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Experimenting the Long-Haul Association between Components of Consuming Renewable Energy: ARDL Method with Special Reference to Malaysia

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ABSTRACT

Global warming is a standout amongst the present most critical environmental issues, caused generally by emission of greenhouse gases, for example, carbon dioxide from the consuming of fossil fuels. Emissions of carbon dioxide fluctuate all through nations in Asia. It is progressively perceived that nations must act to advance the more prominent utilization of renewable energy resources as a component of activities looking to relieve environmental change. This paper shows a survey of the energy request situation in Malaysia and Indonesia. In this renewable energy, resources are getting to be attractive for sustainable energy development in Malaysia. It is essential for Malaysia to build the consumption of renewable energy to lessen its reliance on dirty fossil fuels for electricity generation. This paper endeavours to examine the elements influencing renewable electricity consumption (REC) in Malaysia. In particular, our examination means to investigate the long-haul relationship among REC, economic growth, CO_2 emanations, foreign direct investment (FDI) and exchange transparency over the period from 1980 to 2015. By utilizing autoregressive distributed lag (ARDL) bounds testing cointegration approach, we locate that financial development and FDI are the real drivers for REC. Exchange transparency, be that as it may, is found to have a negative effect on REC over the long haul. Strangely, the impact of CO_2 outflows on REC isn't critical. In addition, the vector error correction model (VECM) Granger causality test finds the presence of a unidirectional causality relationship running from GDP to REC, affirming the legitimacy of conservation hypothesis in Malaysia. Some significant policy suggestions are likewise talked about. It is accordingly prescribed that the policymakers are required to concentrate on the green energy generation part by expanding renewable energy creation from the current sources.

Keywords: Renewable Electricity, Consumption, GDP, Auto Regressive Distributed Bound Testing, VECM Granger Causality Test, Malaysia
JEL Classifications: N70, F43

1. INTRODUCTION

Energy is required in nearly our day-by-day life including agriculture, transportation, media transmission and mechanical exercises that affect the economic development. The economic development is measure by total national output (GDP) and in Malaysia, GDP is connecting precisely with the energy consumption of the nation (Rabie, 2018). The development in the economy in Malaysia is dependent on a continuous supply of energy.

As per the estimation of international Energy Agency, 53% worldwide energy consumption will be expanded by 2030, with 70% of the growth popular originating from creating nations (Oh et al., 2010). Malaysia is a standout amongst the most creating nations among ASEAN nations by Singapore, with GDP of US$15,400 per capita (PPP premise), and enduring GDP growth of 4.6% in 2009 (IMF, 2010). Malaysian economy grew at 5% in 2005 and in general, energy request is required to increment at a normal rate of 6% per annum (Saidur et al., 2009). In parallel with Malaysia's quick economic development, last energy consumption grew at

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rate of 5.6% from 2000 to 2005 and achieved 38.9 Mtoe in 2005. The last energy consumption is relied upon to achieve 98.7, almost three times the 2002 dimension. The mechanical sector will have the highest growth rate of 4.3%. Modern sector represented some 48% of all out-energy use in 2007, which speaks to the highest.

Renewable energy will be energy produced from natural resources, for example, sunlight, wind, rain, tides and geothermal heat. Renewable energy will be energy that is produced from natural procedures that are persistently recharged (Promsri, 2018). Elective energy is a term utilized for an energy source that is an option in contrast to utilizing fossil fuels.

