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## Article

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# The Natural Gas Consumption and Economic Development Nexus: Fresh Evidence from Indonesia

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## ABSTRACT

Indonesia is the 26<sup>th</sup> largest natural gas consuming country in the world. Currently the government is strategically planning to get into developed countries by boosting up the status of its economic growth. This study empirically examines the situation of country's strategic planning to get achieved by utilizing the available resources and the association between capital and labor, natural-gas (NG) consumptions, and exports of the country. The current study is utilizing time-series data from the year 1980 to 2018. In order to confirm the cointegration Johansen Cointegration technique has been used while short-run and long-run coefficients are estimated by applying ARDL bound test. Results indicate that economic growth reduces while exports, and the consumption of capital and labor boost the use of natural gas (NG) in Indonesia. So, an affiliation between consuming natural gas consumption effects inversely by the economic growth of Indonesia. Furthermore, labor utilization plays a significant and maximum contribution in the consumption of NG and also in the GDP of the country. This research recommends the active manipulation of natural gas availability and resources of Indonesia, a strenuous determination in order to develop labor resources and protection a representative time in planning amongst other resources.

**Keywords:** Natural Gas, Economic Growth, Capital, Labor, Johansen Cointegration, ARDL

**JEL Classifications:** O13, Q42, Q43

## 1. INTRODUCTION

In the region of Southeast Asia, Indonesia is the largest economy. Per Capita GDP of Indonesia has increased from \$823 in the year 2000 to \$3,932 in the year 2018. The country was the 10<sup>th</sup> largest natural gas producing country in 2015, and is ranked 26<sup>th</sup> around the globe in the consumption of natural gas. The economic planning of Indonesia tracks a 20-year extended developing plan, which spanning from 2005 to 2025. Also, it further subdivided into small sections of five-year mid-term plans and termed as Rencana-Pembangunan-Jangka-Menengah-Nasional (RPJMN). From the period 2015 to 2020 third phase of the long-term plan started, which is the current ongoing period. The main focus of Indonesia is to attain a faster rate of economic growth, to minimize economic instability, and to lower down the rate of unemployment amongst other countries.

In the period ranging from 2005 to 2010, the RPJMN was strategically designed with the maximum wide-ranging and numerous perilous lunges, which aimed to develop a buoyant nation throughout the opportunities of encouragement the life quality and to increase the financial liability. Additionally, the mid-term plan also emphasizes ensuring high economic growth sustainability by the resources of robust the resources of economic development, essentially concluded the corporate and financial organizations and moreover judicious management of macroeconomics. The mid-term plan also aimed to endorse the capabilities of competitiveness among all the indigenous productive organizations in Indonesia by empowering them to encounter the challenges of liberalization and globalization. To achieve this the mid-term strategy has been devised in such a fashion that the overall labor of Indonesia would become robust and to make available a knowledgeable, competent and productive working environment that would be having high

capabilities, innovation, and competencies, and correspondingly follow the development of friendly environment predictions that all are in accordance to the Kyoto agreement.

This vital task for Indonesia is to attain the position of existence amongst the developed countries (Zin, 2017; Burgos and Bocco, 2020). In order to accomplish this Indonesian government devised many plans and strategies in its mid-term period. After all these strategies and their implementation in a way to achieve the status of the developed country it is predicted to achieve per capita income of US\$ 12,140 in the year 2020, which means that the real gross domestic product (GDP) is predicted to increase by 6 percent yearly and to continue this growth (Zin, 2017; Carranza et al., 2020). Following the discussed predictions, this research elevated the query of what could be contribution of consumption of natural gas, exports, labor, and capital on the way to enhance the Indonesian economic growth which ultimately will help to fulfill the mid-term economic development targets. Would the variables be affective indicators to make sure such overwhelming economic conversions?

As per Hosseini and Abdul (2014) reported that Indonesia is blessed with 2,866 (Billion m<sup>3</sup>) proven reserves of natural gas in 2018 which made Indonesia 13<sup>th</sup> largest (NG) natural gas container in the entire world. Additionally, the EIA (2011) mentioned in its report that total energy consumption is a proxy of the world's natural-gas (NS) consumption and there has been an increase of 3% from the year 1990 to the year 2007. The EIA predicted in its reports that the consumption of natural gas will be increasing continuously all over the world and anticipated an increase of 18% yearly from the year 2007 to the year 2035. Since the continued increase in the use of (NG) natural gas and trimming prices of fossil fuel will add a sufficient advantage to the economic growth of Indonesia. Apergis and Payne (2010) confirmed that natural gas (NG) is significantly used to attain economic preeminence if we compare (NG) natural gas with the other fossil fuels.

Researchers found that the natural gas (NG) is a more efficient and effective substitute because it produces a comparatively low level of emissions of (CO<sub>2</sub>) carbon dioxide, operational efficiency is better for NG, it is more efficient, and reduced costs of capital as compared to all other fossil-fuels. Emphasizing potential practicalities of natural gas (NG), the researchers additionally maintains that it will be more advantageous if considering natural gas (NG) to priorities over all other substitutes of energy source both in household level as well as at industrial levels. As per the Kyoto agreement, every country is responsible for reducing the emissions of (CO<sub>2</sub>) and making sure of friendly environment working conditions, thus the usage of the (NG) natural gas is most suitable because of its practicalities. Thus, it will also be following the mid-term plan of Indonesia. The data of CO<sub>2</sub> emissions, Trade and GDP per capita from 2014 to 2018 is reported in Table 1.

