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THE IMPACT OF DISAGGREGATE ENERGY CONSUMPTION ON SECTORIAL OUTPUT IN MALAYSIA

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Abstract-This study aims to investigate the impact of oil, gas and electricity consumption on agricultural, industrial, and transportation output. Data from 1990 to 2014 were analysed using several tests, namely FMOLS, DOLS, PMG and MG. The results show that an increase in energy consumption can help boost economic growth in the long run in Malaysia. Specifically, all energy types (oil, gas, and electricity) can affect aggregate output in the long run. In the short run, this study found that oil consumption plays an important role in determining aggregate output. However, this study found that other energy types do not have a significant effect on aggregate output in the short run. Gas consumption can influence output in the industrial sector and transportation sector in the short run. Electricity and oil consumption does not play an important role in determining output in all sectors in the short run. These findings are important to formulate policies to reduce environmental degradation.

Keywords: Oil Consumption, Gas Consumption, Electricity Consumption, Sectorial Output, Energy, Industrial Sector and Transportation Sector.

1. INTRODUCTION

Several factors can influence economic growth such as FDI [1] and energy consumption [2]. Energy acts a catalyst for economic development. In the absence of sufficient energy supply may cripple economic activities. Thus, it is of the utmost importance in production. Due to the fact that many countries are heading towards developing their economies, energy supply remains unpredictable as energy sources such as oil, gas and coal can be exhausted [3]. If energy remains scarce, it can pose a great challenge to all countries to manage their limited resources efficiently. Increasing demand for energy, especially in emerging economies such as China and India have set alarm bells

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ringing. They are struggling to meet the rising demand.

The importance of energy in the economy has been evidenced by a large number of previous studies such as [4] [5].[6] stated that energy is used for economic development as it generates economic activities. [7] found that in upper and lower-middle income countries, energy consumption is the determinant of national output. Thus, a rise in energy can expand the economy. [8] used several types of energy sources such as oil and electricity as the proxy of energy, and determined which energy will influence national output. It was found that national output hinges on several sources of energy. Therefore, exhaustion or reduction of any type of energy can disrupt national output.

Nevertheless, its consumption can create environmental problems as it can produce CO2 emissions [9]. Therefore, a policy to reduce energy consumption as well as CO2 emission should be formulated with much attention on both economic development and the environment. [10] found that coal and other low quality energy consumption should be limited in order to preserve the environment as their consumption can have deleterious effects on the environment. Therefore, the consumption of energy should be reduced to conserve the environment. However, this reduction can pose damaging effects on national output.

According to [11], policies to reduce energy are complex if the results show that national output hinges on energy. In addition, [12] stated that increasing more energy to enhance national output can have an unfavourable effect on the environment as it can cause CO2 emission to escalate. [13] stated that energy conservation policies can be formulated if energy consumption has no effect on the economy.

In Malaysia, the transportation sector is the largest energy consumer compared to other sectors in 2012. If there is a reduction in energy consumption, it can hinder the transportation sector in Malaysia, thus disrupting the national output. The industrial sector is an important sector in Malaysian gross domestic product. This sector relies on various types of energy sources. Any reduction in energy consumption definitely affects this sector and thus can dampen the economy as this sector makes up the second largest share of gross domestic product. The agricultural sector consumes relatively less amount of energy, but it is still an important sector as it contributes to large employment especially in rural areas [14]. In addition, Malaysia still needs this sector for food security and supply of essential food as it is still not self-sufficient. Therefore, all of these sectors are indispensable for the economy. Sufficient energy consumption is important to ensure that Malaysia can be developed by the year 2020. Therefore, this study aims to investigate the effects of energy consumption such as oil, gas and electricity on sectorial output, particularly agriculture, industry and transportation in Malaysia.

2. LITERATURE REVIEW

The debate pertaining to the association between energy consumption and national

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output has long been addressed by energy analysts and economists all over the countries (see [15]; [16] and [4]; [17]; [18]; [5]). Exemplifying such studies are the ones conducted in the United States by [15], Stern [16], [4] and [17] using different analyses; namely the co-integration analysis, Vector Error Correction Model (VECM) and Vector Auto-regression (VAR). [15] first investigated the connection between energy input and GNP in the United States in the period 1947 to 1974. Based on the Sims causality test, the findings showed that a rise in GNP causes energy consumption to rise simultaneously. However, GNP does not include all outputs produced within the country, as it does not consider output produced by foreign labour. Instead, it includes all output produced by the country's citizens regardless of where they are.