1.1. Renewable Energy in Malaysia

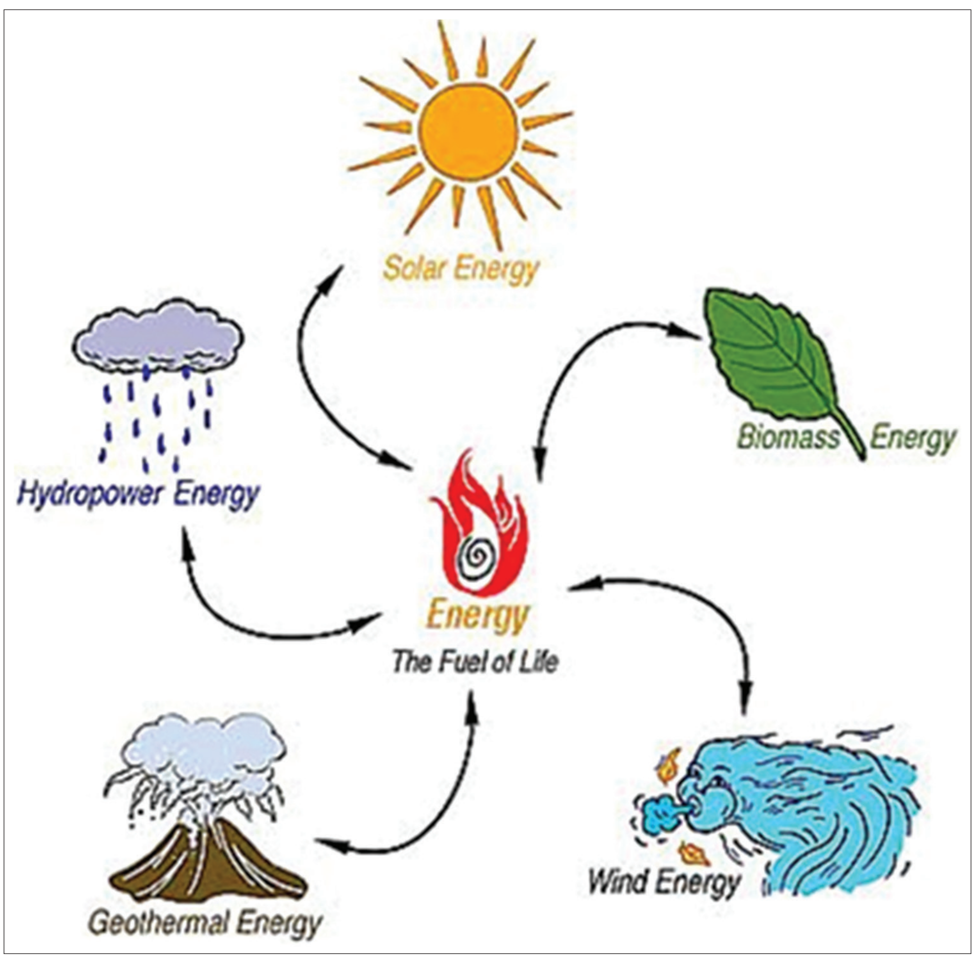
The Government received the four-fuel strategy, supplementing the national exhaustion policy, went for guaranteeing reliability and security of supply. The exhaustion of fossil fuels will expect Malaysia to utilize more sources of renewable energy for the supportability of its development. The National Biofuel Policy energizes the utilization of biofuels in accordance with the country's Five-Fuel Diversification Policy. The principle target of National Biofuel Policy is to decrease the relying upon fossil fuel that related with environmental issue, for example, the greenhouse gas discharge. On April 2009, Malaysia formulated the National Green Technology Policy to mirror that Malaysia's earnestness in driving the message that 'perfect and green' is the route forward towards making an economy that depends on feasible arrangements. It will likewise be the reason for all Malaysians to appreciate an improved personal satisfaction (Pineda and Maderazo 2018). The government needs to elevate green technology utilization to push for economic growth in the new economic model.

1.2. Consuming Renewable Energy in Malaysia

Renewable energies incorporate wind, sun powered, biomass and geothermal energy sources. This implies all energy sources that recharge themselves inside a brief timeframe or are for all time accessible. Energy from hydropower is just somewhat a renewable energy. This is positively the situation with river or tidal power plants. Something else, various dams or repositories additionally produce blended forms, for example by siphoning water into their repositories around evening time and recouping energy from them amid the day when there is an expanded interest for electricity. Since it is preposterous to obviously decide the measure of produced energy, all energies from hydropower are shown independently.

The primary indigenous renewable sources in Malaysia incorporate; palm oil biomass wastage, "hydropower, sun powered power, strong waste and landfill gas, wind energy. Among these resources, hydropower is reasonable for both little and extensive scale applications, sun-based photograph voltaic power is

Figure 1: Renewable energy



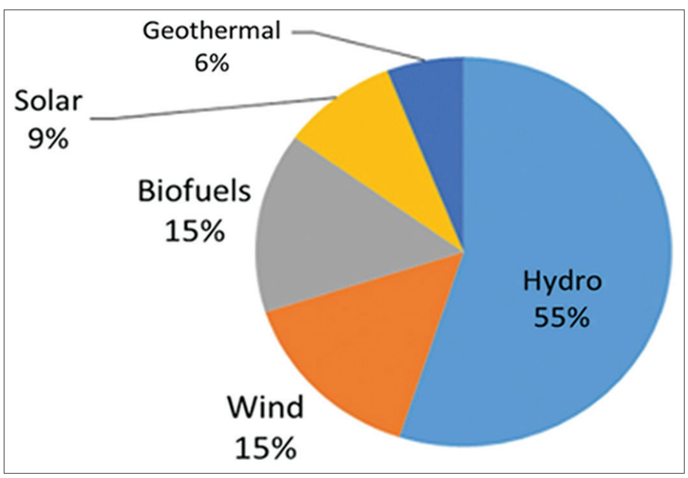
appropriate for use in little - scale applications and at the family level. Biomass development have been set up and demonstrated practical understanding, especially everywhere scales and in mechanical applications (Malek et al., 2010). Furthermore, Malaysia's local oil generation happens seaward, essentially close to the Peninsular Malaysia. Toward the finish of 2015, Malaysia's raw petroleum save, including condensate, was 5.5 billion barrels of proportionate. Malaysia likewise has a rich natural gas hold. Figures 1 and 2 shows the renewable sources in Malaysia. Toward the finish of 2015, Malaysia's demonstrated natural gas holds were 14.66 billion barrels of comparable. Malaysia's hydropower potential is surveyed at 29 000 megawatts; 85% of potential destinations are situated in East Malaysia. Biomass resources are for the most part from palm oil, wood and agro-industries."

