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The Dynamic Relationship between Natural Gas and Economic Growth: Evidence from Indonesia

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ABSTRACT

The aim of the current study is to examine the importance of natural gas (NG) energy utilization in influencing economic growth using time series data from 1980 to 2017 in Indonesia. In doing so, the current study has adopted the refined methodology of Auto-Regressive Distributed Lags (ARDL) bound testing approach to examine the dynamic relationship among NG and economic growth with amplified understanding of the critical association to support the course of economic planning and policy making. The results of ARDL bound testing approach confirm that capital, labor force and NG utilization are strong determinants of economic growth in Indonesia. Likewise, the outcomes affirm that NG utilization have a constructive and positive effect on economic growth in Indonesia which implies that the NG is the main source of economic growth in Indonesia in the long run and short run. Also, the results of variance decomposition method confirm a bi-directional causal relationship between economic growth, NG utilization, labor force and capital in Indonesia.

Keywords: Natural Gas Utilization, Economic Growth, Labor Force, Indonesia
JEL Classifications: Q4, O1, O4

1. INTRODUCTION

The role of energy in influencing economic activities and development process is a well-grounded conception. Excesses dependence on energy carried the adverse effects to the environmental stability, however, its usage in inevitable as it underlies the potential to disturb growth process (Salem et al., 2018). The contentious arguments regarding the association between energy utilization and income advancements resulted into the rise of conflicting views (Mahadevan and Asafu-Adjaye, 2007). In this regard, the adherents of Neo-classical believe that energy plays merely an intermediator role in economic activities instead of primary input (Stiglitz, 1974; Ockwell, 2008; Salem et al., 2016; Tatli, 2018). Contrarily, the believers of ecological economists consider that neo-classical view is deficient in ignoring the crucial laws of thermodynamics mass-balance principal and entropy law (Ockwell, 2008). The fundamentals of both laws regard energy as the central notion of production. Thus, the connection between energy and economic progress seems to be inseparable, therefore, demands thorough investigations (Rafindadi and Ozturk, 2015; Shahbaz et al. 2014; Taib et al. 2018).

The role of energy in economic advancements have been particularly highlighted in the industrial era. The mass production to attain economies of scale, through fueling machinery with several sources of power, have been resulted in growth accretion of numerous economies (Solarin and Shahbaz, 2015). In this regard, the role of natural gas (NG) is eminent to instigate country's progress. NG is considered as a major non-renewable source of energy generation (Shahbaz et al., 2013). Recently, the utilization of NG due to its comparative proficiency to coal with low carbon release and rapid generation is being witnessed in both industrial and domestic levels for power generation (Heidari et al., 2013).

NG is set to become one of the three major sources of world energy. The power share for NG is expected to double from 17.3% in 2000 by 2035 given its extensive accessibility, viable supply outlays and ecological compensations in terms of releasing half the carbon compared to coal (Mujiyanto and Tiess, 2013; Saudi et al., 2019a). However, the optimistic trends are not so evident for Indonesia. Indonesia has abundant capabilities of generating energy. It is among the biggest global exporter of steam coal and has gigantic supplies of gaseous petrol and oil (Dutu, 2016; Sinaga et al., 2019a) and highly depends on NG for utilization and exports (Ali and Haseeb, 2019; Haseeb et al., 2018; Suryanto et al., 2018). However, the output of Indonesia's gas industry has gradually showing the declining trend from its 2010 ultimate position, hastening the falling tendency in its share of world output and exports (IEA, 2015). The negative inclination is subject to local barriers to enhance production, including suspensions in field expansion or controlled local prices persisting too low to appeal investments (Dutu, 2016; Saudi et al., 2019b), thereby likely to impact economic development (Abdullah et al. 2018; Dogan, 2015 ; Hwang and Yoo, 2014; Lim and Yoo 2012).

Many studies in past have examined the impact of NG on economic growth, however, the focus of ample investigations have been towards performing panel estimations (Alam et al., 2017; Apergis and Payne, 2010; Balitskiy et al., 2016; Bildirici and Bakirtas, 2014; Solarin and Ozturk, 2016). Even though panel investigations are fruitful in projecting general consensus, however, fail to identify specific implication arise due to shifts in trends. Furthermore, many examinations that carried country specific estimations analyzing NG trending in country dynamics, limited to simplified methods and empirical estimations (Brunnschweiler, 2008; Chi et al., 2009; Shah and Rivera, 2007), thus, lack in terms of reliable outcomes (Sinaga et al., 2019b).

