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Does COVID-19 affect GDP? A relationship between GDP and unemployment rate

Siti Sarah Januri *, Zaitul Anna Melisa Md Yasin, Noryanti Nasir, Isnewati Ab Malek

Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Cawangan Negeri Sembilan, Kampus Seremban, Negeri Sembilan, Malaysia

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ABSTRACT

This study aims to examine the long-term relationship between the unemployment rate and the growth of domestic product (GDP) in Malaysia, thereby revealing unemployment's impact on GDP. In this COVID-19 pandemic situation, numerous people have lost their jobs. That indirectly increases the unemployment rate which later has a variety of negative consequences on the government, society, and individuals. The Malaysian government has taken a big step in announcing the Movement Control Order (MCO) to slow down the spread of infections. Such decisions have affected the unemployment rate, as some businesses have to reduce their employees and some high-risk companies temporarily closed to stop the spreading of COVID cases. The cointegration test is employed to identify the relationship between the unemployment rate and GDP and then validate it by analyzing the error. Quarterly unemployment rate and GDP data were obtained from the Department of Statistics Malaysia (DOSM) website from the first quarter of 2010 to the fourth quarter of 2020. The study found that the variables were stationary at first differencing and long-run relationships existed among them. According to the empirical findings in this study, long-run and short-run unemployment rates have a high influence on the GDP rate. However, the result contradicted one work in literature that claimed a negative association between GDP and unemployment for the past fifty years. This could have occurred as a result of the worldwide COVID-19 pandemic.

1. Introduction

The current outbreak which emerged from Wuhan, China named as novel coronavirus disease 2019, shortly called COVID-19 has been spreading globally with almost 200 million cases of people getting infected and caused almost 4 million deaths as of July 2021 reported by the WHO (2021). Fever, a dry cough, and lethargy are common symptoms of COVID-19. Other afflicted persons may experience minor symptoms such as migraines, muscle soreness, fever, sore throat, or diarrhea. Some COVID-19 individuals may be affected by things that can lead to mortality, such as severe influenza, organ malfunction (e.g., kidney), upper respiratory tract infection, and septic shock (Zhou et al., 2020). Since COVID-19 spreads mostly through person-to-person contact, some countries responded to the pandemic by imposing stay-at-home orders in response to the high number of cases and deaths (Chan et al., 2020). The COVID-19 outbreak affected the entire world and to break the chain of the contagious disease, many countries enforced social distancing, known as stay-at-home, and adhered to the social operating procedure (SOP).

Malaysia is one of more than 200 countries and territories struggling against COVID-19. A restricted lock-down technique known as the Movement Control Order (MCO) was swiftly implemented for the entire country to slow the spread of COVID-19. At a time when everything looks to be falling apart, whether it's global oil prices, currency, stock, GDP, or the global economy, there are a few macroeconomic indicators that are rising, one of which is employment. 2.8 million of Malaysia's 15.23 million working population were self-employed, according to the Chief Statistician of the Department of Statistics, and were vulnerable to the possibility of unemployment and job cuts, which impacted their income during the MCO phase, partly because they were unable to work.

* Corresponding Author.
Email Address: sarahjanuri@uitm.edu.my (S. S. Januri)
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Corresponding author's ORCID profile:
https://orcid.org/0000-0001-7098-6387

The growth domestic product (GDP) growth rate is a key indicator of a country's economic performance. The performance of the GDP of Malaysia continuously declining, heavily affected by the announcement of the global pandemic by the WHO on 11th March 2020 due to the outbreak of COVID-19 (Cucinotta and Vanelli, 2020). Simultaneously, the unemployment rate in Malaysia has tremendously risen to 5.1% which is equivalent to 14.88 million unemployed in the second quarter of 2020 which by far is the highest record in ten years of history as reported by the Department of Statistics Malaysia. In addition, governments employed a lockdown approach to slow the spread of the COVID-19 pandemic. Shutting down businesses where social interactions occur for example by closing schools, ordering individuals to stay at home, and prohibiting big gatherings. During a pandemic, this method limits people's movement and social connections while simultaneously increasing the unemployment rate (Bartik et al., 2020). This caused most businesses have close and staff has been laid off, causing economic activity to suffer a severe contraction and the unemployment rate to rise. One example is the restrictions imposed by the suspension of air traffic, demand for diesel fuel energy services is in short supply. As a result of the observed phenomena, global oil prices have dropped to their lowest level in several years (Kozicki and Gornikiewicz, 2020). Other industries' demand has been deemed to be non-essential and drastically lowered by the industry. The impacts on the economy can be observed in the stock market's volatility, an increase in unemployment insurance claims, and the closure of multiple businesses across the country (Canilang et al., 2020).