In 2015, renewable energies accounted for around 5.2% of actual total consumption in Malaysia. The following chart shows the percentage share from 1990 to 2015:

2. LITERATURE REVIEW

Malaysia presented renewable energy as the fifth fuel strategy in the energy-blend under the National Energy Policy in 2001. An objective was set at 500 MW matrix associated power generations by 2005 from renewable energy sources. Abd (Abd Halim, 2012) the little renewable energy power program (SREP) was propelled in the meantime with monetary impetuses to support this activity. Malaysia has colossal potential renewable energy resources as biomass, sunlight based and hydro. Nevertheless, the implementation of SREP was not up to desire because of a few hindrances and difficulties looked by the experts and engineers, and the objective was updated in 2006 to 350 MW by 2010. At the COP15 in Copenhagen, Malaysia swore a wilful decrease of up to 40% regarding emissions force of GDP continuously 2020 contrasted with 2005 dimensions. With this dedication, the Renewable Energy Act was ordered in 2011 with the arrangement of Feed-in Tariff, giving progressively appealing motivating forces to goad the implementation of framework associated power generation from renewable energy resources. With the new RE Act 2010, the objective is modified to 985 MW by 2015 This paper depicts the development of renewable energy policy structure, techniques and initiatives for renewable energy implementation in Malaysia, with an end goal to diminish carbon emissions as vowed at the COP15. This paper additionally gives instances of renewable power generation at present executed and the on-going research and development exercises to improve the exploitation of renewable energy resources in Malaysia (Rahman and Zhang, 2017).

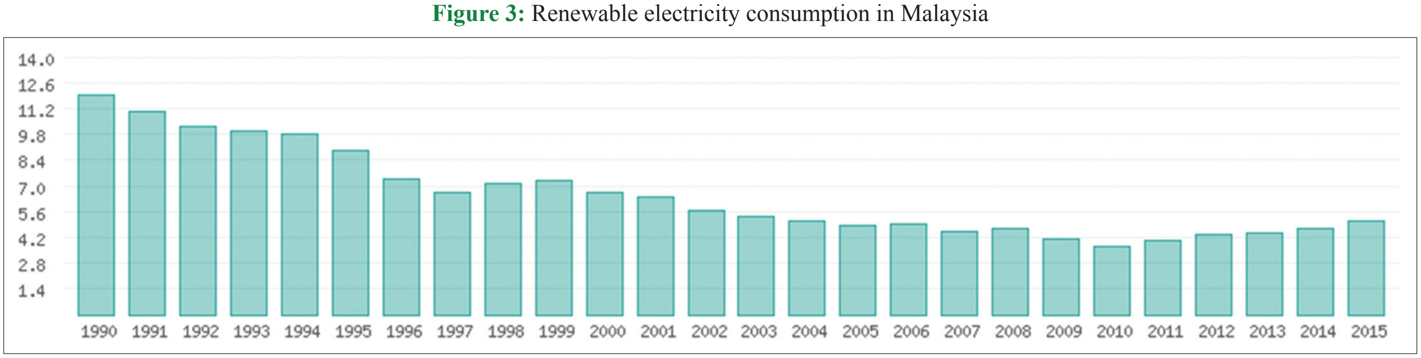
Figure 2: Renewable energy generation from the different sources



Malaysia has a decent blend of energy resources like oil, natural gas, coal and renewable energies, for example, biomass, and sun powered and hydro. Disregarding this many resource, the nation is dependent on fossil fuel for modern and transportation sector. (Andriyana, 2011) In 2009, 94.5% of electricity is created by utilizing fossil fuel, for example, natural gas, coal, diesel oil and fuel oil. As of not long ago, Malaysia stills a net energy exporter. Worries about energy security, the vacillation of raw petroleum cost and environmental change are driving significant changes in how energy and electricity explicitly, is created, transmitted and consumed in Malaysia. In such manner, renewable energy resources are getting to be alluring for supportable energy development in Malaysia. There is because renewable sources of energy are abundant in Malaysia, the significant ones being biomass and sunlight based (Rahman, 2017). This article displays an audit of present energy circumstance and energy policies for the energy sector in Malaysia. Examination of different renewable energy and inspect the energy and environmental issues related with this energy. The audit of current utilization of renewable energy sources and furthermore its potential implementation is assessed to give answer for the national. Figure 3 shows the renewable electricity consumption in Malaysia.