Keeping in mind the gap of the literature and the importance of NG in influencing economic growth, the current study seeks to perform the time series investigation to analyze the dynamic link between NG and gross domestic product in Indonesia. Given the deteriorating output in Indonesian industrial sector, the results of the study would be able to provide country specific consciousness and knowledge to project the potential impact of NG movements on economic progress of the country. In doing so, the current study has adopted the refined methodology of auto-regressive distributed lags (ARDL) bound testing that has been accepted as the advanced measure of attaining the reliable results and reaching unbiased conclusions. Hence, the expected findings could shed greater insights into the dynamic relationship among NG and economic growth with amplified understanding of the critical association to support the course of economic planning and policy making.

The remaining of the investigation is structured as below. Section two encompasses the review of the related studies and report their findings. Section three would present the utilized methodology for the empirical investigation. It is followed by section four that demonstrate statistical results and their interpretation. Lastly, section five will conclude the study and present policy implication.

2. LITERATURE REVIEW

Several studies examined the impact of energy utilization on economic growth (Asafu-Adjaye, 2000; Paul and Bhattacharya, 2004; Mahadevan and Asafu-Adjaye, 2007), however, very few have investigated how the NG utilization can influence economic advancements. Among them, Shahbaz et al. (2013) examined the role of NG utilization in stimulating economic activities and development in Pakistan. The study used the data from the period of 1972-2010. Applying ARDL bound testing, the findings of the investigation revealed that NG is significant to influence economic development of the country suggesting that increase in NG utilization will bring positivity in economic advancements. Furthermore, the results of causal analysis suggested that there exist a uni-directional causal association between NG and output growth where the direction of causality run from NG to economic development in Pakistan.

More recently, in a panel investigation, Alam et al. (2017) examined the link between NG and output growth in developing nations. The study utilized data from the period of 1990 to 2012. Applying Heterogenous panel investigations, the findings of the top fifteen NG consuming developing nations showed that NG is significant to influence economic development of the sampled countries indicating that increase in NG utilization will bring positivity in output growth. In Iran, Heidari et al. (2013) examined the relationship between NG and economic growth. The study utilized data from the period of 1972 to 2007. Similar to Shahbaz et al. (2013), the study also applied ARDL bound testing approach for performing empirical analysis. The results of the study found that NG is significant to influence economic development based on production model. However, as per demand side framework, the study failed to find the significant association among the variables. Furthermore, the results of causal investigations suggested that there exist a bi-directional causal association between NG and output growth in Iran.

In addition, Apergis and Payne (2010) also performed a panel analysis by evaluating the relationship between NG utilization and economic development. The authors used the sample of sixty seven countries from the period of 1992-2005. The findings from heterogenous panel analysis confirmed the existence of positive long-run connection between NG and output growth of the sampled countries. Similar to Heidari et al. (2013), the results of causal investigations revealed the presence of bi-directional causal connections among the variables. In another panel investigation, Bildirici and Bakirtas (2014) analyzed the association between NG and economic growth in six countries included in BRICTS. The study used the data from the period of 1980-2011. Applying ARDL bound testing, the findings of the investigation revealed that NG is significant to influence economic development in the long run only for Brazil. Furthermore, the results of causal analysis suggested that there exist a bi-directional causal association between NG and output growth in Brazil, Turkey and Russia.

For the panel investigation in OECD countries, Destek (2016) examined the relationship of NG with economic development of twenty-six OECD nations. The study utilized data from the period of 1991-2013. In order to perform statistical investigation, the authors applied the empirical techniques of DOLS and FMOLS for identifying long term relationships along with VECM to investigate causal connections. The results of long run association revealed that NG has a significant positive connection with economic development of the sampled countries. Furthermore, the results of causal investigations suggested that there exist a uni-directional causal association between NG and output development in short-run, however, the study confirmed the presence of the bi-directional causal relationship between NG and output growth in long-run for OECD nations.