The lacking premise in the work of [15] has paved [16] to explore the connection between GDP and energy consumption in the United States in the period 1947-1994. Employing the VAR model and treating labour and capital as other factors of national output, the preliminary results showed that any change in energy consumption does not affect GDP. However, when energy consumption was adjusted for changing fuel composition, the results indicated that energy consumption affects GDP. Seven years later, employing the Johansen co-integration method, [4] extended his previous study by exploring the connection between national output and energy consumption using GDP as the proxy for national output in the same period (i.e., from 1947 to 1994). The study achieved similar results to his previous findings. In the same demeanour, [5] also assessed the linkage between national output and energy consumption for the Australian country in the period 1960-2009. They used labour and capital as other factors of national output. The study, which used Johansen and Toda-Yamamoto causality tests analysis, found that energy consumption is as important as capital and labour in determining real GDP.

Meanwhile, in China, [18] explored the consumption of energy and its effects on economy allowing for structural breaks within the period of 1953-2007, employing Johansen co-integration approach. Focusing on demand and production sides, they advocated that there is a connection between national output and energy consumption. When the VECM was used, the findings showed that total energy consumption has an influence on GDP in the short run. Therefore, energy reservation can be detrimental to national output in China. [19] explored the efficiency of energy consumption in national output in China within 1980-2006. Using a method known as the Logarithmic Mean Divisia Index (LMDI), the study found a support for the importance of energy consumption in output.

Several studies found a mutual connection between national output and energy consumption such as [20], and [21]. [20] assessed the connection between GDP and energy consumption in Turkey within 1970-2003. The co-integration and Granger causality tests were performed and the findings showed that energy consumption can change GDP with feedback in Turkey. [21] examined the association between national output and energy consumption in India within 1950-1996. The analysis was based on the co-integration and Granger causality and the study found that energy consumption can affect national output with feedback in India. Besides, interests on the relationship between energy consumption and national output, it is noted that these studies have different interest on the types of energy (oil, biomass, gas, and electricity). For instance, the work by [8] who examined the linkage between national output and several types of energy and in Nigeria using the data from 1970 to 2005. Employing the Johansen co-integration, he found that the long run linkages between oil, gas, biomass and electricity consumptions and national output do exist. When the Granger causality test was employed, the results indicated that national output is dependent on gas consumption, electricity consumption, and oil consumption. Interestingly, however, only oil consumption is affected by national output.

While, [22] explored the linkage between national output and energy consumption in Malaysia from 1980 to 2010. Using the same analysis approach, namely, the Johansen co-integration and Granger causality test, but adding another type of energy source which is coal, the findings revealed that national output is not affected by oil and coal consumption and vice versa. In particular, they found that national output can influence electricity consumption without feedback and national output cannot influence coal consumption with feedback. Whereas in Pakistan, a group of researchers, [23], examined the linkage between the industrial outputs and disaggregate energy type within 1972-2010. The analysis was based on the Johansen co-integration method. The results showed that gas consumption has no connection with the industrial output. The results also explained that oil consumption can affect the industrial output with feedback and electricity consumption can affect the industrial output without feedback. Besides, the industrial output can have an impact on coal consumption, and gas consumption does not affect industrial output.

All of the studies mentioned above only focused on the linkage between national output and aggregate energy consumption. While some of them used GDP as a proxy for national output and other studies used GNP. However, most of the previous studies did not highlight the sectorial outputs such as industrial, agriculture and transportation sectors although these sectors consume energy with different patterns. Among the studies that highlighted the sectorial outputs, it is noted that most of them did so for the industrial sector (as this sector is highly dependent on energy) at the expense of other sectors such as the agricultural. Several studies explored the relationship between a single type of energy and output ([24]; [25]; [26]). Based on the review of relevant literature, energy consumption can be divided into several energy types such as oil consumption, gas consumption, coal consumption and etc. Some previous studies focused on only a single type of energy consumption, for example oil, gas, biomass, electricity and coal, as a proxy for energy to explore the relationship between energy consumption and output.