Apergis et al. (2010) explore the long-run reliance between environmental corruption and renewable consumption. The examination used information from the time of 1984 to 2007

Figure 3: Renewable electricity consumption in Malaysia



and connected panel vector error rectification model to think about research the relationship in nineteen rising economies. The findings of the investigation establish that renewable energy is generous to diminish carbon emanation in long run. The findings of the examination anyway neglected to discover significance of renewable in affecting carbon outflow in short run.

The similar studies of Azlina and Mustapha (2012) also studied the likewise association in Malaysia. The aftereffects of these examinations uncovered the reliance of renewables on environmental corruption and recommend the unit-directional connection between the variable expressing that an increase in renewable is probably going to decline environmental deterioration as carbon emission.

3. RESEARCH METHODOLOGY

3.1. Sources of Data Collection

The investigation utilizes annual time series information for the period from 1980 to 2015 in Malaysia. The information is gotten from International Energy Statistics, World Development Indicators (WDI) and Emissions Database for Global Atmospheric Research (EDGAR).

3.1.1. Variables used in this study

The needy variable in the model alludes to renewable electricity consumption (REC) which is estimated utilizing renewable electricity net consumption in billion kWh. In the interim, the explanatory factors included are economic growth, carbon dioxide (CO_2) emissions, exchange transparency, FDI which are signified by GDP per capita (US$), CO_2 emissions in metric tons per capita, offer of import and fare in GDP, proportion of foreign investment to GDP individually. To decrease the variety and prompt stationarity in the variance covariance matrix, the common logarithmic form (ln) is connected to every one of the factors.

3.1.2. Procedure

The examination is begun by deciding the order of integration of the factors utilizing unit root test. Augmented Dickey Fuller (ADF) is a standout amongst the best-realized unit root tests dependent on the model of the main request autoregressive procedure (Box and Jenkins, 1970). Also, Phillips and Perron (PP) test takes into account milder suspicions on the error distribution and controls for higher request sequential relationship in the series just as heteroscedasticity. In the wake of choosing the request of integration, the presence of long-run connection between the factors is tested. The autoregressive distributed lag (ARDL) strategy is proposed because of its compelling applications for little example sizes contrasted with Johansen (1988) and Engle and Granger (1987) tests. ARDL is additionally material independent of the factors are coordinated of request zero or one or commonly cointegrated as long as not structure two. Additionally, Banerjee et al. (1998) guaranteed that ARDL does not change over the short run coefficients into residuals. Fundamentally, ARDL strategy includes the estimation of unlimited error change model (UECM) in first contrast form, augmented with one period lagged of all factors in the model. The UECM model is appeared as pursues:

$$\begin{aligned}\Delta \ln REC_t = \alpha_0 + \beta_1 lnREC_{t-1} + \beta_2 lnGDP_{t-1} + \beta_3 lnCO2_{t-1} + \\ \beta_4 lnTRADE_{t-1} + \beta_5 lnFDI_{t-1} + \sum_{i=1}^{p} \beta_i \Delta lnREC_{t-i} + \\ \sum_{j=0}^{q} \beta_j \Delta lnGDP_{t-j} + \sum_{k=0}^{r} \beta_k \Delta lnCO2_{t-k} + \\ \sum_{l=0}^{s} \beta_l \Delta lnTRADE_{t-l} + \sum_{m=0}^{t} \beta_m \Delta \ln FDI_{t-m} + \mu t\end{aligned} \quad (1)$$

Where REC is REC, GDP is economic development, CO_2 is carbon dioxide emissions, TRADE will be exchange transparency and FDI is foreign direct investment, Δ is the main distinction administrator and is error term individually. The ideal lag length is chosen dependent on Akaike's Information Criterion (AIC). The F-statistics got from Wald tests is utilized to decide the joint significance of the coefficients of the lagged dimension of the factors. The null hypothesis of no cointegration is set up as: 1 + 2 + 3 + 4 + 5 = 0. The upper bound critical value (UCB) accept that all the regressors are I (1) while I (0) for lower bound critical value (LCB). Given that the sample size of this investigation is moderately little (T=36), the rejection of null hypothesis alludes to the critical value re-enacted by Narayan (2005). It was demonstrated that the cointegration existed between the factors if F-statistics is more noteworthy than UCB. Something else, the null hypothesis can't be rejected if F-statistics is lower than LCB which shows that the factors are not cointegrated. As indicated by Bardsen (1989), the long-run coefficients are evaluated utilizing the proportion of coefficients of every independent variable to dependent variable's coefficient individually.