In Group of seven countries, Kum et al. (2012) investigated the link between NG and output growth. The study used the data from the period of 1970-2008. Applying the Granger causality, the findings of the investigation revealed that NG has uni-directional causal effects on economic development of Italy. On the other hand, the results of causal analysis for United Kingdom suggested that there exist a uni-directional causal association between NG and output growth where the direction of causality run from economic development to NG. As for United States, France & Germany, the study confirmed the presence of feedback association among the variables. Similarly, Balitskiy et al. (2016) examined the relationship of NG with economic development of twenty-six European Union states. The study utilized data from the period of 1997-2011. In order to perform two-way statistical investigation, the authors applied error correction model (ECM) to investigate causal connections among the variables. The results of analysis association revealed that the relationship between NG and output growth is significant negative, whereas, the association between output growth and NG is significant positive in the sampled countries.

As for Gulf Cooperation Council (GCC) nations, Ozturk and Al-Mulali (2015) examined the role of NG utilization in stimulating output growth. The study used the data from the period of 1980-2012. Similar to Destek (2016), the authors utilized the empirical techniques of DOLS and FMOLS to investigate the long-run relationship among the variables along with the causal analysis of VECM. The findings of the investigation revealed that NG is significant to influence economic development of the sampled countries in long-run suggesting that increase in NG utilization brought positivity in economic advancements. Furthermore, the results of causal analysis suggested that there exist a bi-directional causal association between NG and output growth in the GCC countries.

In another panel investigation of OPEC nations, Solarin and Ozturk (2016) investigated the relationship of NG utilization with output growth of twelve OPEC members. The study utilized data from the period of 1980-2012. Applying panel granger causality technique, the findings of the overall OPEC nations showed the presence of bi-directional causal connections among NG and economic growth. As for the individual levels, the results of the study reported the existence of uni-directional causal connections and the confirmation of growth effect in the countries of Saudi Arabia, Iraq, Libya, Kuwait and Nigeria. Furthermore, the evidence of conservation effect was found in the nations of Iran, Venezuela, Algeria and United Arab Emirates. As for the rest of the countries, the study failed to find any causal connections among NG and economic growth.

3. METHODOLOGY

In this paper, we investigate the dynamic relationship between NG energy utilization and economic growth by using Cobb-Douglas production function and the empirical model is given below:

$$Y=\beta_0+\beta_1(CAP)+\beta_2(LBF)+\beta_3(NG)+\varepsilon_t$$

Where, ε_t is the error term, *CAP* denotes the capital which is calculated by the total gross fixed capital formation (in local currency unit), *LBF* denotes the labor force which is estimated by total number or employed, and unemployed labor and *NG* represents *NG* utilization which is calculated by the total gas utilization in year. The sample for the current study is gathered from the time span of 1980-2017. All the sample are gathered from World Development Indicators (World Bank).

3.1 Unit Root Tests

After the descriptive statistics, we apply unit root test to check the stationarity property of the focus time series data. In doing so, the current study applies two renown unit root approaches that are Augmented-Dickey Fuller (ADF) and Philip-Perron (PP) unit root tests. For confirming the stationarity property, we first examine the data on level series and then of first difference series (Jabarullah and Hussain, 2019).

3.2 ARDL Bound Testing Cointegration Analysis

For examining the role of NG on economic growth in Indonesia, we study the ARDL methodology of long-term linkages which was introduced by Pesaran et al. (2001, 2000), Pesaran et al. (1999), Pesaran and Pesaran (1997). The ARDL methodology is applied with the help of unhindered vector error correction system to investigate the long-run relationship between NG and economic growth. This methodology has a few advantages on previous long-term association investigations (like J.J cointegration and simple correlation). This methodology might be useful whether the focus

Table 1: Results of unit root test

Variables	ADF unit root test				PP unit root test			
	I (0)		I (1)		I (0)		I (1)	
	C	C and T	C	C and T	C	C and T	C	C and T
Y	1.265	1.302	−4.907	−4.913	1.112	1.138	−4.875	−4.201
CAP	0.328	0.405	−3.959	−3.834	0.320	0.407	−4.227	−4.167
LBF	−0.203	−0.200	−4.200	−4.575	−0.191	−0.222	−4.464	−4.447
NG	−1.335	−1.235	−4.162	−4.217	−1.250	−1.229	−4.170	−4.197