Practically every industrialized economy has seen an increase in aggregate consumption, investment, and output during the COVID-19 pandemic. Non-essential enterprises have been forced to close due to the global COVID-19 pandemic that has resulted in an extraordinary increase in the number of people infected. Numerous businesses are on the brink of insolvency by cutting off their revenue streams. Credit lines were cut, financial reserves were depleted, and employees were laid off or furloughed, which could all contribute to reductions in job opportunities, hence increasing the unemployment rate during COVID-19 (Kong and Prinz, 2020). Ruth et al. (2014) stated the impact of unemployment is a global issue that all countries must confront and address, whether it is serious or minor. A high unemployment rate, from an economic standpoint, indicates that labor availability is not being employed properly (Mandel and Liebens, 2019). Unemployment can have a variety of negative implications for the government, society, and individuals.

In Fig. 1, the GDP is the total value of goods and services generated within a country's geographic borders over a given period, usually a year. Malaysia's GDP growth rate stayed constant at roughly 4% in 2019, according to 2019 analyzed by Chong et al. (2021). Following the COVID-19 outbreak, growth declined from 3.6 percent to 0.7 percent in the first quarter of 2020. The second-quarter GDP figure was negative, falling to -17.1 percent. Furthermore, in the first quarter of 2020, Malaysia's unemployment rate remained reasonably constant, rising only slightly from 3.2 to 3.5 percent. In the second quarter, the jobless rate increased by more than 40% to 5.1 percent. If the COVID-19 outbreak is not contained, Malaysia may suffer even more job losses due to the time it takes for the economic repercussions of coronavirus to show up in the unemployment rate. The significant drop in productivity and rising unemployment rate, on the other hand, raises concerns about the economy's general stability.

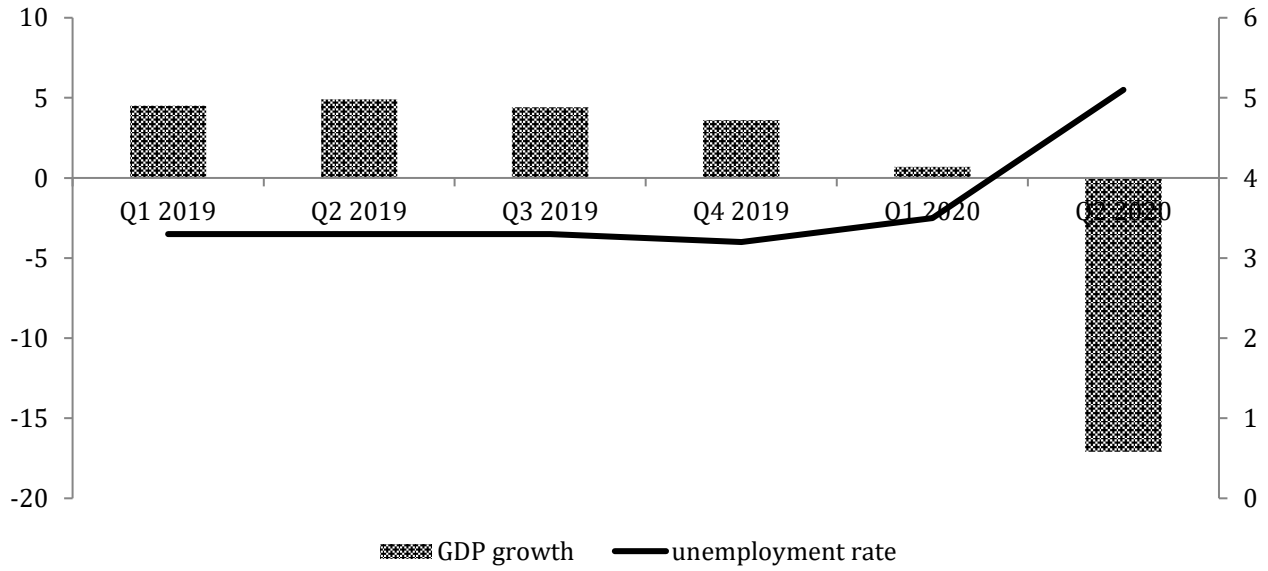

Fig. 1: Economic performance of Malaysia (Chong et al., 2021)