This is trailed by Granger causality test to examine the causal connection between the factors in short run. On the off chance that the factors are not cointegrated, the vector autoregressive (VAR) in first contrast form is utilized. Interestingly, if the cointegration is found between the factors, the examination appraises the heading of causality utilizing vector error rectification models (VECM).

$$\begin{aligned}\Delta lnREC_t = v_1 + \sum_{i=1}^{k} \gamma_{1i} \Delta lnREC_{t-i} + \sum_{i=0}^{k} \delta 1i \ \delta 1i \Delta lnGDP_{t-i} + \\ \sum_{i=0}^{k} \theta_{1i} \ \Delta lnCO2_{t-i} + \sum_{i=0}^{k} \sigma_{1i} \sigma 1i \Delta lnTRADE_{t-i} + \\ \sum_{i=0}^{k} \Delta lnFDI_{t-i} + \zeta_{1t}\end{aligned} \quad (2)$$

Where Δ is the primary distinction operator, k is the optimal lag order dependent on AIC and $\zeta 1t$ is error term.

Table 1: Explanatory statistics

	REC	GDP per capita	CO_2 emissions	Trade	FDI
Mean	5.960	6,478.374	4.881	159.897	3.965
Max	14.806	10,876.73	8.141	220.407	8.761
Min	1.290	3,308.772	1.953	105.057	0.056
Std. Dev.	3.075	2,294.132	2.148	37.295	1.869
Skewness	1.114	0.210	0.062	-0.018	0.416
Kurtosis	4.569	1.866	1.546	1.690	3.566

REC: Renewable electricity consumption (billion kilowatt-hours), GDP per capita (constant US$), CO_2 emissions (metric tons per capita), Trade (Share of import and export in GDP in current US), FDI (net inflows, % of GDP)

Table 2: Unit root test

	ADF		PP	
	Level	Difference	Level	Difference
REC	−3.1020 (1)	−5.3638 (1)***	−2.2602	−4.7036***
GDP	−1.7677 (0)	−4.8434 (0)***	−1.9633	−4.8434***
CO2	−0.8178 (0)	−4.5520 (8)***	−1.0483	−4.8662***
TRADE	−0.4222 (1)	−4.0373 (0)**	0.0900	−3.8114**
FDI	−5.0415 (0)***	−6.4872 (1)***	−5.0448***	−23.6103***

Both capture and deterministic trend are incorporated into the test equation for the variable in level and first contrast. The ADF and PP are evaluated with t-Statistic. The optimal lag length in ADF equation is accounted for in () and dependent on AIC. ***, ** and * indicate significance at 1%, 5% and 10%, individually

4. DATA ANALYSIS AND RESULTS

4.1. Explanatory Analysis

Table 1 demonstrates the descriptive statistics of the factors utilized in our investigation. The mean of renewable electricity consumption is added up to 5.960 billion kilowatt-hours with standard deviation of 3.075 billion kilowatt-hours over the time of 1980-2015. The consumption of renewable electricity can accomplish as high as 14.806 billion kilowatt-hours or as low as 1.29 billion kilowatt-hours all through these 36 years. In addition, the normal of CO_2 emissions is recorded as 4.881 metric tons per capita with the standard deviation of 2.148 metric tons per capita. The most extreme and least values are added up to 8.141 and 1.953 metric tons per capita separately. Also, GDP, exchange and FDI convey the mean of US$ 6,478.374, 159.897 and 3.965% separately. The standard deviations are added up to US$ 2,294.132, 37.295 and 1.869 individually. The statistic of skewness uncovers that REC, GDP, CO_2 emissions and FDI are skewed to right while TRADE has the left side skewness. Besides, the characteristic logarithmic form (ln) is connected to every one of the factors to diminish the variety and instigate stationarity in the variance-covariance matrix.

4.1.1. Unit Root Test

Table 2 displays the consequences of the ADF and PP unit pull tests for the five factors both at level and first contrast of the natural log values. Strangely, every one of the factors in ADF test is non-stationarity at level aside from FDI. The factors transform into stationary when they are first differenced at 1% significance dimension while exchange is the main variable noteworthy at 5% level. In addition, PP test produces results like ADF test. Just FDI accomplishes stationarity at level while different factors, for example, REC, GDP, CO_2 emissions and exchange become stationary at first contrast with 5% significance dimension. As every one of the factors are found to have the order of I (0) and I (1), we utilize ARDL bound test so as to decide the long-run cointegration between GDP, CO_2 emissions, exchange and FDI with REC in Malaysia. Moreover, it is likewise relevant in VECM Granger causality with the integration of I (0) and I (1) (Sinha and Sinha, 1998).