Source: Authors' estimations. The critical values for ADP and PP tests with constant (C) and with constant and trend (C and T) 1%, 5% and 10% level of significance are −3.711, −2.981, −2.629 and −4.394, −3.612 and −3.243 respectively, ADF: Augmented-dickey fuller, NG: Natural gas time series data are totally I (0), I (1) or similarly co-incorporated. The ARDL structure is suggested for above investigation is given below:

$$\Delta Y = \varphi_0 + \varphi_1 \sum_{i=1}^{p} Y_{t-1} + \varphi_2 \sum_{i=1}^{p} CAP_{t-1} + \varphi_3 \sum_{i=1}^{p} LBF_{t-1} + \varphi_4 \sum_{i=1}^{p} NG_{t-1} + \gamma_1 Y_{t-1} + \gamma_2 CAP_{t-1} + \gamma_3 LBF_{t-1} + \gamma_4 NG_{t-1} + \mu_t$$

where, φ_0 is consistent term and μ_t is background noise period, the error correction limit is explained to by the indication of summation though the other proportion of the equation identifies with long-run association. The Schwarz Bayesian Criteria (SBC) is used to look at the greatest lag length choice for every factor (Jabarullah and Hussain, 2018). In ARDL technique, at first the present investigation ascertains the F-stats importance by applying the appropriate ARDL systems. Then, the Wald (F-stats) method is used to investigate the long-run relationship between the factors. In the event that long-term relationship between Y, NG, CAP and LBF are estimated, at that point the present investigation determined the long-term parameter estimations by utilizing resulting framework.

$$Y_t = \zeta_0 + \zeta_1 \sum_{i=1}^{p} Y_{t-1} + \zeta_2 \sum_{i=1}^{p} CAP_{t-1} + \zeta_3 \sum_{i=1}^{p} LBF_{t-1} + \zeta_4 \sum_{i=1}^{p} NG_{t-1} + \mu_t$$

Initially, in the current study if the long-run association between *Y*, *CAP*, *LBF* and *NG* is established with sign then we estimate the beta coefficient of the short-run by focusing the below equation:

$$Y_t = \delta_0 + \delta_1 \sum_{i=1}^{p} Y_{t-1} + \delta_2 \sum_{i=1}^{p} CAP_{t-1} + \delta_3 \sum_{i=1}^{p} LBF_{t-1} + \delta_4 \sum_{i=1}^{p} NG_{t-1} + nECT_{t-1} + \mu_t$$

Finally, the ECM demonstrate the speed of change permit to gauge the long-run equilibrium because of a short-run variation. The n is the estimation of ECT in the system that clarify the speed of change.

3.3. Variance Decomposition Method (VDM)

In this study, we further apply VDM to confirm the causal relationship between Y, CAP, LBF and NG in Indonesia. The VDM provides the size of the predicted error variation for an information accountable for originalities by each predictor upon different time frequency.

Table 2: Results of bound testing for cointegration

Lags order	AIC	HQ	SBC	F-test statistics
0	−4.368	−4.923	−4.975	47.981*
1	−6.813*	−6.609*	−6.699*	
2	−5.286	−5.222	−5.292	
3	−5.279	−5.165	−5.561	

Source: Authors' estimation, *1% level of significant, SBC: Schwarz bayesian criteria

Table 3: Results of lag length selection (SBC)

Lag	0	1	2	Nominated lags
CAP	1.457	−4.709	−2.921	1
LBF	3.321	−3.655	−2.629	1
NG	1.613	−5.332	−4.722	1

Source: Authors' estimation, *indicate minimum SBC values, SBC: Schwarz Bayesian criteria, NG: Natural gas

4. DATA ANALYSIS AND DISCUSSION

The present unit explains about the information investigation. Principally, we utilized stationary test to affirm the stationary property of the focus factors. The outcomes of unit root test are accounted for in Table 1. We used two different unit root tests to be specific (ADF and PP) test to confirm the stationary properties of the factors. The outcomes affirm that Y, CAP, LBF and NG at first are not stationary at level and ends up stationary at first difference series. In general, from the results of unit root test, we can infer that series of the considerable number of factors show the stationary properties and permit for proceeding to the long-term analysis.

