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The Effects of Capital, Labor and Electricity Consumption on Economic Growth in Malaysia

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ABSTRACT

Capital and labour are common factors of production in boosting the economic growth. Apart from that, electricity consumption is a vital key to most industry sectors. However, there are very limited studies which consider this factor in the analysis particularly in Malaysia. Therefore, this study aims to investigate the effects of capital, labour and electricity consumption on economic growth in Malaysia using data period of 1982-2017. The autoregressive distributed lag bound testing approach was employed and the results reveal the significant effects of capital and electricity consumption on economic growth both in the short runs and the long runs. However, there is no significant effect of labour on economic growth in Malaysia for both short runs and long runs. The results may provide more understanding of prevalent factors of production that affects economic growth and can be a guideline for policy makers to boost the economic growth in Malaysia.

Keywords: Capital, Labour, Electricity Consumption, Economic Growth, Autoregressive Distributed Lag
JEL Classifications: O40, O44, Q4

1. INTRODUCTION

Economic growth is considered as one of the economic policy strategy and act as a signal to the efforts made to improve economic performance of a region (Iskandar et al., 2017). Economic growth shows an increase in the production of goods and services in an economy and it is a vital indicator in conducting an economic development analysis (Nuraini, 2017). Generally, economic growth plays a crucial role in fostering the standard of living and welfare of the people (Zumaidah and Soelistyo, 2018).

Capital accumulation is often suggested as a tool for developing countries to rise their long-term growth rates (Ajose and Oyedokun, 2018). Economic growth will only be possible if there is a sustained increase in the stock of national capital as a result of large public and private investment (Onyinye et al., 2017). Ali (2017) asserts that capital helps the improvement in technology and facilities in trade transaction that results in higher foreign exchange can expand the non-developed economic sectors. Apart from that, human capital or as known as labour is a common driver of economic growth used by many countries (Sharma, 2019). Recently, the supply of higher number of more technical education format ensues in higher number of skilled worker to boost the gross domestic product (GDP) growth (Haque et al., 2019).

Undeniably, capital accumulation and human capital are the key factor in boosting the economic growth in most countries including Malaysia. Skill labour can improve productivity and boost to economic growth of a country (Ali, 2017). Labour productivity is one measure of labour efficiency in producing output. However, these two factors solely are insufficient to explain the effects of production on economic growth. Energy consumption is one of the other intermediate inputs that can equally affect production and economic growth theories (Costantini and Martini, 2010; Shahbaz and Ali, 2016; Thaker et al., 2019). However, Ghali and El-Sakka (2004) and Xuan et al. (2018) advocated that energy consumption seems as a restrictive factor for economic growth.

In order to make the 2030 Agenda a reality, the sustainable development goals (SDGs no. 12) is to achieve the sustainable management and efficient use of natural resources. Hence, electricity consumption is of interest because electricity consumes natural resources and its shortages may cause serious distortions to the GDP and subsequently destabilize a country's economy (Shahbaz and Ali, 2016). In 2017, the industry sectors in Malaysia has highly contributed 48% of electricity consumption (Department of Statistics Malaysia, 2017). Due to this fact, this study is trying to fulfil the gap by employing the ARDL method in investigating the effects of electricity, labour and capital on the economic growth in Malaysia. Therefore, this study seeks to assess the effects of labor capital, labour and electricity consumption as the determinants of economic growth.

2. LITERATURE REVIEW

The impact of capital, labour, and energy use on economic growth have been studied in various studies (Abokyi et al. 2018; Fang and Liu, 2019; Ismail et al., 2017). Most of the previous studies used Granger's causality test to examine the effects of capital, labor and electricity consumption on economic growth (Ameyaw et al., 2016; Okorie and Manu, 2016; Zhao et al., 2016). In the context of the developed countries, Churchill and Ivanovski (2020) have used ARDL and Granger causality to examine the long-term and short-term relationship between electricity consumption, labor and economic output capital in seven Australian states over the period 1990-2015. The results reveal that in short run and long run, electricity consumption is positively influenced to gross state product, and the growth effect also extend to traditional inputs such as capital and labour. The result also shown the bi-directional causality between state economic growth and capital, labour and electricity consumption, emphasizing the importance of capital and labour as well as electricity consumption in the growth process.