4.1.2. ARDL bound test

Table 3 displays the consequences of the bounds test dependent on REC and its determinants. The ARDL (1, 4, 0, 2, 3) model is chosen to fit the information of value included per capita in-service sector. The optimal lag chose is one dependent on AIC tests. The processed F-statistic of 13.591 in ARDL bound test is more prominent than the upper critical bound value of 6.250 at 1% significance dimension dependent. The rejection of null hypothesis of no cointegration proposes that the presence of consistent state long-run relationship among GDP, CO_2 emissions, exchange, FDI and REC in Malaysia. This is in accordance with the examinations led by Sadorsky (2009) and Sebri and Ben-Salha (2014) who uncover a long-run relationship among the factors.

Table 3: Bound test based on ARDL

Model	F-statistic	Conclusion
REC=f (GDP, CO2, TRADE, FDI)	13.591***	Cointegrated
Optimal lag	[1,4, 0, 2, 3]	
Critical value	I (0)	I (1)
1% significance level	4.428	6.250
5% significance level	3.202	4.544
10% significance level	2.660	3.838
Diagnostic test		
Breusch-Godfrey LM test	0.4654 (0.6366)	
Heteroskedasticity test	0.0300 (0.8636)	
Ramsey RESET	0.0493 (0.9613)	

ARDL: Autoregressive distributed lag

Table 4: Long-Haul coefficient related with components of renewable energy

Variable	Coefficient	Standard error	t-Statistic
C	−2.482	5.914	−0.419
GDP	1.189*	0.666	1.783
CO2	0.429	0.596	0.719
TRADE	−1.352***	0.275	−4.908
FDI	0.299***	0.097	3.056

***, ** and * denote significance at 1%, 5% and 10%, respectively

The Breusch-Godfrey serial correlation LM test shows that the model is free from serial correlation issue. There is no heteroskedasticity issue found from ARCH test.

Table 4 shows the aftereffects of long-run flexibilities of explanatory variables on REC. Strikingly, all the explanatory variables are observed to be huge in clarifying the REC over the long haul for Malaysia aside from CO_2 emissions. It is apparent that GDP has a positive and noteworthy coefficient all through the long keep running at 10% significance level, showing that 1% expansion of GDP would build the REC by 1.189%. The assessed income flexibility of REC or request is decidedly more noteworthy than 1, showing that it tends to be considered as a predominant decent in Malaysia. The outcome is inside our desire as higher economic development would enable the economy to have more assets to advance the utilization of greener energy sources that incorporate renewable electricity. Meanwhile, better economic performance empowers individuals in the nation to have more salary to be spent on natural insurance and to request a greater amount of renewable energy. The positive effect of

GDP on REC is confirmed by past examinations, for example, Marques and Fuinhas (2011). Moreover, the finding further infers the significance of economic development in boosting REC by expanding its capacity to create technologies identified with renewable electricity in Malaysia.

Extra rate increment in FDI likewise altogether raises REC by 0.299%. This recommends mechanical exchange through FDI has effectively upgraded the consumption of renewable electricity. Our finding concurs with the prevalent view that FDI is basic in improving REC.

Trade openness is observed to be contrarily identified with REC over the long haul. The REC is lessened by 1.352% with one percent expansion in trade openness. The outcome demonstrates that foreign trade can't energize the exchange of renewable advancements in electricity generation by means of mechanical exchange. As it were, it doesn't advance the consumption of renewable electricity in Malaysia. Be that as it may, it negates with ends archived in writing, for example, Ben Jebli and Ben Youssef (2015) and Omri and Nguyen (2014) who guarantee that trade openness prompts an expansion in the utilization of renewable energy.

Then again, our outcomes demonstrate that CO_2 emissions don't significantly affect REC. The value of the coefficient is sure however not critical. This demonstrates our finding isn't in accordance with past examination. The positive connection between CO_2 emissions and REC, in any case, is steady and guarantee that an ascent in CO_2 emissions is the real driver for REC. On account of Malaysia, a positive yet immaterial connection between the two variables can be clarified by the way that public awareness on the significance of using renewable electricity is as yet weak among Malaysians.

4.1.3. VECM granger causality test

The consequences of Granger causality as appeared Table 5 demonstrates that GDP does Granger-cause REC in a unidirectional manner at 10% significance level. This outcome affirms the significance of economic development of Malaysia in advancing REC. Like findings acquired Kula (2014), a unidirectional causality is likewise found from GDP to REC. Be that as it may, our finding contrasts from concentrates by Farhani and Shahbaz (2014) and Al-mulali et al. (2014) who found no causality and a bidirectional connection between economic development and REC individually.