Moreover, to investigate the long run relationship between Y, CAP, LBF and NG in Indonesia, the recent research used the novel approach of ARDL. In doing so, the initial step is to specify the maximum lag-length of entire variables selected for this study. The order of this maximum lag-length is selected by the principles of SBC as mentioned earlier. So, the results of the ARDL long run association outcomes are demonstrated in Table 2.

The outcomes of Table 2 affirm the Ho asserting that not cointegration between the factors is rejected. This is because of the coefficient of the F-stats is bigger than UBC coefficient at 1% criticalness level. Along these lines, it is in the support of

Table 4: Results using ARDL approach (long run)

Variables	Coeff.	t-stats	Prob.
C	0.341	4.498	0.000
Y (−1)	0.170	8.988	0.000
CAP	0.447	5.093	0.000
CAP (−1)	0.032	5.368	0.000
LBF	0.444	6.852	0.000
LBF (−1)	0.173	4.432	0.000
NG	0.453	11.680	0.000
NG (−1)	0.310	3.208	0.000
Adj. R^2	0.919		
D.W stats	2.023		
F-stats (Prob.)	3021.346 (0.000)		

Source: Authors' estimation, ARDL: Auto-regressive distributed lags

Table 5: Results using ARDL approach (short run)

Variables	Coeff.	t-stats	Prob.
C	0.343	3.112	0.000
ΔY (−1)	0.063	1.801	0.074
ΔCAP	0.362	4.890	0.000
ΔCAP (−1)	0.048	1.598	0.170
ΔLBF	0.362	4.853	0.000
ΔLBF (−1)	0.141	0.287	0.774
ΔNG	0.359	6.321	0.000
ΔNG (−1)	0.253	1.182	0.238
ECM (1)	−0.435	−6.583	0.000
Adj. R^2	0.892		
D.W stats	1.982		
F-stats (Prob.)	1538.582 (0.000)		

Source: Authors' estimation, ARDL: Auto-regressive distributed lags acceptance of the H_1 which recommend that there is a valid long-run association present among Y, CAP, LBF and NG in Indonesia.

The findings of ARDL bound testing cointegration test, subsequently, set up the robustness of attained outcomes. It is shown that a valid long-run relationship presents between Y, CAP, LBF and NG in Indonesia. Also, after affirming the indication of long run association between the focused factors, the next step of the investigation is to identify the ARDL framework with the point of finding the beta estimation of long-short run time. For this purpose, the current investigation estimates the lag length order of all the considered factors by the minimum estimation of SBC The results of lag length selection criteria is presented in Table-3.

Table 6: Results of variance decomposition approach

Variance Decomposition of Y				
Period	**Y**	**CAP**	**LBF**	**NG**
1	100	0.000	0.000	0.000
2	98.389	1.436	0.134	0.041
3	95.105	4.598	0.124	0.173
4	89.858	8.228	0.387	1.526
5	84.036	10.786	0.671	4.507
6	78.768	11.774	0.815	8.643
7	74.488	11.774	0.895	12.842
8	70.980	11.439	1.098	16.484
9	67.517	11.139	1.733	19.612
10	63.291	11.017	3.112	22.580
Variance decomposition of CAP				
Period	**Y**	**CAP**	**LBF**	**NG**
1	9.295	90.705	0.000	0.000
2	15.994	66.333	15.712	1.962
3	33.985	47.936	11.885	6.194
4	30.365	43.048	21.080	5.507
5	27.807	38.489	26.234	7.470
6	34.198	30.811	24.961	10.030
7	39.029	27.539	22.335	11.096
8	39.340	28.153	21.458	11.049
9	39.022	28.695	21.344	10.939
10	39.279	28.213	21.740	10.768
Variance decomposition of LBF				
Period	**Y**	**CAP**	**LBF**	**NG**
1	4.715	1.558	93.727	0.000
2	37.135	1.373	51.246	10.247
3	55.531	0.835	35.989	7.646
4	61.752	2.477	29.108	6.663
5	63.120	4.969	26.102	5.809
6	62.105	6.638	25.398	5.859
7	60.906	7.026	25.633	6.434
8	59.918	6.921	26.195	6.965
9	59.515	6.783	26.465	7.236
10	59.701	6.701	26.175	7.423
Variance Decomposition of NG				
Period	**Y**	**CAP**	**LBF**	**NG**
1	9.278	0.008	0.657	90.057
2	14.756	2.562	2.857	79.825
3	15.472	4.675	14.719	65.133
4	11.200	6.521	21.334	60.945
5	8.338	6.614	26.240	58.808
6	6.707	5.912	28.797	58.584
7	5.632	5.242	30.649	58.477
8	4.977	4.753	32.493	57.776
9	4.701	4.506	34.398	56.395
10	4.503	4.486	36.251	54.760

