. These results suggest that all variables are non-stationary in levels, and their first differences are stationary, implying that they are I(1) variables. Consequently, estimating non-stationary or integrated variables will produce a spurious result, in which one cannot make inferences and invalidates the hypothesis testing. Thus, cointegrability among variables is important to validate a regression model.

Table 4 presents the results of the cointegration tests and the estimated long-run models for the LOE and all lockdown policy variables. Panel A reports the cointegration results of the cointegrating regression [Equation (1)] using OLS with robust standard error. The cointegration tests suggest that there are no lockdown models that are not cointegrated. In all cases, the DF t-statistics suggest that the null hypothesis of non-cointegration can be rejected at the 1% level. Nevertheless, except for restrictions on domestic travel, banning public gatherings and stay at home requirement, other lockdown policy variables show a positive impact on the LOE in Malaysia in 2020. Thus, the results in Panel A support the long-run relationships between LOE and lockdown policy indicators.

Table 2: Correlation Matrix

	LOE	Domestic travel	Gatherings	Int. travel	Public events	Public transport	School closure	Stay at home	Work-place closure
LOE	1								
Domestic travel	-0.01	1							
	(-0.19)								
Gatherings	0.26***	0.64***	1						
	(5.05)	(15.64)							
International travel	0.20***	0.33***	0.58***	1					
	(3.80)	(6.56)	(13.53)						
Public events	0.32***	0.65***	0.83***	0.55***	1				
	(6.39)	(16.37)	(28.54)	(12.58)					
Public transport	0.00	0.24***	0.51***	0.21***	0.09	1			
	(-0.04)	(4.68)	(11.36)	(4.17)	(1.64)				
School closure	0.26***	0.65***	0.89***	0.54***	0.83***	0.36***	1		
	(5.08)	(16.34)	(37.89)	(12.30)	(28.03)	(7.28)			
Stay at home	-0.03	0.56***	0.61***	0.29***	0.31***	0.73***	0.64***	1	
	(-0.52)	(12.85)	(14.59)	(5.73)	(6.29)	(20.27)	(16.01)		
Workplace closure	0.26***	0.73***	0.88***	0.51***	0.92***	0.27***	0.87***	0.51***	1
	(5.13)	(20.27)	(35.59)	(11.22)	(44.04)	(5.35)	(34.02)	(11.34)	

Notes: Asterisk *** denotes statistically significant at 1% level. Figures in round brackets are t-statistics. All series are in logarithm.

Table 3: Results of Augmented Dickey-Fuller unit root tests on the series

Series in logarithm	Level		First difference	
	Intercept	Intercept + trend	Intercept	Intercept + trend
Loss of employment	-2.9709(8)	-3.0452 (8)	-9.0972***(12)	-9.1143***(12)
Domestic travel	-2.1294 (0)	-2.1031 (0)	-18.979***(0)	-18.973***(0)
Restrictions on gathering	-1.7119 (0)	-2.1431 (0)	-19.056***(0)	-19.044***(0)
International travel	-3.4156(0)	-3.1328 (0)	-19.016***(0)	-19.084***(0)
Cancel public events	-2.0233 (0)	-1.0274 (0)	-19.002***(0)	-19.198***(0)
Restrictions on public transport	-0.4708 (0)	-1.6228 (0)	-19.026***(0)	-19.063***(0)
School closure	-2.0786 (0)	-2.1408 (0)	-19.006***(0)	-18.998***(0)
Stay at home	-1.3221 (0)	-1.7301 (0)	-19.003***(0)	-18.984***(0)
Workplace closure	-2.1417 (0)	-2.0747 (0)	-19.632***(0)	-19.650***(0)

Notes: Asterisks *** denotes statistically significant at 1% level. Figures in round brackets (…) are truncated lag length.

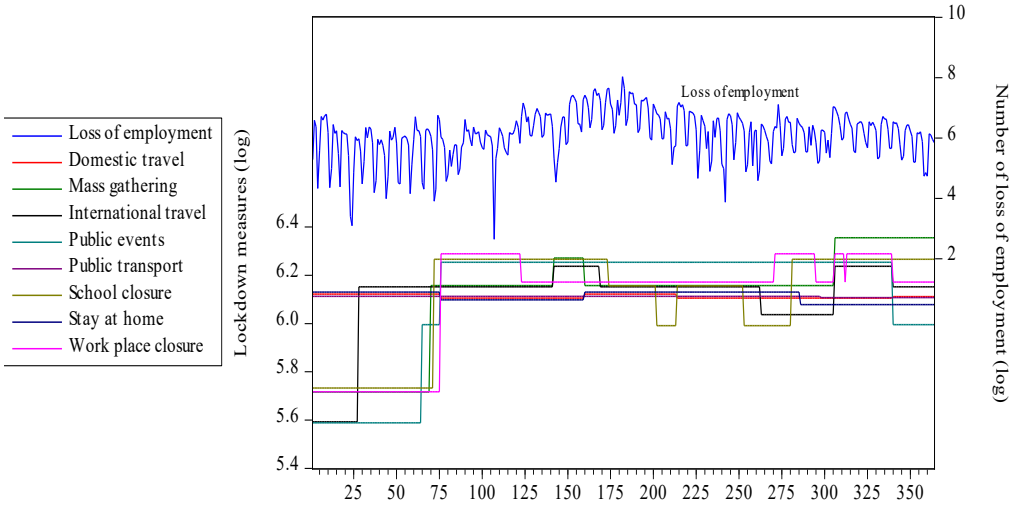
Table 4: Results of the Impact of Lockdown Measures on LOE

