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Fitting Cobb-Douglas function in modelling the impact of COVID-19 on the Malaysia's economy

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Abstract:

Early in 2020, many nations around the world are introducing measure to slow the spread of COVID-19 from national quarantine regulations, restricted international and domestic movements to businesses closures. More than a year after the first case of COVID-19 entered Malaysia on 23 January 2020, Malaysia is still on a full-fledged fight against this pandemic. At present, there were more than 300 thousand cases of infection and more than 1 thousand fatalities. Some restrictive measure is still in place in Malaysia since the fight to level the third wave of COVID-19 was still ongoing. The second quarter of 2020 revealed a significant downturn in economic activity around the world, as well as in Malaysia. This study proposes to evaluate the development of Malaysia's economy as well as to fit a model in order to assess the impact of the COVID-19 health crisis on labour market by fitting into the Cobb-Douglas production function.

Keywords:

Labour; economy; Cobb-Douglas function; forecast

1. Introduction:

The year 2020 has been an unprecedented roller coaster ride after the first case of COVID-19 entered Malaysia on 23 January 2020, the country is still on a full-fledged fight against this pandemic. The first wave of infection occurred as the number of cases increased to 22 cases by 16 February 2020. After successfully containing the pandemic from spreading in the community, the appearance of the second wave on 27 February 2020 prompted Movement Control Order (MCO) since 18 March 2020. One of the restrictions imposed by the government was the closure of non-essential services, which comprised the major part of economic sectors, including education-related activities.

For the first three months, as businesses could no longer operate as usual, the labour force was affected following limited working hours, job rotation, and consequent reduction in income. Then, with fewer new cases recorded daily and the pandemic situation was more in control, economic activities started to resume in line with the implementation of Conditional MCO (CMCO) starting on 4 May 2020. Strict standard operating procedures continued to be imposed on businesses while inter-state and inter-district travel remained prohibited. Since the implementation of Recovery MCO (RMCO), which started on 10 June 2020, most economic sectors have gradually resumed. Toward the end of 2020, the fight to level the third wave of infection was still ongoing. The government and private sectors continued to work hand-in-hand to strike the equilibrium between life and livelihood. Thus, this study aims to evaluate the development of Malaysia's economy and fit a model to assess the impact of the COVID-19 health crisis on the labour market by fitting into the Cobb-Douglas production function.

2. Methodology

In economics, a production function relates the physical output of a production process to physical inputs or factors of production, i.e., labour and capital. It is mathematical modelling that correlates the maximum amount of output that can be obtained from a given number of inputs.¹ The Cobb-Douglas production function (1928) is an economic production function with two or more variables as inputs that describe a firm's output. The Cobb-Douglas production function formula for a single good with two factors of production is formulated as follows:

$$Y = AL^{\beta_1}K^{\beta_2} \quad (1)$$

where the output or total production of an economic sector (Y) depends on the factor productivity (A), labour input (L) which indicate the total number of worker that went into the production and capital input (K) which shows the quantity of capital that used during production. The coefficients β^1 and β^2 represent the output elasticity of labour and capital, respectively. The Cobb-Douglas production function clearly not a linear model. Basically, linear functions are helpful in economic modelling because a solution can easily be found. Hence, a nonlinear function can be transformed into a linear model using logarithmic transformation (Amuka et al, 2018; Prajneshu, 2008), turning it into a straight line and then using a linear regression model. Taking log on both sides of Equation (1), the function transforms to a log-linear form as:

$$\ln Y = \ln A + \beta_1 \ln L + \beta_2 \ln K \quad (2)$$

Analysis was carried out using annual time series data for Gross Domestic Product (GDP), employment and Gross Fixed Capital Formation (GFCF) for Malaysia for the period of 2008-2020. These data published by the Department of Statistics Malaysia (DOSM) were used to represent production, labour, and capital variables respectively. In the first instance, Equation (2) was fitted to data using the method of least squares. Further analysis will include an estimation of labour & capital elasticity and the return to scale parameters. Lastly, Equation (1) was fitted to the data using nonlinear estimation procedures in order to build the production model.