Similarly, Fang and Liu (2019) investigated the impact of electricity consumption in China's major economic regions by adopting the general divisional index model. The results show that all three quantitative factors have a stimulating effect on electricity consumption, with capital having the greatest effect on electricity consumption. Zhao et al. (2016) also examined the effect of GDP, electricity consumption, total investment in fixed assets, and employment for six provinces in North China, including Beijing City, Tianjin City, Hebei Province, Shanxi Province, Shandong Province and Inner Mongolia from the timeline of 1995 to 2014. The cross-sectional dependence test, Padroni's panel co-integration test and Granger Causality test were used and the study found that the capital contributed the most to real GDP growth and followed by electricity consumption. The contribution of labour force inputs to GDP growth is relatively large in regions where economic growth is less developed and dependent on heavy industry. Moreover, the result of Granger causality test discovered the bi-directional causality run between the electricity consumption and the real GDP in six provinces except Hebei, and there is a bi-directional relationship between capital and economic growth as well as labour force input and economic growth except for Beijing and Hebei.

Studies on developing countries such as Abokyi et al. (2018) who explored the relationships between capital, labour and electricity consumption and economics growth in Ghana by employing ARDL approach for the period of 1971-2014. The findings showed that labour force and electricity consumption negatively affect the industrial growth while trade openness and capital formation were found to impact industrial growth positively. It is recommended for Ghana government to increase public investment on capital goods and international trade through a progressive reduction of trade barriers as to promote industrial growth in Ghana. However, the labour sector need to be emphasized on human resource development.

Besides, Ameyaw et al. (2016) also examined the electricity consumption-economic growth nexus for the case of Ghana over the period of 1970-2014 based on the Cobb-Douglas growth model by using Vector Error Correction Model and Granger Causality. The findings disclosed the existence of long-run equilibrium co-integration among output, labour, capital and electricity consumption. While the result of Granger causality showed a unidirectional causality from GDP to electricity consumption. This implies the fact that Ghana is a less energy-dependent economy and thus electricity conservation policy is favourable for the Ghanaian economy.

Furthermore, Ogundipe and Apata (2013) investigated the relationship between electricity consumption and economic growth in Nigeria for the period of 1980-2008. This study employed Johansen and Juselius co-integration technique, Vector Error Correction Modelling and the Pairwise Granger Causality while Okorie and Manu (2016) extended the study by using the Johansen co-integration and VAR-based techniques for the period of 1980-2014. Due to the outcome of inelastic impact of electricity consumption on growth, both authors found that electricity consumption contributes greatly to the growth of Nigerian economy both in the short and long run. It is suggested for Nigeria government to increases daily generation of power as to cater the increasing demand for power by having more plant stations.

For ASEAN countries, Ismail et al. (2017) investigated the relationship between capital, labour and electricity consumption on economics growth for the period of 1983 by using advanced panel estimation approaches to examine relationship among variables. The results indicate that no causality in the short run while there is a bidirectional relationship among variables in the long-run. Rezitis and Ahammad (2015) also used the same method who examined the nine South and Southeast Asian countries like Bangladesh, Brunei Darussalam, India, Indonesia, Malaysia, Pakistan, the Philippines, Sri Lanka, and Thailand by using data set from 1990 to 2012. However, the Granger causality test results indicated uni-directional causality from energy consumption, GFC and labour to GDP. The authors believed that economic growth is basically motivated by the energy consumption. In short, this present study is motivated by noticing that previous studies on electricity consumption and economic growth in Malaysia is still handful and no previous studies used the ARDL approach in their analyses.