According to Jeroen (2009), the monetary market worth of all final products and services produced in a country over a year is referred to as GDP. The real GDP per capita is a typical metric for evaluating a country's economic situation over time or in comparison to other countries. Malaysia's GDP contracted by 5.6 percent in 2020, according to the Department of Statistics Malaysia, compared to 4.3 percent in 2019. The downturn in numerous economic sectors had an impact on Malaysia's GDP in 2020. Various Movement Control Order (MCO) stages have been in effect in the country since March 18, 2020, to combat the COVID-19 outbreak. As a result of the Malaysian economy's performance in reaction to local supply and demand issues, as well as the impact of the foreign sector, the Malaysian economy has recorded negative growth for the third quarter in a row for the year 2020 (DOSM, 2021).

A study by Noor et al. (2007), states that over the period of thirty years, there are several economic experts found a strong empirical relationship between the unemployment rate and the GDP. According to Okun's Law in Neely (2010), unemployment in the United States tends to decline by 1 percentage point for every three percentages point increase in gross domestic product, GDP. Economic growth, influenced by laws, technology, tastes, social norms, and demographics, can cause coefficients to change over time. Nevertheless, the problem cannot be tackled alone with the increasing employment rate but also other economic factors.

Fig. 2 shows the chart of the relationship between the GDP reduction rates with the unemployment rate. Especially during the global pandemic due to the COVID-19 outbreak, many countries have halted economic activities which result in a decline in the GDP rate and a significant increase in the number of employees losing their job. On top of that, even while the economy shut down in cities and regions within the U.S, some sectors and industries remain unaffected such as farming, government, hospitals, and food stores (Chien, 2020).

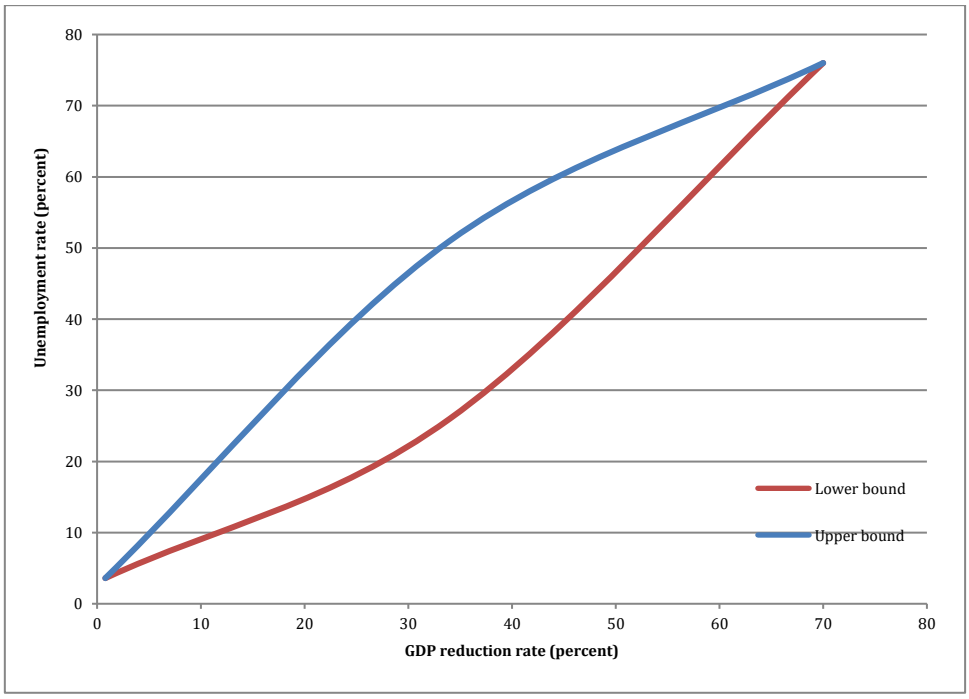

Fig. 2: Relationship between GDP and unemployment rate (Chien, 2020)

2. Methodology

2.1. Description of data

Cointegration test and error correction model are applied to the time-series data of the unemployment rate and the GDP of Malaysia within the range of the first quarter of 2010 until the fourth quarter of 2020. Therefore, secondary data used in this study were obtained from the Department of Statistics Malaysia (DOSM).