3. Result

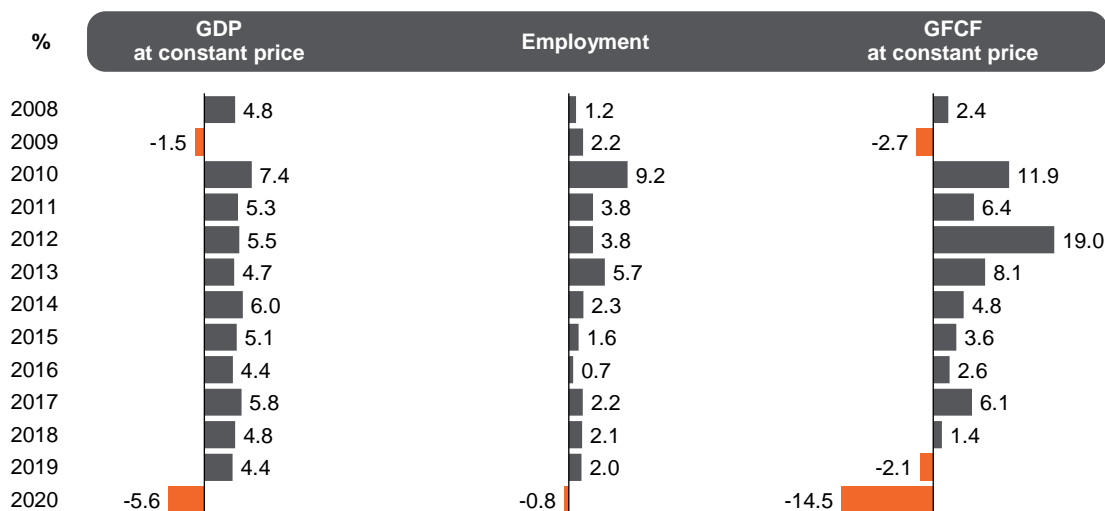
Overall, the COVID-19 pandemic that hit the whole country has also affected Malaysia's economy. GDP for 2020 declined 5.6 per cent compared to positive growth of 4.4 per cent in 2019 due to the restrictions on economic activity resulting from the containment measures in response to the COVID-19 pandemic (DOSM, 2021c). The last seen decline in Malaysia's economy was in 2009, which was negative 1.5 per cent due to the Global Financial Crisis (GFC) 2008. All the five main economic sectors registered a drop in correspondence with a highly challenging domestic operating situation and lower global demand.

In terms of capital, the investment on the fixed asset, known as Gross Fixed Capital Formation (GFCF), contracted 14.5 percent in 2020 due to the decline in all types of assets, namely Structure, Machinery & equipment, and Other assets. The trend of time series GFCF declined was observed since 2019. The GFCF plays a significant role in producing future national output. The reduction in GFCF may lead to a lower capacity for future production. The reduction in investments leads to a lower production capacity in the future and thus has implications for potential output (DOSM, 2021c).

¹ What is a production function in economics? <https://askinglot.com/what-is-a-production-function-in-economics>

From the labour perspective, employment posted a marginal decline of 0.8 percent to 15.0 million persons in 2020 following the health crisis and the subsequent economic ramification during the year (DOSM, 2021a). Before this, employment increased by 2.0 and 2.2 percent for the period of 2017 to 2019. [Chart 1]

Chart 1: Annual percentage change of GDP, employment and GFCF, Malaysia, 2008-2020



Source:
DOSM (2021a & 2021c)

The estimates of Cobb-Douglas production function such as the labour and capital elasticity, the returns to scale parameters, the standard errors, and the proportion of the variance for a dependent variable that is explained by an independent variable or variables in a fitting model² summarized in **Table 1**.

Table 1: Summary of Fitting Cobb-Douglas function

Labour elasticity β^1	Capital elasticity β^2	$SE(\beta^1)$	$SE(\beta^2)$	Return of scale $(\beta^1 + \beta^2)$	R^2
2.7501	0.4731	0.5181	0.1680	3.2232	0.9456

Note: Author's calculation based on the data from DOSM

The estimated results clearly demonstrate that the economy in Malaysia generally seems to underlie the case of increasing returns to scale, i.e., a unit increase in either labour or capital input causes output to grow at a more than 1 percent rate. Malaysia's economy exhibits a very high significance of R^2 , which the model in Equation (2) is fitted the data very well.

In order to forecast the production, it was noted that all the standard errors were much more minor compared to the respective estimates. So, the parameters had been estimated efficiently. The fitted model can be written down straightforwardly, but the expression is very cumbersome (Prajneshu, 2008). However, for academic interest, its equivalent form, on using Equation (1), as Equation (3):

$$Y = 0.0536L^{2.7501}K^{0.4731} \tag{3}$$

² R-Squared Definition, <https://www.investopedia.com/terms/r/r-squared.asp>

4. Discussion and Conclusion

This study brings out a quantitative review of the impact of the COVID-19 pandemic on Malaysia's economy. COVID-19 pandemic has affected economies throughout the world. According to the World Bank (2020), the global GDP forecast in 2020 will shrink by 5.2 per cent, and it is proven that Malaysia's GDP declined by 5.6 per cent in 2020. Despite imposing the most stringent lockdown, Malaysia still on a full-fledged fight against this pandemic. Looking at the 2021 situation, the number of COVID-19 new cases continued to register a spike exceeding an average of 3,200 cases daily in January 2021. To balance the health and economic interest, most economic activities were allowed to comply with strict standard operating procedures. Additionally, Government has initiated Perlindungan Ekonomi dan Rakyat Malaysia (PERMAI) to support the survival of businesses.

Besides that, empirical results from this study show a strong relationship between the input and output variables. The relationship shows that by increasing the amount of labour and capital, production can be increased. Moreover, the labour input is relatively higher, so the labour intensive technique is a more useful tool than the capital intensive technique in the production process in Malaysia. However, as physical distancing is becoming a new norm, many non-essential industries opt for working remotely to sustain productivity. Businesses and even government agencies were pushed to adopt various technological solutions to continue their operations (DOSM, 2020c). Hence accelerating adaptation of digitalisation as a solution for businesses to remain resilient and subsequently increase the number of goods and services produce besides creating more skilled jobs.

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