3. METHODOLOGY

This study used data for GDP, Capital (K), Labour (L) and electricity consumption (EC) for the period of 35 years from 1982 to 2017. Data for GDP and capital formation (K) were collected from the World Development Indicators of World Bank while data for labour (L) and electricity consumption (EC) were extracted from Department of Statics Malaysia and Malaysia Energy Information Hub (MEIH) respectively. Several tests will be conducted such as unit root test namely as Augmented Dickey Fuller (ADF) test, ARDL or bound test for cointegration and diagnostic tests. All the variables were then transformed into natural logarithms for a linear estimation. Therefore, the model specification for this study is shown as follows;

$$\Delta \ln GDP_t = \beta_0 + \beta_1 \ln GDP_t + \beta_2 \ln K_t + \beta_3 \ln L_t + \beta_4 \ln EC_t + \varepsilon t \quad (1)$$

Where $\ln K_t$, $\ln L_t$, and $\ln EC_t$ represents log of Capital, log of Labour, and Log of electricity consumption respectively is error correction terms and *t* is period of time. In order to see the cointegration among the variables, ARDL or bound test need to be conducted. The bounds test is relatively more efficient in small or finite sample data sizes as compared to cointegration test proposed by Johansen and Juselius (1990) which requires a large sample size (Pesaran et al., 2001) is suitable for this study. ARDL model also provides the Wald test (F- stats), which help in identifying the long run relationship among all the variable. If the F-statistic is higher than the critical value for the upper bound, there is a long-run relationship. Conversely, if the F-statistic is below the lower bound then there is no long-run relationship. On the other hand, if the F-statistic is between the upper critical bound and the lower critical bound the results are inconclusive (Pesaran et al., 2001). Therefore, the equation 1 can be rewritten as follows;

$$\Delta \ln GDP_t = \beta_0 + \beta_1 \ln GDP_{t-1} + \beta_2 \ln K_{t-1} + \beta_3 \ln L_{t-1} + \beta_4 \ln EC_{t-1} + \sum_{i=1}^{p} \Delta \ln GDP_{t-i} + \sum_{j=0}^{q} \beta_j \Delta \ln K_{t-j} + \sum_{k=0}^{r} \beta_k \Delta \ln L_{t-k} + \sum_{l=0}^{s} \beta_l \Delta \ln EC_{t-1} + \varepsilon t \quad (2)$$

where p, q, r and s refers to the lag length of respective variables. To estimate the short-term coefficients and adjustment speed, ARDL equation for error correction model (ECM) can be represented by rewrite equations (3) the following equation:

$$\Delta \ln GDP_t = \gamma_0 + \sum_{i=1}^{p} \delta_i \Delta \ln GDP_{t-i} + \sum_{j=0}^{q} \delta_j \Delta \ln K_{t-j} + \sum_{k=0}^{r} \delta_k \Delta \ln L_{t-k} + \sum_{l=0}^{s} \delta_l \Delta \ln EC_{t-1} + \lambda ECT_{t-1} + \varepsilon t \quad (3)$$

where ECT_{t-1} is the difference of one period following the long-term equation of equation (3) between dependent and independent variables. If the error correction value (ECT_{t-1}) is negative as well as significant, it indicates a cointegration (or long-term relationships), and λ measures speed adjustment to equilibrium position. A negative value for λ indicates that the model stable and any deviation from the equilibrium will corrected in the long run. According to the Pesaran et al. (2001), the existence of error correction models indicates co-integration with variables. Therefore, long-term relationships are legal and independent from the problem of false regression.

4. FINDINGS

Table 1 represents the unit root test results based on Augmented Dickey Fuller (ADF) test at level and first differentiation with intercept and intercept with trend. For all variables, the result shows that under the intercept, it is not significant at the level and significant at first difference. However, under intercept and trend, only LNEC is not significant at both level and at first difference.

To detect the presence of cointegration among the variables, bound or ARDL test is required. Tables 2 shows that F-statistical test is significant at the 1% level. The results show that F-statistic value is 24.2088, where the value is significantly higher than the upper bound value at 10% (3.532), 5% (4.194) and 1% (5.816) level of significance. Therefore, it can be concluded that there is a co-integration or long-term relationship between GDP (LNGDP), capital (LNK), labour (LNL) and electricity consumption (LNEC).