Independent variables	$constant$	$loglockdown$	R^2	SER	DF *t-stat*
Panel A. OLS-robust, loe_t					
Domestic travel	6.1219***	-0.0116	0.0000	0.7976	-2.9809***
	(42.111)	(-0.1039)			
Restrictions on gathering	5.7168***	0.3050***	0.0659	0.7709	-3.3924***
	(61.059)	(4.4796)			
International travel	5.5929***	0.3076***	0.0384	0.7821	-3.1484***
	(29.076)	(2.7204)			
Cancelation of public events	5.5891***	0.4605***	0.1012	0.7562	-3.8673***
	(59.091)	(5.3818)			
Restrictions on public transport	6.1123***	-0.0050	0.0000	0.7976	-2.9801***
	(77.855)	(-0.0386)			
School closure	5.7325***	0.2933***	0.0666	0.7706	-3.3509***
	(64.370)	(4.1554)			
Stay at home	6.1302***	-0.0362	0.0007	0.7973	-2.9843***
	(62.889)	(-0.3861)			
Workplace closure	5.7174***	0.3144***	0.0676	0.7702	-3.4779***
	(63.458)	(4.5172)			
Panel B. Robust M-estimation, loe_t					
Domestic travel	6.2664***	-0.0805	0.0039	0.8033	-2.9188***
	(97.644)	(-1.4059)			
Restrictions on gathering	5.8773***	0.2311***	0.0335	0.7752	-3.2377***
	(69.393)	(3.9771)			
International travel	5.7917***	0.2312***	0.0175	0.7862	-3.0087***
	(42.852)	(3.0117)			
Cancel public events	5.7542***	0.3769***	0.0591	0.7608	-3.6366***
	(65.163)	(5.3795)			
Restrictions on public transport	6.1983***	-0.0762	0.0011	0.8015	-2.9358***
	(143.75)	(-0.6689)			
School closure	5.8856***	0.2295***	0.0360	0.7751	-3.1975***
	(71.927)	(4.1209)			
Stay at home	6.2533***	-0.1078	0.0106	0.8032	-2.9137***
	(123.31)	(-1.6895)			
Workplace closure	5.8953***	0.2232***	0.0292	0.7751	-3.2829***
	(69.698)	(3.7365)			

Notes: Asterisks *** denotes statistically significant at 1% level. Figures in round brackets are t-statistics. For the cointegration tests (with null hypothesis of non-cointegration), the Engle and Granger (1987) two-step procedure was performed to test on the residuals of the cointegrating regressions. Then the residuals were tested for unit root, and the calculated Dickey and Fuller (1981) t-statistics were compared with those computed in MacKinnon (1996). $R^2$and SER denote R-squared and standard error of regression, respectively. loe denotes loss of employment in logarithm.

In Figure 5, we plot the estimated LOE concerning each of the lockdown measures for January to December 2020. It appears that there are long-run movements of LOE with each of the lockdown measures in Malaysia during the period under study. Generally, with an increase in the intensity of lockdown measures, there is an increase in LOE. Our empirical evidence above has shown that five lockdown measures, namely, restriction on mass gatherings, restriction on international travel, banning on public events, school closure, and workplace closure, increased the number of LOE during the COVID-19 pandemic for the period between January and December 2020.