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3. METHOD

Energy is used to ensure that output can be produced in economic sectors such as industrial, transportation and agriculture. This study will use panel data on some variables from 1990 to 2014. This method is based on the Cobb-Douglas production function. Data on oil consumption, gas consumption and electricity consumption are extracted from International Energy Agency (2014) while data on sectorial output are obtained from Department of Statistics, Malaysia (2014). The Cobb-Douglas production function is to show the relationship between inputs such as capital and labour and production and the equation is as follows.

$$Q = K^{\alpha} L^{\beta} \quad (1)$$

Due to its simplicity, however, the above production function omits energy consumption as an important input. Energy is used to ensure that output can be produced in economic sectors such as industrial, transportation and agriculture. Therefore, energy is a catalyst for sectorial productivity. Adding this variable to equation (1) yields the following:

$$Q = K^{\alpha} L^{\beta} EC^{\gamma} \quad (2)$$

where EC is energy consumption while γ is the energy elasticity of output. Like other parameters, $\gamma$is assumed to be a positive fraction, $0 <\gamma< 1$. In order to ensure that this model is linear in parameters, there is a need to take logarithms for each variable. Doing so and adding the error term *u* as well as the time subscript *t*, the model becomes as follows:

$$\ln Q_t = \alpha \ln K_t + \beta \ln L_t + \gamma \ln EC_t + u_t \quad (3)$$

This equation represents the baseline model in estimating the effect of capital, labour and energy consumption on output.
The panel estimation can be performed to see the long-run relationship among energy consumption, economic sectors and carbon dioxide emission in Malaysia on the condition that there is an existence of a panel co-integration. In this case, FMOLS by [27] and extended by [28], [29], and DOLS by [30] and extended by [31] can be employed in the panel estimation. DOLS is better than FMOLS in terms of bias in a

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small sample. [31] explained that FMOLS and DOLS generate estimators in a co-integrated regression which are asymptotically normal with zero mean, while the OLS estimator using panel data suffers from inconsistency and biasedness which cannot be ignored in infinite samples.

According to [28], [29], FMOLS estimation methods were developed to estimate and test hypotheses of co-integration vectors in panel heterogeneity leading to unbiased parameters asymptotically when there are idiosyncratic dynamics and fixed effects. Furthermore, according to [32], this method can solve the problem of endogeneity, simultaneity and non-stationarity in this study.

[27] addressed the problem of asymptotic bias and nuisance parameter related to the estimated co-integration vector in a single equation. Then, [33] showed the advantage of FMOLS methods when VAR is not stationary with the unknown co-integrated rank. FMOLS estimators can produce good inference in a dynamic heterogeneous panel model when cross-sectional dimension increases but the dimension of time-series is short. The group-mean FMOLS will be used in this study since its estimation method can have more flexible alternative hypothesis based on the presence of heterogeneity of vector co-integration and it is less problematic with the small sample size compared with the pooled panel FMOLS.

In the context of FMOLS estimation, the co-integrated system for the panel sector $i = 1, 2, \ldots, N$ as shown by equation (4) and equation (5) is used to derive FMOLS estimator

$$y_{it} = \alpha_i + \beta x_{it} + \mu_{it} \qquad (4)$$

$$x_{it} = x_{it-1} + \mathcal{E}_{it} \qquad (5)$$

where y_it and x_itare non-stationary, the error vector $\xi_{it} = \left(\mu_{it}, \mathcal{E}_{it}\right) \sim I\ (0)$ has a long-term covariance matrix or asymptotic covariance matrix, $\Omega_i = L_i L_i$,is under triangular decomposition of Ω_i). $y_{it}$and x_{it}variables are co-integrated for each member of the panel with co-integration vector β. The intercept term represents a specific fixed effect, allowing for co-integrated relationship. Asymptotic covariance matrix Ω_i is different across each panel member and it is divided into, $\Omega_i = \Omega_i^0 + \Gamma_i + \Gamma_i$, where $\Omega_i^0$is the contemporaneous covariance and Γ_i is the number of auto-covariance. Equation 3.35 showed the estimator of the average group of FMOLS.

$$\check{\beta}^*{}_{GFM} = \frac{1}{N}\sum_i \left[\frac{\sum_{t=1}^{T}(x_{i,t} - \bar{x}_i)y_{i,t}^* - T\check{y}_i}{\sum_{t=1}^{T}(x_{i,t} - \bar{x}_i)^2}\right], \qquad (6)$$