Since there is a long run relationship between the variables, Table 3 shows the result of long-run estimation. The results show that capital (LNK) has positive and a significant impact on the GDP at 1% significance level. The coefficient value is 0.2982. This means that an increase of capital by 1% will increase the GDP by 0.2982% in the long run. Thus, it proves that the capital stimulation is vital to boost economic growth in Malaysia.

Table 1: Unit root test

Variables	Intercept		Intercept and trend	
	Level	First difference	Level	First difference
LNGDP	−1.0773 (0.7138)	−4.8126 (0.0025)***	−1.2379 (0.8866)	−4.7855 (0.0005)***
LNK	−0.7555 (0.8192)	−4.1154 (0.0139)**	−1.7171 (0.7222)	−4.1817 (0.0025)***
LNL	−0.7603 (0.8179)	−4.8773 (0.0021)***	−3.5836 (0.0474)**	−4.9431 (0.0003)***
LNEC	−3.2156 (0.0305)**	−4.3848 (0.0094)***	−2.4432 (0.3509)	−2.2625 (0.1910)

***, ** and * indicates 1%, 5% and 10% significance levels

Table 2: Bound test

	F-statistics	
	24.2088***	
	Critical value	
Significance level	Lower bound	Upper bound
10%	2.618	3.532
5%	3.164	4.194
1%	4.428	5.816

***, ** and * indicates 1%, 5% and 10% significance levels

Table 3: ARDL long-run estimation (2, 1, 0, 1)

Variables	Coefficient	T-statistics	Prob.
LNK	0.2982***	2.4285***	0.0024***
LNL	0.4606	1.6935	0.1023
LNEC	0.2957***	3.2226***	0.0034***
C	9.6837***	3.0856***	0.0048***

***, ** and * indicates 1%, 5% and 10% significance levels

Table 4: ARDL short run Estimation (2, 1, 0, 1)

	Coefficient	T-statistics	Prob.
LNK (−1)	0.0601***	3.6317***	0.0012***
LNL	0.0929	1.1438	0.2631
LNEC (−1)	0.0596*	1.7384*	0.0940*
ECT (−1)	−0.2016**	−2.5267**	0.0179**
R2=0.9995	ADJUSTED R2=0.9993		DW=1.9095

***, ** and * indicates 1%, 5% and 10% significance levels

Next, labour (LNL) does not has significant impact on GDP at any significant level. The probability is 0.1023 and coefficient value is 0.4606. This means that the amount of labour does not affect economic growth rate in the long run. Lastly, electricity consumption (LNEC) has positive and significant impact on GDP at 1% significance level as the probability value is 0.0034. The value of the coefficient 0.2957 shows that in the long run, when electricity consumption increases by 1%, then the GDP will increase by 0.2957%. It proves that the effectiveness of the government in regulating the electricity policies and the efficiency of private sectors in electricity consumption can stimulate economic growth.

Table 4 shows the results of short-run estimation. The result shows that change value of capital (LNK) positively affect GDP at 1% significance level. This means 1% increase in capital will increase GDP as much as 0.0601%. In addition, it can be inferred that change in value of labour (LNL) has no effect on economic growth. This means the amount of labour does not reflect the rate of economic growth. Therefore, to promote economic growth, the Malaysian government must encourage the production of labour-power in terms of skill and productivity. In the meantime, electricity use (LNEC) has an important and optimistic effect on economic growth at a high level of 10%. This indicates that energy demand rises by 1% to increase GDP by 0.0596%. The negative ECT value means that the model should be balanced on an annual basis. In the short term, economic growth will be adjusted by the deviation from the balance of the previous year. This ensures that the deviations from the long-term equilibrium between variables are adjusted by 20.16% within a year.