2.2. Stationarity test

The main assumption of using the cointegration test is by making sure the data series is stationary which indicates there is no sign of a growth or decline pattern. There are three methods to verify whether the data series is stationary or otherwise such as the Dickey-Fuller (DF) test, Phillips-Perron (PP) test, and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. One of the methods that are commonly used is the stationarity test, the Dickey-Fuller test but the augmented version (ADF). The ADF test has been the first statistical test designed to test the null hypothesis that a unit root is existing in an autoregressive model of a given time series and that the process is thus not stationary. ADF statistic is a negative number and the more negative the dismissal of the hypothesis that there is a unit root.

Most statistical techniques of forecasting are built on the presumption that by using mathematical transformations, the time series can be formed nearly stationary (i.e., “stationarized”). In order to

make it stationary, differencing in statistics is a transformation applied to time-series data. This makes it possible for the properties not to depend on observation time, eliminating trend and seasonality and stabilizing the time series mean. A stationary series are easier to predict and the statistical features in the future are the same as they were before (Hyndman and Athanasopoulos, 2018). Through the EViews software, the stationarity test of the augmented dickey fuller is being conducted on the time series data of the unemployment rate and GDP rate.

2.3. Cointegration test

An assumption is made in order to analyze time-series data. The process is called stationary if the variances and means of the series are constants which is independent of time. Whereas non-stationary time series do not fulfill this criterion, any hypothesis test findings will be skewed or misleading. The Engle-Granger (EG), augmented Engle-Granger (AEG), Johansen Test, and Durbin-Watson cointegrating regression (CRDW) tests are the most widely used tests for cointegration. This research is using Johansen Test to test the cointegration among the variables. The hypothesis test is as follows:

H_0: There is no cointegration exists (No long-run relationship between variables)
H_1: There is a cointegration that exists (Long-run relationship between variables)

The Johansen test is used to determine whether or not many non-stationary time series data are cointegrating. When compared to the Engle-Granger test, one of the advantages of employing the Johansen Test is that it allows for more than one cointegrating connection. Even so, because a tiny sample size would give incorrect findings, it is subjected to asymptotic characteristics. The trace test and the maximum eigenvalue test are the two primary types of Johansen's test. The presence of a cointegration connection in the sample will be revealed by both outcomes.

The objective of this test is to check if there is any long-term cointegration between the variables. Johansen's cointegration test can be used once it is confirmed that all the variables are stationary without any issues on the unit root (Rahman et al., 2017). If the variables are found to be non-stationary in their levels, this test is run with integration order 1, assuming that their first-order differences are found to be stationary. Cointegration is a mathematical notion that simulates the existence of a long-run equilibrium relationship in which variables converge over time.

2.4. Error correction model

The error correction model (ECM) is the next approach employed in this study to investigate the empirical analysis of the variables. For time series, picking the right estimate approach is critical. To avoid erroneous regression, make sure the data you're using is steady. As a result, employing the cointegration process helped to avoid the problem. The regression equation could be estimated using the Engle-Granger procedure, which consists of two steps: the first is to estimate a long-run relationship equation using ordinary least square (OLS) with variables that are integrated at the first-order level, and the second is to estimate a long-run relationship equation using ordinary least square (OLS) with variables that are integrated at the first-order level. The residuals' stationarity denotes a cointegrating relationship between the variables in the long-run equation. To see the short-run dynamics, the next step is to estimate the relevant error correction model based on the long-run cointegrating relationship (Engle and Granger, 1987). The estimation of ECM may be done using the residual from the long-run equation. Because all of the I (1) regressors are in first difference form, the ECM is based on stationary data and contains the lagged residuals of the long-run equation, which are also I (0) when the variables have a cointegrating relationship. (Engle and Granger, 1987). Empirically this can be shown as:

$$\Delta U_t = \theta_0 + \theta_1 \mu_{t-1} + \delta_1 \Delta Y_t + \varepsilon_t \quad (1)$$

where:

$$\mu_{t-1} = U_{t-1} - \eta_0 - \eta_1 Y_{t-1} - \eta_2 T$$

$$\Delta U_t = \theta^1{}_0 + \theta^1{}_1 \mu_{t-1} + \delta^1{}_1 \Delta U_t + \varepsilon^1{}_t \quad (2)$$

where:

$$\mu_{t-1} = Y_{t-1} - \eta^1{}_0 - \eta^1{}_1 U_{t-1} - \eta^1{}_2 T.$$

U_{t-1} and Y_{t-1} are regressors with one period lagged for the unemployment rate and GDP rate, respectively. T is the trend variable, whereas μ_{t-1} is the one period lagged value of the error from the cointegration equation? The above model stated that ΔU_t depends upon both μ_{t-1} and ΔY_t. If μ_{t-1} is different from zero then there will be disequilibrium.