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with $y_{i,t}^{*} = (y_{it} - \bar{y}_i) - \frac{\hat{L}_{21,i}}{\hat{L}_{22,i}} \Delta x_{it}$ and $\hat{y}_i = \hat{T}_{21,i} + \hat{\Omega}_{21,i}^{0} - \frac{\hat{L}_{21,i}}{\hat{L}_{22,i}}(\hat{T}_{22,i} + \hat{\Omega}_{22,i}^{0})$ and $\hat{\Omega}_{22,i}^{0}$ are the long-term covariance between errorstationary and auto-regressive error unit. The estimator is shown by the following equation:

$$\hat{\beta}^{*}{}_{FM} = \left[\sum_{i=1}^{n}\sum_{t=1}^{T}(x_{it} - \bar{x}_i)(x_{it} - \bar{x}_i)\right]^{-1}\left[\sum_{i=1}^{n}\left(\sum_{t=1}^{T}(x_{it} - \bar{x}_i)\hat{y}_{it} - T\Delta^{+}{}_{\varepsilon\mu}\right)\right] \quad (7)$$

with $\Delta_{\mathcal{E}\mu}^{+}$ is a serial correlation correction terms and y_{it}^{+} is a co-integration correction.

The hypothesis test group average FMOLS allows the null hypothesis, $H_0 : \beta_i = \beta_0$ and the alternative hypothesis, $H_1 : \beta_i \neq \beta_0$ for all i. This means that homogeneity does not apply across panel units under the alternative hypothesis. T-statistic towards $\hat{\beta}_{FM}^{*}$ is represented by equation (8):

$$t_{\hat{\beta}^{*}{}_{FM}} = \left(\hat{\beta}^{*}{}_{FM} - \beta\right)\left(\sum_{i=1}^{N} L^{-2}{}_{22,i}\sum_{i=1}^{T}(x_{it} - \bar{x}_i)^2\right)^{-\frac{1}{2}} \quad (8)$$

Next, the Mean Group (MG) test and Pooled Mean Group (PMG) test are conducted to achieve objective 2 and objective 3 (to explore the effects of energy on CO_2 emission in the short and long runs, and to examine the impacts of output on CO_2 emission in the short and long runs). PMG and MG are used in this study to capture the short run effects for the overall economy and each sector. Pesaran and Smith introduced the MG method in 1995, while the PMG method was introduced in 1999. The MG and PMG tests are also conducted in this study to examine the short- and long-runs effects of energy consumption and national output on CO_2 emission.
The selection of lag length for both MG and PMG models must be appropriate.In these two methods, the Hausman test is conducted to determine which one is favorable, either MG or PMG. If the results of the Hausman test suggest that it is significant, it means that PMG is better than MG, and vice versa.
If the results show no correlation between regressors and their effects, then PMG is consistent and MG is not consistent. If the results show the existence of correlation, then MG is consistent and PMG is not consistent. There is no difference between the estimators under the null hypothesis of no correlation. Therefore, to conduct the Hausman test. We calculate $\hat{\beta}_{PMG} - \hat{\beta}_{MG}$ and its covariance. The covariance of an efficient estimator with its difference from an inefficient estimator should be zero. Under the null hypothesis, we should estimate:

$$W = (\beta_{PMG} - \beta_{MG})'\hat{\Sigma}^{-1}\beta_{PMG} - \beta_{MG}) \sim x^2(k) \quad (9)$$

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If W is significant, then MG is favourable and if W is insignificant, then PMG is favourable.
The MG model is derived from the ARDL model. The regression should be analyzed separately for the panel data. The MG model is as follows:

$$a_i(Q)y_{it} = b_i(Q)x_{it} + d_i z_{it} + e_{it} \quad (10)$$

where Q refers to output, i refers to the long-run parameter for the number of sector 1,2,…., N and t refers to time 1,2,…,T. Meanwhile $\theta_i = \frac{b_i(1)}{d_i(1)}$, and MG estimator for the whole panel data for error correction coefficient is $\theta = \frac{1}{N}\sum_{i=1}^{N}\widehat{\theta_i}$ and the variance is $\hat{\Delta}_{\hat{\theta}} = \frac{1}{N(N-1)}\sum_{i=1}^{N}(\hat{\theta}_i - \hat{\theta})^2$.
However, [34] combined several data sets and introduced PMG estimation. The estimation can estimate the short- and long-runs coefficients. The maximum likelihood (ML) estimation refers to PMG estimator and is used to estimate a long-run coefficient, θ. Unrestricted specification ARDL model for time period, t = 1, 2, …,T and the number of sector, i = 1,2,…,N and the following equation is derived:

$$y_{it} = \sum_{j=1}^{m}\lambda_{ij}\, y_{i,t-j} + \sum_{j=0}^{n}\delta_{ij}^{'}\, x_{i,t-j} + \mu_i + \varepsilon_{it} \quad (11)$$

where x_{ij} refers to the explanatory variables vector, (k x 1) for group i and μ_i refers to fixed effects. The parameter for VECM is as follows:

$$\Delta y_{it} = \theta_i\left(y_{i,t-1} - \beta_i^{'}x_{i,t-1}\right) + \sum_{j=1}^{m-1}\gamma_{ij}\,\Delta y_{i,t-j} + \sum_{j=1}^{n-1}\sigma_{ij}^{'}\, x_{i,t-j} + \sum_{j=1}^{p-1}\tau_{ij}^{'} z_{i,t-j} + \mu_i + \varepsilon_{it} \quad (12)$$

where β'_i refers to long-run parameter, γ_{ij} and γ'_{ij} refer to short run coefficient vectors, y_{it}refers to dependent variables (lnQ and lnCO_2), $x_{i,t-j}$ refers to the vector of non-stationary variables, $z_{i,t-j}$ refers to stationary variables, μ refers to fixed effect, ε refers to error term and θ_i refers to error correction parameter. The PMG model is developed based on the VECM model.

4. RESULTS

Table 2 shows the results of the long-run panel estimations for dependent variable lnQ. From the results, we can achieve the first objective which is to examine the effects of energy consumption on output in the long run. The results show that capital is one of the significant determinants of aggregate output. These results are consistent across the two methods (FMOLS and PMG) albeit with different magnitudes. The results of FMOLS

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show that the estimated coefficient of capital is positive (as expected) and significant at the 5% level of significance; its magnitude of 0.1510 suggests that an increase of 1% in capital can cause output to increase by 0.1510% in the long run.

TABLE 2:
Long-Run Panel Estimation Results for Aggregate Output (Dependent Variable: lnQ)

Long run FMOLS			
Independent Variables	Coefficient	t-statistic	Prob.
lnK	0.1510**	2.2086	0.0330
lnL	0.8291***	4.2619	0.0001
lnO	0.0583*	1.7720	0.0840
lnG	0.3557**	2.4094	0.0207
lnE	0.1096*	1.8076	0.0782
Long run PMG			
Independent Variables	Coefficient	z-value	Prob.
lnK	0.2942***	3.30	0.001
lnL	0.3492*	1.65	0.099
lnO	0.1614***	3.57	0.000
lnG	0.0490***	3.32	0.001
lnE	-0.0203	-0.88	0.379
Long run MG			
Independent Variables	Coefficient	z-value	Prob.
lnK	2.5104	1.24	0.216
Table 4.4 (Continue)			
lnL	0.0642	0.08	0.937
lnO	0.0213	0.13	0.899
lnG	-0.3026	-0.92	0.356
lnE	-0.0540	-1.21	0.226
Hausman Test: 0.9091			

Note: The Hausman probability is subjected to its variance which is not positive definite. ***, **, and * denote the significance level at 1%, 5% and 10%, respectively.

Due to the insignificant value in the Hausman test, PMG is favourable. The results of PMG show that the estimated coefficient of capital is positive (as expected) and significant at the 1% level of significance; its magnitude of 0.2942 suggests that an increase of 1% in capital can cause output to increase by 0.2942% in the long run. Apart from that, the results from Table 2 show that labour can influence aggregate output in

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the long run. The significant relationship between these two variables are consistently obtained from the FMOLS and PMG tests although they produce quite distinct results in terms of magnitude. This means that labour is an important factor in determining aggregate output. The results of FMOLS show that it is significant at 1%. The coefficient value of 0.8291 indicates that a 1% increase in labour can cause aggregate output to increase by 0.8291%. The results of PMG also show a positive relationship with a coefficient value of 0.3492. The results show that it is significant at 1%. Therefore, a 1% increase in labour can increase in aggregate output by 0.3492%.