Likewise, a unidirectional causal relationship is found from trade openness to CO_2 emissions at 1% significance dimension showing that trade progression contributes to the disintegration of environmental quality in Malaysia. It is predictable with the findings of Kasman and Duman (2015) who additionally find a unidirectional causality from trade openness to CO_2 emissions on account of new EU part nations. Our outcome, in any case, is conflicting with the finding by Ohlan (2015) who proposes that there is no causality between the two variables.

4.1.4. Variance decomposition analysis

Table 6 demonstrates the aftereffects of variance decomposition analysis (VDC) that different the variety for each endogenous variable into the part shocks to the VECM. The VDC of REC obviously shows that TRADE and GDP are crucially disclosing the advancement to REC (Hussain et al., 2019). The shocks to REC in light of a one standard deviation development in TRADE and GDP exceptionally extend from 0% to 20.96% and 20.93% individually (Johari et al., 2018). Like the findings of ARDL and IRF, these VDC findings affirm the dynamic impact of shocks from TRADE and GDP towards REC (Saudi et al., 2019). This suggests the development and development of Malaysian economy is critical to improve the consumption of renewable electricity. Then again, the shocks of CO_{2} (8.77%) and FDI (6.46%) are found to contribute the minor impact on the shocks of REC in the discrete time frames.

In addition, the VDC of GDP demonstrates the most critical shocks impact of CO2 emissions (12.53%) towards the shocks of GDP contrasted with REC (11.15%), TRADE (4.02%) and FDI (0.15%) separately. Moreover, the VDC of CO_2 finds that the shocks impact of TRADE exceedingly reacts to one standard deviation development in CO_2 emissions. This is in accordance with the findings of VECM Granger causality that TRADE granger causes CO_2 emissions. In the interim, one standard deviation shock in GDP clarifies CO_2 emissions by 27.25%. The presence of modified U-shaped relationship among GDP and CO_2 emissions in Malaysia is demonstrated as GDP increments at the underlying stage and starts to decrease in the wake of achieving the pinnacle point. The commitments of REC, GDP, CO_2 and FDI to TRADE are added up to 18.65%, 4.88%, 5.50% and 4.62% individually. Moreover, the changes of FDI are clarified by one standard deviation shock in REC, GDP, CO_2 and TRADE with the level of 1.73%, 32.82%, 14.66% and 11.87% separately.

5. CONCLUSION

This present paper researches the job of renewable energy consumption in affecting economic prosperity of Malaysia by utilizing the annual information over the time from 1980 to 2015. Malaysia has substantial resources of RE as biomass, hydro and sunlight-based energy. The National Energy Policy and procedures are as of now set up for the significant commitment of RE in the

Table 5: Vector error correction model granger causality

Dependent variables	D (REC)	D (GDP)	D (CO_2)	D (TRADE)	D (FDI)	ECT (-1)
D (REC)	-	3.5041*	1.7657	0.0285	0.1219	−0.0453***
D (GDP)	0.0299	-	0.0441	1.2022	0.0007	0.0016
D (CO2)	1.1187	1.2484	-	7.1720***	0.0042	0.0058
D (TRADE)	1.2587	0.4189	0.8548	-	0.0029	0.0011
D (FDI)	0.6351	0.0371	0.1555	0.2362	-	0.2469***