Suppose ΔY_t is zero and μ_{t-1} is positive, this means U_{t-1} is too high to be in equilibrium, that is $U_{t-1}$is above its equilibrium value. Since θ_1 is expected to be negative, the term μ_{t-1} will be negative. Therefore, ΔU_t is expected to be negative to restore equilibrium. If U_t is above its equilibrium value, it will start falling in the next period to correct the equilibrium error. If μ_{t-1} is negative and U_t is below its equilibrium value, then $\theta\mu_{t-1}$ will be positive, which will cause ΔU_t to be positive, leading U_t to rise in period t.

3. Results and discussions

Through this chapter, the process of the cointegration test and error correction model was

applied to the unemployment rate and the GDP rate is explained.

3.1. Stationary test

A stationary test is applied to test whether the data have any pattern. Based on Fig. 3, the mean GDP and unemployment rate have not remained constant over time. This is an indicator that the data is not stationary. Hence, the augmented dickey fuller (ADF) test is applied to test the stationarity of data.

Since the unemployment rate is non-stationary, it showed underwent the first-order differencing of the ADF test to achieve the stationarity of the dataset where it stabilizes the time series data by reducing the trend and seasonality. Thus, the output for the augmented dickey fuller test on the unemployment rate after differencing is significant where the p-value is less than 0.05.

Meanwhile, the ADF was being tested on the GDP in Malaysia from the first quarter of 2010 until the fourth quarter of 2020 to make sure the dataset is stationary and significant before proceeding with the objective of the study which is to compare the dataset of the unemployment rate and the GDP in Malaysia. The output of the ADF test in Table 1 shows the GDP in Malaysia is significant as the p-value is equal to 0.0218 is lower than the significance value, 0.05.

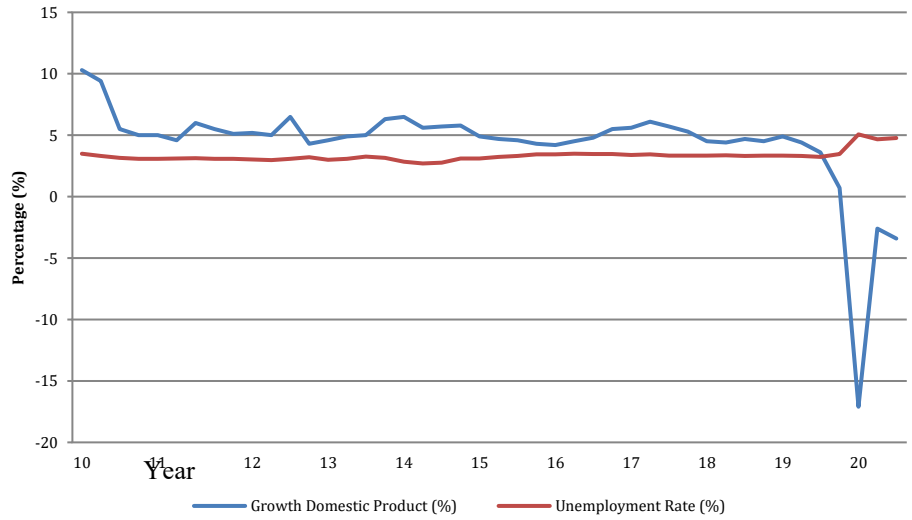

Fig. 3: The GDP and unemployment rate according to year

It is one of the requirements to apply cointegration where both datasets need to undergo the same level of differencing order. Therefore, the GDP dataset is being tested for first-order differencing to match the level differencing of the unemployment rate. As result, the GDP is shown significantly in Table 1 with the p-value equal to zero lower than the significance value, 0.05. Therefore, the GDP is identified as stationary in the first-order differencing. After the variables are stationary in the first differences, an estimation of the model can be made.