Source: Authors' estimation

The results of long run estimations are displayed in Table 4. The findings along these lines set up that capital, labor force and NG utilization are strong determinants of economic growth in Indonesia. Likewise, the outcomes affirm that NG utilization have a constructive and positive effect on economic growth in Indonesia which implies that the NG is the main source of economic growth in Indonesia in the long run. Also, it can be debated that all factors including capital, labor force and NG energy utilization assume a noteworthy contributor to enlightening the economic growth in Indonesia which confirm the Cobb-Douglas production function in Indonesia.

The outcomes of short run coefficient of ARDL analysis is demonstrated in Table 5. The results confirmed a substantial short-run connection between Y, CAP, LBF and NG in Indonesia. The measure of error term is signifying around -0.435 propose that almost 43.5% of instability is change in the recent year. Moreover, the results also suggest the noteworthy effect of capital, labor force and NG utilization on economic growth in Indonesia in short run as well.

The results of Table 6 show the causal relationship among Y, CAP, LBF and NG in Indonesia. The outcomes of Y model define that in first stage, the variation in Y is pronounced 100% totally by its improvements. In the following level, 98.389% display by own improvements, 1.436% by capital, 0.134% by labor force and 0.041% by NG. In 3rd year, period the changes in Y define 95.105 % by its own improvements, 4.598% by capital, 0.124% by labor force and 0.173% by NG utilization. In the 5th year, the variations in Y define 84.036% by its own enhancement, 10.786% by capital, 0.671% by labor force and 4.507% by NG energy. In the 10th year, the variations in Y define 63.291% by own enhancement, 11.017% by capital, 3.112% by labor force and 22.580% by NG energy utilization in Indonesia. The results of Table 6 further recommend the bi-directional causal relationship between all the variables however, the propensity of the causality is different.

5. CONCLUSION AND RECOMMENDATION

NG is set to become one of the three major sources of world energy. The power share for NG is expected to double from 17.3% in 2000 by 2035 given its extensive accessibility, viable supply outlays and ecological compensations in terms of releasing half the carbon compared to coal. However, the optimistic trends are not so evident for Indonesia. Indonesia has abundant capabilities of generating energy. It is among the biggest global exporter of steam coal and has gigantic supplies of gaseous petrol and oil and highly depends on NG for utilization and exports. However, the output of Indonesia's gas industry has gradually showing the declining trend from its 2010 ultimate position, hastening the falling tendency in its share of world output and exports. The negative inclination is subject to local barriers to enhance production, including suspensions in field expansion or controlled local prices persisting too low to appeal investments, thereby likely to impact economic development.

The aim of the current study is to examine the importance of NG in influencing economic growth, also the current study seeks to perform the time series investigation to analyze the dynamic link between NG and gross domestic product in Indonesia. Given the deteriorating output in Indonesian industrial sector, the results of the study would be able to provide country specific consciousness and knowledge to project the potential impact of NG movements on economic progress of the country. In doing so, the current study has adopted the refined methodology of ARDL bound testing approach to examine the dynamic relationship among NG and economic growth with amplified understanding of the critical association to support the course of economic planning and policy making. The results of ARDL bound testing approach confirm that capital, labor force and NG utilization are strong determinants of economic growth in Indonesia. Likewise, the outcomes affirm that NG utilization have a constructive and positive effect on economic growth in Indonesia which implies that the NG is the main source of economic growth in Indonesia in the long run and short run. Also, the results of variance decomposition method confirm a bi-directional causal relationship between economic growth, NG utilization, labor force and capital in Indonesia.

REFERENCES

Abdullah, N., Safiah, N., Ghani, A.A., Maamor, S., Wahab, N.A., Razimi, A., Elias, N.H. (2018), Examining level of spirituality among Malaysian youth. Indian Journal of Public Health Research and Development, 9(11), 1515-1520.