Oil consumption can boost aggregate output in the long run. These findings are consistent using FMOLS and PMG although the magnitude of the estimated coefficients differ a bit. The results imply that oil consumption is undeniably related to aggregate output. The results from FMOLS show that there is a positive and significant relationship between oil consumption and aggregate output. The coefficient value of 0.0583 suggests that a 1% rise in oil consumption can push aggregate output up by 0.0583%. This significant result is supported by the results of PMG which both of the tests show significant values of 1%. The results for PMG show that the estimated coefficient of oil consumption is positive (as expected); its magnitude of 0.1614 suggests that an increase of 1% in oil consumption can cause output to increase by 0.1614% in the long run. Gas consumption can also influence output in the long run. This significant result is supported using both FMOLS and PMG approach. The results of FMOLS show that it is significant at 5% and the coefficient value is 0.3557. Therefore, an increase of 1% in gas consumption can cause output to increase by 0.3557%. The results of PMG show that it is significant at 1% with its magnitude of 0.0490. Therefore a 1% increase in gas consumption can increase output by about 0.0490% in the long run.

Electricity consumption can also influence output in the long run. It is supported by the results of FMOLS. The results of FMOLS show that it is significant at 10% and the coefficient value is 0.1096. Therefore, an increase of 1% in gas consumption can cause output to increase by 0.1096%. The PMG analysis does not show any significant value of the relationship between gas consumption and aggregate output. However, FMOLS is advantageous in the group-means version for the long-run relationship [35].

From the long-run estimation, we now move to the short-run estimation. In this case, only PMG and MG are employed since FMOLS cannot estimate the short-run relationship. Table 3 shows the short-run effects of energy consumption on aggregate output using the PMG and MG approaches. Since the results of the Hausman test show that the Hausman statistic is not significant, PMG is favourable compared to MG. The findings show that the ECT value is negative and significant at 1%. The coefficient value is 0.7401, it means that the deviations from the long-run growth rate in aggregate output are corrected by 0.7401%. The results also show that labour can affect aggregate output in the short run. The results of PMG show that it is significant at 1% and the coefficient value is 0.4340, thus a 1% increase in labour can help boost aggregate output by 0.4340%

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TABLE 3:
Short-Run Panel Estimation Results for Aggregate Output (Dependent Variable: lnQ)

Short run PMG			
Independent Variables	Coefficient	z-value	Prob.
lnK	0.7698	1.25	0.210
lnL	0.4340***	3.61	0.000
lnO	0.0403	0.74	0.462
lnG	0.1466	1.20	0.231
lnE	0.0581	0.83	0.408
Constant	-3.0216	-1.41	0.160
ECT	-0.7401***	-3.70	0.000

Short run MG			
Independent Variables	Coefficient	z-value	Prob.
lnK	0.2024**	2.00	0.045
lnL	0.4968***	4.30	0.000
lnO	0.0685	1.19	0.234
lnG	-0.0697	-1.49	0.135
lnE	0.0947	0.88	0.377
Constant	-22.9846	-1.40	0.161
ECT	-0.4905	-1.48	0.139
Hausman Test :0.9091			

Note: The Hausman probability is subjected to its variance which is not positive definite.
*** and ** denote the significance level at 1%, 5% and 10%, respectively.

The results of PMG do not show any significant relationship between capital and aggregate output in the short run. Other than that, the results of PMG also show that all energy types (oil, gas and electricity) do not have any significant effect on aggregate output in the short run. Besides examining the effects of energy consumption on aggregate output, we may also examine the effects of energy consumption on sectorial output. The idea is to see the relative dependence of sectorial output on energy. The economy is divided into three sectors consisting of agriculture, industrial and transportation, and the short-run effects of energy consumption on the output for each

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sector are analysed by conducting the PMG and MG tests. In view of the Hausman test result, however, this study rejects the use of MG in favour of PMG.

Table 5 shows the results of short-run panel estimation for each sector. Based on the results, we can see which energy consumption can influence agricultural, industrial, and transportation sectors. It can be learnt that there is no factor influencing the agricultural output in the short run. In the industrial sector, labour and gas do affect industrial output. The coefficient value for the relationship between labour and industrial output is 0.6148 and it is significant at 5%. Therefore, a 1% increase in labour can help boost industrial output by 0.6148% in the short run. Apart from that, gas consumption also plays an important role in determining output in the industrial sector as it is significant at 1% with the coefficient value of 0.3897. Therefore a 1% increase in gas consumption can increase industrial output by 0.3897%. However, other variables such as oil and electricity consumptions do not influence the industrial output. In the transportation sector, the results show that there is a significant relationship between labour and output (with its significant level of 5%). The coefficient value is 0.4814 and therefore, a 1% increase in labour can increase output by 0.4814%. Besides, the results also show that there is a significant relationship between gas consumption and output (with significant level of 10%). The coefficient value is 0.0501 and thus suggesting that a 1% increase in gas consumption can boost output in the transportation sector by 0.0501%. However other energy types such as oil and electricity consumptions do not influence the output.