Table 1: Augmented dickey-fuller (ADF) test

Variables	Test	t-statistics	p-value	t-Statistic	p-value
		Levels		First difference	
Real GDP Growth	ADF	-3.285083	0.0218	-9.515317	0.0000
Unemployment Rate	ADF	-0.794315	0.8106	-6.908937	0.0000

3.2. Cointegration test

A cointegration test is conducted to determine if there was a long-term relationship existing between GDP and the unemployment rate.

Thus, an examination of the cointegration test results reveals that both eigenvalue and test statistics are at this level greater than 0.05 critical value respectively. Based on the hypothesized number of cointegration equations, the first row of Table 2 shows none* means there is a likelihood of rejection of the hypothesis at 0.05 level. The trace statistic in the first row of the hypothesis, 25.90339, is greater than the critical value, -3.596616, which implies that there is a cointegration equation exists in the model. Looking at the second row, at most 1, the value of trace statistics is more than the critical value, showing that at the 0.05% level, the null hypothesis failed to be rejected.

Given the findings, the null hypothesis of the cointegrating equation is rejected at the 5% level, implying that the variables have a long-term association. The results indicate that existence of cointegration between the GDP and unemployment rate since one of the probabilities (p-value) is less than 0.05. In other words, a long-run relationship existed among the variables, and estimating an error correction model is necessary. Mandel and Liebens (2019) discovered that the unemployment rate has had a negative relationship with GDP over the past

fifty years. This research, however, was undertaken prior to the Covid-19 outbreak. Table 2 shows the Cointegration test.

Table 2: Cointegration test

Unrestricted cointegration rank test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value	Prob.
None*	0.435542	25.90339	-3.596616	0.0075
At most 1	0.043866	1.884023	9.164546	0.8007

*: A likelihood of rejection of the hypothesis at 0.05 level

3.3. Error correction model (ECM)

The short-run model is built using the error correction model (ECM). To begin, the long-run connection between GDP and unemployment rate is estimated using the ordinary least square (OLS) method using quarterly data from 2010 to 2020. Table 3 shows the estimated long-run model equation:

$$\widehat{GDP}_t = 27.52310 - 6.978001\ UNEMPLOYMENT\_RATE_t$$

The estimated coefficient of -6.978001 of the unemployment rate showed negative and statistical significance. This means that a 1% increase in the unemployment rate will decrease the GDP rate by 6.98%. This is in line with the work of (Chien, 2020) regarding the influence of this variable on GDP growth in Malaysia.

Table 3: Long-run model estimation result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEMPLOYMENT_RATE	-6.978001	0.798365	-8.740370	0.0000
C	27.52310	2.677853	10.27805	0.0000

Next, the ADF test conducted on the residual of the long-run model indicates that the data is stationary implying cointegration between the unemployment rate and GDP. The estimation of the short-run model can be made using the residual from the long-run equation. The short-run equation contains a different form of the unemployment rate (regressor) and the lagged residuals as given in Table 4.

$$\Delta GDP_t = -0.021278 - 11.41660\ \Delta UNEMPLOYMEN\_RATE_t - 0.716623 ECM_{t-1}$$

Table 4: Short-run model estimation result (ECM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UNEMPLOYMENT_RATE)	-11.41660	0.857351	-13.31612	0.0000
ECM (-1)	-0.716623	0.100921	-7.100802	0.0000
C	-0.021278	0.234340	-0.090799	0.9281

In the short run, the coefficient estimate for the unemployment rate is -11.41660 and is statistically significant. The estimated coefficient of ECM is -0.716623 which is good since it lies between -1 and 0. Besides, it is statistically significant since the p-value is less than 0.05. This means that 71% correction is made from short run to long run. Therefore, the ECM is appropriate to include in the long-run model hence indicating there is cointegration between GDP and unemployment rate.

4. Conclusion

The study examined the influence of the unemployment rate on GDP in Malaysia from 2010 to 2020. The long-run model was evaluated using the ordinary least square (OLS) approach and the short-run model was estimated using the error correction model (ECM). The augmented dickey fuller (ADF) test was used to conduct a test of stationarity and run the cointegration test. The variables including the dependent variable were found to be stationary at the first-order differencing by respective tests. The cointegration test follows revealed that the variables had a long-run relationship. The accompanied empirical findings in this work also showed that the unemployment rate impacted GDP in the short run.

The study confirms that one of the essential factors of GDP growth is the unemployment rate. In this COVID-19 pandemic, the unemployment rate raised due to the new economic policies and it is uncontrollable. May this problem solve once the pandemic is cured.

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Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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