Alam, M.S., Paramati, S.R., Shahbaz, M., Bhattacharya, M. (2017), Natural gas, trade and sustainable growth: Empirical evidence from the top gas consumers of the developing world. Applied Economics, 49(7), 635-649.

Ali, A., Haseeb, M. (2019), Radio frequency identification (RFID) technology as a strategic tool towards higher performance of supply chain operations in textile and apparel industry of Malaysia. Uncertain Supply Chain Management, 7(2), 215-226.

Apergis, N., Payne, J.E. (2010), Natural gas consumption and economic growth: A panel investigation of 67 countries. Applied Energy, 87(8), 2759-2763.

Asafu-Adjaye, J. (2000), The relationship between energy consumption, energy prices and economic growth: Time series evidence from Asian developing countries. Energy Economics, 22(6), 615-625.

Balitskiy, S., Bilan, Y., Strielkowski, W., Štreimikienė, D. (2016), Energy efficiency and natural gas consumption in the context of economic development in the European Union. Renewable and Sustainable Energy Reviews, 55, 156-168.

Bildirici, M.E., Bakirtas, T. (2014), The relationship among oil, natural gas and coal consumption and economic growth in BRICTS (Brazil, Russian, India, China, Turkey and South Africa) countries. Energy, 65, 134-144.

Brunnschweiler, C.N. (2008), Cursing the blessings? Natural resource abundance, institutions, and economic growth. World Development, 36(3), 399-419.

Chi, K.C., Nuttall, W.J., Reiner, D.M. (2009), Dynamics of the UK natural gas industry: System dynamics modelling and long-term energy policy analysis. Technological Forecasting and Social Change, 76(3), 339-357.

Destek, M.A. (2016), Natural gas consumption and economic growth: Panel evidence from OECD countries. Energy, 114, 1007-1015.

Dogan, E. (2015), Revisiting the relationship between natural gas consumption and economic growth in Turkey. Energy Sources, Part B: Economics, Planning, and Policy, 10(4), 361-370.

Haseeb, M., Abidin, I.S.Z., Hye, Q.M.A., Hartani, N.H. (2018), The impact of renewable energy on economic well-being of Malaysia: Fresh evidence from auto regressive distributed lag bound testing approach. International Journal of Energy Economics and Policy, 9(1), 269-275.

Heidari, H., Katircioglu, S.T., Saeidpour, L. (2013), Natural gas consumption and economic growth: Are we ready to natural gas price liberalization in Iran? Energy Policy, 63, 638-645.

Hwang, J.H., Yoo, S.H. (2014), Energy consumption, CO 2 emissions, and economic growth: Evidence from Indonesia. Quality and Quantity, 48(1), 63-73.

IEA. (2015), Energy Policies Beyond IEA Countries-Indonesia 2015. Paris: OECD/IEA Publishing.

Jabarullah, NH., Hussain, H.I. (2018) Comparison of higher TVET education and “normal” academic education: The determinants of electrical engineering students performance. International Journal of Engineering and Technology, 7(429), 82-85.

Jabarullah, N.H., Hussain, H.I. (2019), The effectiveness of problem-based learning in technical and vocational education in Malaysia. Education and Training, 5(5), 1-3.

Kum, H., Ocal, O., Aslan, A. (2012), The relationship among natural gas energy consumption, capital and economic growth: Bootstrap-corrected causality tests from G-7 countries. Renewable and Sustainable Energy Reviews, 16(5), 2361-2365.

Lim, H.J., Yoo, S.H. (2012), Natural gas consumption and economic growth in Korea: A causality analysis. Energy Sources, Part B: Economics, Planning, and Policy, 7(2), 169-176.

Mahadevan, R., Asafu-Adjaye, J. (2007), Energy consumption, economic growth and prices: A reassessment using panel VECM for developed and developing countries. Energy Policy, 35(4), 2481-2490.

Mujiyanto, S., Tiess, G. (2013), Secure energy supply in 2025: Indonesia’s need for an energy policy strategy. Energy Policy, 61, 31-41.

Ockwell, D.G. (2008), Energy and economic growth: Grounding our understanding in physical reality. Energy Policy, 36(12), 4600-4604.

Ozturk, I., Al-Mulali, U. (2015), Natural gas consumption and economic growth nexus: Panel data analysis for GCC countries. Renewable and Sustainable Energy Reviews, 51, 998-1003.