TABLE 5:
Short-Run Panel Estimation for Sectorial Output (Dependent Variable: lnQ)

	Agriculture		
Independent variables	Coefficient	z-value	Prob.
lnK	1.9844	0.45	0.650
lnL	0.2060	0.75	0.453
lnO	0.0208	0.64	0.521
lnG	-	-	-
lnE	-	-	-
Constant	-1.2578	-1.36	0.175
	Industrial		
Independent variables	Coefficient	z-value	Prob.
lnK	0.3209	1.54	0.123
lnL	0.6148**	2.35	0.019
lnO	-0.0434	-0.82	0.415
lnG	0.3897**	2.07	0.039
lnE	0.1976	0.70	0.484
Constant	-0.5108	-1.02	0.310

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Transportation

Independent variables	Coefficient	z-value	Prob.
lnK	0.0042	0.05	0.961
lnL	0.4814**	2.50	0.013
lnO	0.1435	1.42	0.156
lnG	0.0501*	1.89	0.059
lnE	-0.0234	-1.15	0.250
Constant	-7.2962***	-2.65	0.008

Note: ***, **, and * denote the significance level at 1%, 5% and 10%, respectively.

5. DISCUSSION AND CONCLUSION

The findings of this current study is split into two time dimensions: short run and long run. In the long run, energy consumption can influence economic growth in Malaysia. The results suggest that an increase in energy consumption can help boost economic growth in the long run in Malaysia. Parallel with that, any energy policy to reduce energy consumption might impede economic growth in Malaysia. This finding was supported by [5] who investigated the factor of energy consumption influencing output and the results indicated that energy consumption is as important as capital and labour in determining national output. However, the study used data on aggregate energy consumption without dividing into several energy types. Not all energy types can influence economic growth since energy policies nowadays have reduced some energy types. Hence, it is important to disaggregate energy and therefore, this current study extends the previous study by including oil, gas and electricity.

Specifically, all energy types (oil, gas, and electricity) can affect aggregate output in the long run. The finding of this significant and positive relationship between oil consumption and national output is consistent with the finding by [36]. The finding of the significant effects of gas consumption on output was supported by [37]. The finding of the existence of a long-run relationship between electricity consumption and output corresponds to the findings of [38]. Therefore, we concluded that a decrease in any energy type can disrupt economic growth in Malaysia. In the short run, this study found that oil consumption plays an important role in determining aggregate output. This finding is consistent with the finding of [39] who investigated the relationship between oil consumption and economic growth and found that economic growth is dependent on oil consumption in the short run. However, this study found that other energy types do not have a significant effect on aggregate output in the short run. Therefore, a reduction in all energy types (except oil), do not have any effect on sectorial output.

However, gas consumption can influence output in the industrial sector and transportation sector in the short run. This is because the Malaysian government has increased the consumption of natural gas to conserve the environment. This energy can produce the smallest amount of CO2 emission, and thus slowing down the environmental degradation. The effects of gas consumption in the industrial sector is greater than that of gas consumption in the transportation sector. This is because the industrial sector consumes a larger amount of gas compared to the transportation sector. In 2014, the industrial sector consumed 226,506 TJ compared to 12,480 TJ which were consumed in the transportation sector. Electricity consumption does not play an important role in determining output in all sectors in the short run. This finding is supported by the finding of [40] which stated that there is no relationship between energy consumption and output in UAE. An increase in electricity consumption does not matter to output in all sectors. This is because electricity is still consumed regardless of how many outputs are produced. Electricity is largely consumed in buildings for all sectors and it does not affect output. We consume the same amount of electricity to produce more or less output as the size or the number of buildings remain the same, or the working hours remain the same.

From the findings, it can be learnt that energy plays an important role in boosting economic growth especially in the long run. Even though Malaysia has implemented the carbon footprint and Kyoto protocol, its reinforcement should be closely monitored and constantly revised. This is to ensure that the CO2 emissions can be reduced not only in the agriculture sector but also for the transportation sector.

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