Figure 5: Loss of Employment (LOE) and estimated lockdown measures, January to December 2020



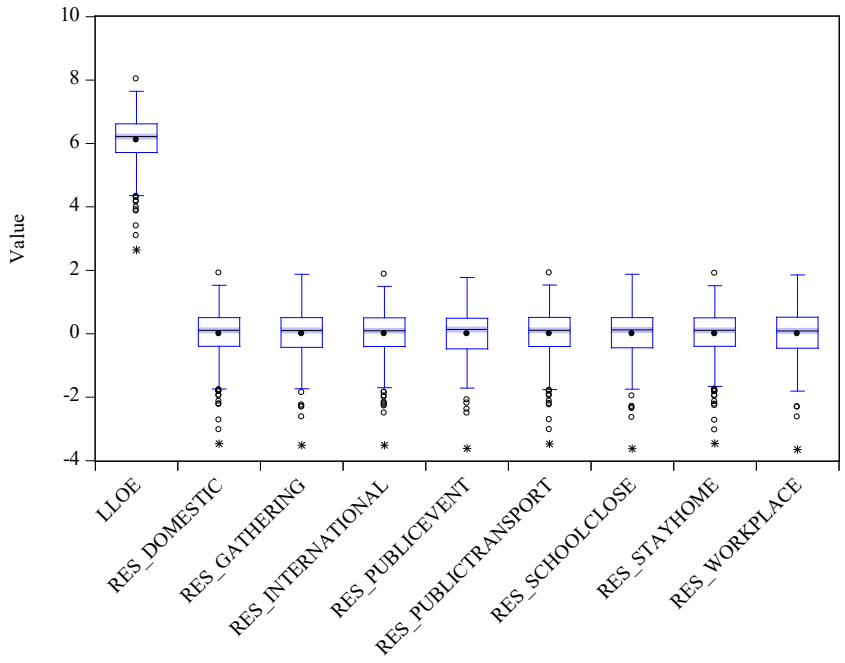
5. ROBUSTNESS CHECKS

One may ask how reliable and robust are the estimation results presented in Table 4. In answering this technical question, we demonstrate the box-plots of the LOE and all eight residuals of the respective estimated equations in Figure 6. Namely, restrictions on domestic travel (RES_DOMESTIC), bans on public gatherings (RES_GATHERINGS), restrictions on international travel (RES_INTERNATIONAL), banning of public events (RES_PUBLICEVENT), restrictions of public transport (RES_PUBLICTRANSPORT), the closing of schools

(RES_SCHOOLCLOSE), stay at home requirement (RES_STAYHOME), and workplace closure (RES_WORKPLACE).

The box-plots provide the overall information about the univariate data distribution. The core data are plotted as a rectangular box, while the top and bottom are the lower and higher quartiles of the data distribution. The horizontal line in the box signifies the data median. The lines above and below the box are called the 'whiskers'. The whiskers have a length equal to 1.5 times the inter-quantile range, and the outliers are the objects located above or below the whiskers (Daszykowski et al., 2007). As shown in Figure 6, the variables; LOE and the residuals of all estimated regressions contain outliers. These outliers are located at the bottom of the lower whiskers.

Figure 6: Box-plots for loss of employment (in log) and residuals of equation (1) for the respective lockdown measures



Barnett and Lewis (1994) stated that the presence of outliers could lead to inflated error rates and substantial distortions of parameter and statistical estimates when using either parametric or non-parametric tests. Statistically, the increase in error variance will reduce the power of the statistical tests,

decrease normality and seriously bias or influence parameter estimates (Perez, 2013). Some studies have shown that OLS cannot cope with a single outlier since one outlier can be sufficient to move the coefficient estimates arbitrarily far away from the actual underlying values; consequently, outliers cause unreliable estimates (Hampel et al., 1986; Rousseeuw & Leroy, 1987; Maronna et al., 2006). Thus, a regression analysis method to overcome and address this problem is needed.

According to Rousseeuw (1984), robust regression is the best method to detect outliers and provide results that are resistant to the outliers. The most common method of robust regression is the M-estimation method introduced by Huber (1964). The M-estimation method extends the maximum likelihood method, which is nearly as efficient as OLS. However, rather than minimising the sum of squared errors, the M-estimation method principle minimises the objective function since the aim is to minimise the function ρ of the errors with M-estimate. The M-estimate target function is given by $\sum_{i=1}^{n} \rho(\mu_i) = \sum_{i=1}^{n} \rho(y_i - \alpha x_i)$. The robust least-squares M-estimator's results are given in Part B in Table 4.

The results shown in Panel B of Table 4 were consistent with the results found earlier using OLS estimates. The cointegration tests' results suggest that there exists cointegration between the LOE and all eight lockdown measures. The null hypothesis of non-cointegration can be rejected at the 1% significant level, implying a long-run relationship between LOE and the lockdown policy measures in Malaysia. The cointegrating regressions results suggest that the lockdown measures are all significant at the 1% level, and again except for restrictions on domestic travel, restrictions on public transport and stay home requirement. Similar to the earlier findings, the lockdown measures positively impacted LOE. Nevertheless, the estimated coefficients of the lockdown measures are lower by 18% to 29% than the OLS estimates. These results suggest that the OLS estimates over-estimate the lockdown impact on LOE as a result of the presence of outliers.