Paul, S., Bhattacharya, R.N. (2004), Causality between energy consumption and economic growth in India: A note on conflicting results. Energy Economics, 26(6), 977-983.

Pesaran, M.H., Pesaran, B. (1997), Working with Microfit 4.0: Interactive Econometric Analysis; [Windows Version]. Oxford: Oxford University Press.

Pesaran, M.H., Shin, Y., Smith, R.J. (2000), Structural analysis of vector error correction models with exogenous I (1) variables. Journal of Econometrics, 97(2), 293-343.

Pesaran, M.H., Shin, Y., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289-326.

Pesaran, M.H., Shin, Y., Smith, R.P. (1999), Pooled mean group estimation of dynamic heterogeneous panels. Journal of the American Statistical Association, 94(446), 621-634.

Rafindadi, A.A., Ozturk, I. (2015), Natural gas consumption and economic growth nexus: Is the 10th Malaysian plan attainable within the limits of its resource? Renewable and Sustainable Energy Reviews, 49, 1221-1232.

Salem, M., Shawtari, F., Shamsudin, M., Hussain, H.I. (2018), The consequences of integrating stakeholders’ engagement on sustainable development (environmental perspectives). Sustainable Development, 26(3), 255-268.

Salem, M.A., Shawtari, F.A., Shamsudin, M.F., Hussain, H.I. (2016), The relation between stakeholders’ integration and environmental competitiveness. Social Responsibility Journal, 12(4), 755-769.

Saudi, M.H.M., Sinaga, O., Jabarullah, N.H. (2019b), The role of renewable, non-renewable energy consumption and technology innovation in testing environmental Kuznets curve in Malaysia. International Journal of Energy Economics and Policy, 9(1), 299-307.

Saudi, M.H.M., Sinaga, O., Roespinoedji, D., Jabarullah, N.H. (2019a), Industrial, commercial and agricultural energy consumption and economic growth leading to environmental degradation. Ekoloji, 28, 299-310.

Shah, K.U., Rivera, J.E. (2007), Export processing zones and corporate environmental performance in emerging economies: The case of the oil, gas, and chemical sectors of Trinidad and Tobago. Policy Sciences, 40(4), 265-285.

Shahbaz, M., Arouri, M., Teulon, F. (2014), Short-and long-run relationships between natural gas consumption and economic growth: Evidence from Pakistan. Economic Modelling, 41, 219-226.

Shahbaz, M., Lean, H.H., Farooq, A. (2013), Natural gas consumption and economic growth in Pakistan. Renewable and Sustainable Energy Reviews, 18, 87-94.

Sinaga, O., Alaeddin, O., Jabarullah, N.H. (2019a), The impact of hydropower energy on the environmental Kuznets curve in Malaysia. International Journal of Energy Economics and Policy, 9(1), 308-315.

Sinaga, O., Saudi, M.H.M., Roespinoedji, D., Jabarullah, N.H. (2019b), Environmental impact of biomass energy consumption on sustainable development: Evidence from ARDL bound testing approach. Ekoloji, 107, 443-452.

Solarin, S.A., Ozturk, I. (2016), The relationship between natural gas consumption and economic growth in OPEC members. Renewable and Sustainable Energy Reviews, 58, 1348-1356.

Solarin, S.A., Shahbaz, M. (2015), Natural gas consumption and economic growth: The role of foreign direct investment, capital formation and trade openness in Malaysia. Renewable and Sustainable Energy Reviews, 42, 835-845.

Stiglitz, J. (1974), Growth with exhaustible natural resources: efficient and optimal growth paths. The Review of Economic Studies, 41, 123-137.

Suryanto, T., Haseeb, M., Hartani, N.H. (2018), The correlates of developing green supply chain management practices: Firms level analysis in Malaysia. International Journal of Supply Chain Management, 7(5), 316-328.

Taib, C.A., Ashraf, M.S., Razimi, M.S.B. (2018), Productivity change in the efficiency of the insurance and takaful industry of Pakistan. Academy of Accounting and Financial Studies Journal, 22(1), 30-40.

Tatli, H. (2018), Multiple determinants of household natural gas demand: A panel data analysis in OECD countries. Asian Development Policy Review, 6(4), 243-253.