***, ** and * denote significance at 1%, 5% and 10%, respectively

Table 6: Experimenting RECs' components

S. no.	S.E.	LNREC	LNGDP	$LNCO_2$	LNTRADE	LNFDI
Variance decomposition of LNREC (%)						
1	0.1743	100.0000	0.0000	0.0000	0.0000	0.0000
2	0.2428	88.4018	2.3773	1.9064	1.5413	5.7730
3	0.2622	83.5519	2.1632	3.2115	1.4686	9.6045
4	0.2678	80.9656	3.0808	3.6432	2.3404	9.9698
5	0.2786	74.8663	6.2389	3.9047	5.7648	9.2252
6	0.2949	66.8649	10.2367	4.4874	10.1230	8.2877
7	0.3142	59.1724	13.9009	5.4189	14.0152	7.4924
8	0.3347	52.5682	16.8844	6.4938	17.1079	6.9454
9	0.3552	47.1674	19.1898	7.6186	19.3989	6.6251
10	0.3745	42.8606	20.9396	8.7702	20.9693	6.4601
Variance decomposition of LNGDP						
1	0.0397	0.0346	99.9653	0.0000	0.0000	0.0000
2	0.0584	1.1093	96.9300	0.2706	1.3843	0.3056
3	0.0708	2.4516	93.4367	1.1670	2.6567	0.2878
4	0.0800	4.1732	89.3736	2.7206	3.4839	0.2485
5	0.0874	5.9885	85.2044	4.5827	4.0066	0.2176
6	0.0937	7.6111	81.4389	6.4744	4.2821	0.1933
7	0.0993	8.9265	78.2830	8.2464	4.3687	0.1752
8	0.1043	9.9280	75.7396	9.8442	4.3254	0.1626
9	0.1090	10.6547	73.7215	11.2680	4.2003	0.1552
10	0.1133	11.1580	72.1206	12.5387	4.0293	0.1532
Variance decomposition of $LNCO_2$						
1	0.0484	0.0533	45.5687	54.3779	0.0000	0.0000
2	0.0686	0.0817	49.7092	41.8845	5.6003	2.7241
3	0.0825	1.2289	50.3528	34.0343	10.7745	3.6094
4	0.0947	4.9786	46.8631	29.5074	15.5598	3.0909
5	0.1065	9.6699	41.3706	26.2685	20.2391	2.4517
6	0.1173	13.7105	36.4817	23.6732	24.0754	2.0589
7	0.1270	16.9428	32.8279	21.5953	26.7753	1.8585
8	0.1354	19.5213	30.2222	19.9730	28.5127	1.7705
9	0.1426	21.5462	28.4221	18.7385	29.5483	1.7447
10	0.1488	23.1019	27.2505	17.8223	30.0795	1.7457
Variance decomposition of LNTRADE						
1	0.0554	12.7151	0.0384	0.3441	86.9022	0.0000
2	0.0915	8.7578	0.4428	1.6003	88.8624	0.3365
3	0.1201	10.0469	0.7980	2.9989	85.4322	0.7238
4	0.1464	12.9015	1.5578	3.5288	80.6826	1.3292
5	0.1704	15.1659	2.5008	3.7398	76.4875	2.1058
6	0.1911	16.5804	3.3189	3.9918	73.2823	2.8263
7	0.2079	17.4696	3.9284	4.3384	70.8467	3.4166
8	0.2214	18.0534	4.3611	4.7305	68.9548	3.8999
9	0.2319	18.4306	4.6666	5.1273	67.4749	4.3004
10	0.2399	18.6587	4.8831	5.5099	66.3185	4.6295
Variance decomposition of LNFDI						
1	0.9515	0.0663	37.3594	11.9953	4.9250	45.6537
2	1.0118	0.4476	34.6022	12.1572	11.9923	40.8005
3	1.0317	0.4547	33.4844	14.8239	11.7656	39.4712
4	1.0368	1.1424	33.1649	14.8722	11.6508	39.1694
5	1.0415	1.6389	32.9601	14.7392	11.6093	39.0523
6	1.0429	1.6916	32.9413	14.7040	11.5987	39.0641
7	1.0432	1.6907	32.9268	14.7154	11.6063	39.0607
8	1.0437	1.6933	32.8973	14.7127	11.6707	39.0257
9	1.0444	1.7047	32.8619	14.6946	11.7647	38.9738
10	1.0453	1.7309	32.8201	14.6696	11.8712	38.9081

REC: Renewable electricity consumption

electricity generation mix. Distinguishing the determinants for REC is significant for Malaysia to configuration proper arrangements and systems that can battle ecological issues. In this examination, we investigate the drivers and hindrances to the consumption of renewable electricity in Malaysia utilizing annual information from 1980 to 2015. To be progressively explicit, our examination means to research the long-run and causal relationship among REC, economic development, CO_2 emissions, foreign direct investment and trade openness utilizing ARDL bounds testing cointegration approach and VECM Granger causality test separately.

Results got from ARDL bounds testing cointegration approach uncover that economic development and FDI are the fundamental drivers for REC in Malaysia. This infers REC could be additionally improved through an expansion in GDP and FDI. Then again, trade openness is found to negatively affect REC over the long haul, demonstrating that exchanges of merchandise and ventures among nations will in general ruin the consumption of renewable electricity. It is discovered that CO_2 emissions irrelevantly influence REC. Moreover, a unidirectional causality relationship is discovered running from GDP to REC, proposing that conservation hypothesis is legitimate for Malaysia. It is likewise affirmed that a unidirectional Granger causality is running from trade openness to CO_2 emissions, however not the other way around. We find that FDI positively affects REC. This outcome is characteristic of the way that FDI can be used as an instrument to advance the utilization of renewables. While pulling in more FDI, the Malaysian government needs to guarantee that just those foreign investors who create and receive renewable energy are welcome to the nation.

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