6. CONCLUSION AND IMPLICATION

Finding appropriate equilibrium in balancing the costs of health and economics is the most challenging aspect experienced in many countries, including Malaysia. Various lockdown measures have differently impacted the magnitude of COVID-19 infection and the labour market as well, and the trade-off between the two components (health and labour market) is unlikely to be avoided. From the perspective of the public health safety measures, social distancing and lockdown efforts are good and effective strategies to contain the spread of the virus. In most countries, governments have adopted these unprecedented measures and have proven effective in reducing and constraining the virus from spreading.

On the other hand, to sustain the health of the economy, a responsible government that practices good governance would quickly enforce and engage in economic stimulus programmes during the lockdown period to provide support via cash and liquidity to affected firms, employers, employees and the public at large. In the context of Malaysia, the government has allocated over RM290 billion into the economy through four economic stimulus package programmes. Aside from the government's stimulus packages, government agencies can help policymakers propose future policies to protect the labour market further and propose policies that will protect the welfare of affected workers who have lost their jobs.

From a policy perspective, evidence-based assessments on how various lockdown measures affect the labour market are crucial for ensuring the effectiveness and sustainability of various approaches to be adopted. This paper provides valuable and meaningful information for policymakers in understanding the magnitude of each lockdown measure and preparing economic “rescue” programmes. Moreover, this paper has shown that restrictions on mass gatherings, restrictions on international travel, banning public events, school closures, and workplace closures increased the LOE numbers. It was found that while the magnitude of each lockdown measure impacting LOE is distinctly different, banning public events disrupts most areas of employment, while school closure has the least impact. Therefore, better outcomes depend on what lockdown measures are adopted given

COVID-19. The fact that each lockdown measure affects employment differently means that a different targeted intervention is required.

Therefore, to improve policy decisions, the analyses provided in this paper may not be adequate in terms of comprehensive and holistic actions. To help the government manage the crisis more efficiently, it is crucial to have timely, quality and disaggregated labour market information (LMI). Such data are critical in understanding, tracking, managing and mitigating labour market conditions affected by pandemics and non-pandemic consequences. To date, the EIS database only captures about 79% of all private-sector employees (excluding public sector employees and foreign workers) and about 10% of non-employee workers (self-employed, unpaid family non-standard employments). Strengthening the current employment system and extending the coverage through mandatory employment registration is a promising strategy to improve the LMI.

In addition to the administrative labour market data, socio-demographic indicators, including employment characteristics of daily infected persons, should be captured and integrated with the economic-health model. This will allow policymakers and healthcare agencies to have a more comprehensive picture and perspective of the outbreaks and propose micro-level strategies effective for both health and economic outcomes. The one-fits-all approach is ineffective given that different lockdown measures may affect different spatial units (e.g., regions, states and districts).

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t**Appendix**: Description of lockdown measures

Indicators	Descriptions	Measurement	Coding method
Restrictions on domestic travelling (internal movement)	Record restrictions on internal movement	Ordinal scale	0 - No measures 1 - Recommend not to travel between regions/cities 2 – internal movement restrictions in place
Restrictions on gatherings	Record the cut-off size for bans on gatherings	Ordinal scale	0 - No restrictions 1 - Restrictions on very large gatherings (the limit is above 1000 people) 2 - Restrictions on gatherings between 101-1000 people 3 - Restrictions on gatherings between 11-100 people 4 - Restrictions on gatherings of 10 people or less
Restrictions on international travelling	Record restrictions on international travel	Ordinal scale	0 - No measures 1 - Screening 2 - Quarantine arrivals from high-risk regions 3 - Ban on arrivals from some regions 4 – Ban on all regions or total border closure
Cancel public events	Record cancelling public events	Ordinal scale	0- No measures 1 - Recommend cancelling 2 - Require cancelling
Close public transport	Record closing of public transport	Ordinal scale	0 - No measures 1 - Recommend closing (or significantly reduce volume/route/means of transport available) 2 - Require closing (or prohibit most citizens from using it)
School closing	Record closings of schools and universities	Ordinal scale	0 - No measures 1 – Recommend closing, or all schools open with alterations resulting in significant differences compared to usual, non-Covid-19 operations 2 - Require closing (only some levels or categories, eg just high school, or just public schools) 3 - Require closing all levels
	Record orders to “shelter-in- place” and otherwise confine to home.	Ordinal scale	0 - No measures 1 - recommend not leaving house 2 - require not leaving house with exceptions for daily exercise, grocery shopping, and ‘essential’ trips 3 - Require not leaving house with minimal exceptions (e.g. allowed to leave only once a week, or only one person can leave at a time, etc.)
Workplace closing	Record closings of workplaces	Ordinal scale	0 - No measures 1 - recommend closing (or work from home) 2 - require closing (or work from home) for some sectors or categories of workers 3 - require closing (or work from home) all-but-essential workplaces (e.g. grocery stores, doctors)

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