Table 5: Diagnostic test

Test statistics	F-statistics (Prob.)
Jarque-Bera	4.5311 (0.1038)
Breusch-Godfrey serial correlation	0.1583 (0.8545)
Heteroscedasticity test	1.0955 (0.3948)
Ramsey RESET stability	0.0729 (0.9425)

Figure 1: Cumulative sum of recursive residual

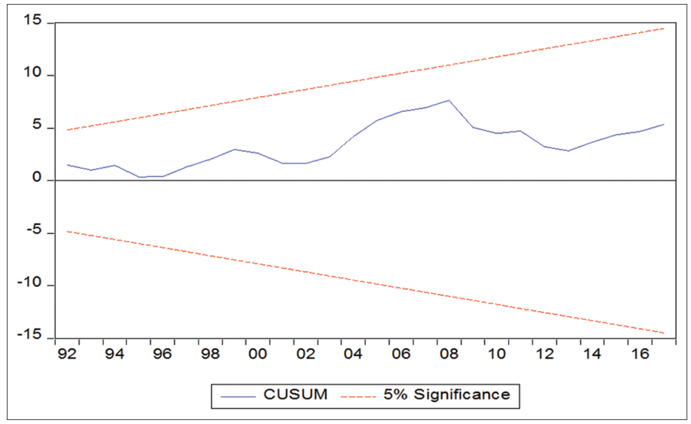
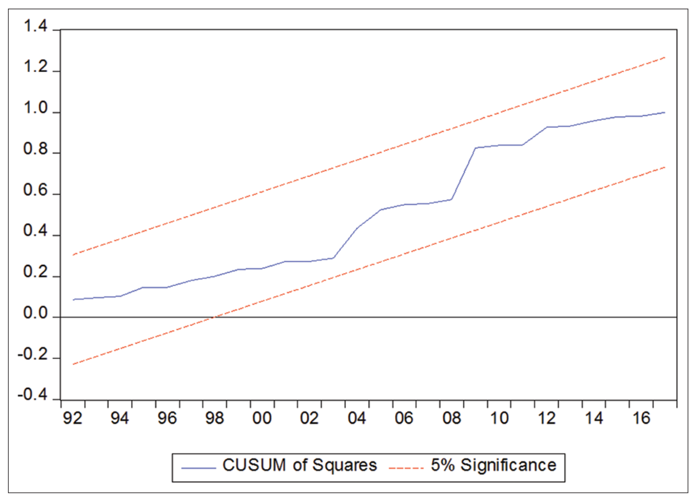


Figure 2: Cumulative sum of square of recursive residual



After estimating the ARDL model, it is important to evaluate the goodness of the model by testing the model for problems of heteroscedasticity, autocorrelation, distribution of normality, reliability of the functional form and stability. This study therefore carried out a diagnostic and stability test and the results are presented in Table 5. Several diagnostic tests such as the Breusch-Godfrey Serial Correlation LM test, the Breusch-Pagan-Godfrey-based Heteroskedasticity test and the Ramsey Reset test are carried out. The findings show that all diagnostic tests display no significance. It can be concluded that the model is good.

The Cumulative Sum of Recursive Residual (CUSUM) and The Cumulative Sum of Recursive Residual (CUSUMSQ) are shown in Figures 1 and 2. Based on the figure, it can be seen that the plots fall inside the boundary, suggesting that the model is stable.

5. CONCLUSION

This study aims to investigate the effects of capital, labour and electricity consumption on economic growth in Malaysia using data period of 1982-2017. The bound test is employed and there is an existence of a co-integrated relationship between capital, labour and electricity consumption and economic growth. The results estimation using ARDL is performed and the results show that capital and electricity consumption can be the determinants of economic growth in both short runs and long runs. However, labour does not have any significant effect on the GDP in this study possibly due to the use of total labour force as proxy for labour and this may due to not all labour forces contribute to the economy growth. According to Department of Statistic Malaysia, labour force consist of 96.6% of employment and 3.4% of unemployment in 2017. This implies that 3.4% of unemployment does not contribute to GDP in Malaysia. Besides, Khalid and Syazwani (2018) stated that different researchers might found different results because different time period and different countries. Based on the findings, policy makers should strive to encourage industry sectors and facilitate research and development (R&D) spending aimed at meeting increasing demand for electricity and embracing more advanced production and energy-saving technologies. In addition, policymakers in Malaysia should increase the social and economic infrastructure expenditure in order to increase the output of the labor force and improve productivity, which will help to boost Malaysia's economic growth.

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