While on the other hand the use of nuclear energy is dangerous, and the world has already seen its damages. For example, in Japan, usage of natural gas (NG) will also secure from those dangers, and it will make available pulsating and more effective liberation of energy and with more revenue generation opportunities. Shahbaz et al., (2013) found in their study, that (NG) natural gas energy

is a severe driver of manufacturing as well as for economic development, as they estimated long term influence of consumption of (NG) natural gas over the economic development with its more significant impact over the other energy intake factors. If the country conserves the usage of natural gas (NG), it ultimately harms the economic development. Before that Loganathan and Subramaniam (2010) to inline that, the Indonesian economy is an energy-intensive economy, as more likely to other developing nations in the Asian region. The facts about CO<sub>2</sub> emissions, trade and GDP per capita is presented in Figure 1.

This scenario made the consumption of energy in Indonesia rapidly increasing in proportion to an increase in economic development predictions. Additionally, the researches argue that the economic development persisted unpredictable over the periods, thus the portion of the use of energy was yet continued in an increasing tendency.

This research analyzes and implements empirically and to check the association among consumption of natural gas (NG), exports, and labor. It might deliver a doubt to the opportunities of increasing the Indonesian economy in the direction of achieving the goals economic development set in the short-term Indonesian plan. It is imperative to develop an understanding with the labor force dynamics, increasing requirements of the (NG) natural gas, capital and exports and also the consequences of economic growth and their association with each other to more improved guidelines and information for the legislators that what available choices they have and likely economic consequences. However, this is imperious at this moment to proclaim that a labor force that is dynamic and the capital deployed or needed are the most vital factors of manufacturing which will permit the exploitation and exploration of the available resources in case of any industrious economic system. In the industrial determined economies as Indonesia, the part of the exports in increasing the economic development cannot be exaggerated.

The exports, for example, intensifying the overall features of manufacturing as of its influence on attaining the economies of scale and all other cooperative outwards which are connected to the exports, and are improvement in the workforce, improving their managerial skillset, transfer of technology, and capacity of production increment. The exports also enable efficient and effective usage of the available resources; also it does not differentiate local domestic markets (Grossman and Helpman, 1989). Natural gas (NS) is the second-largest source of the energy consumption of the country.

## 2. LITERATURE REVIEW

To examine the causal association amongst economic development and natural gas consumption, a lot of researches been done, and the researches utilize various econometric techniques by utilizing different continental and country contexts. Many kinds of research utilize the panel data while others utilize the time series data of different time periods. Discussable researches amongst all are: In Taiwan to investigated economic growth and its association with consumption (Tugcu et al., 2012) used time-series data; Another research utilizing the same technique being done by (Yu and Choi,

1985) in countries of US, Poland and UK. The research was done by (Siddiqui, 2004) in Pakistan to investigate the association amongst consumption of (NG) natural gas also economic growth. The association amongst the natural gas consumptions and the economic growth studies by (Fatai et al., 2004; Hornung, 2020; Janssen, 2020; Chen et al., 2020) in Australia and New Zealand.

In the US, the relationship was investigated by (Ewing et al., 2007) and the association amongst economic growth and the natural gas in the US was studied. Research is done in five South Asian countries to investigate the association amongst natural gas consumption and the economic developments (Asghar, 2008). Ighodaro (2010) did the same study in a Nigerian context. (Apergis and Payne, 2010) collected data from 67 countries and investigate the relations amongst consumption of (NG) natural and with various other constructs. Kum et al., (2012) investigated G7 countries also they checked association amongst economic development and the consumptions of the natural gas (NG) in Bangladesh, (Bakhtyar et al., 2017; Das et al., 2013; Chen et al., 2020) investigated causal association amongst (GDP) gross domestic products and the (NG) natural-gas consumptions.

Recent research was done via (Solarin and Shahbaz, 2015; 3. Codina et al., 2020; Dihor et al., 2020) in Malaysia utilizing data from the year 1971 to the year 2012 to investigate association amongst economic development and (NG) natural-gas-consumption by adding factors of foreign-direct-investment (FDI), capital formation and trade openness. The findings of this Malaysian study found a direct positive influence on economic development of the factors utilizes as (FDI) foreign-direct investments, consumptions of the natural gas (NG), trade-openness also capital formations. The outcomes of the research sustain the occurrence of feedback assumption amongst economic development and consumptions of the natural gas-NG, economic development and (FDI) foreign-direct investment, and (FDI) foreign-direct investment and consumption of (NG) natural gas. Research done on data collected from 80 different countries by (Apergis and Payne, 2012) utilized the factors of association amongst consumptions of non-renewable also renewable energy, the laborforce, the real (GDP) gross-domestic products and the real gross-fixed capital formations. The result of the research discovered the presence of the feedback assumption. This means that there existed two-directional causality, amongst renewable and non-renewable consumption of energy also economic development in almost all the research areas.

To verify the results of (Apergis and Payne, 2012) another research was done by (Tugcu et al., 2012; Akbar et al., 2020; Al-Blooshi et al., 2020). They investigated the association amongst non-renewable and renewable consumptions of energy, oppositely economic development by utilizing collectively augmented and classical manufacturing functions as per of their technique. Additionally, they utilized the multivariate technique. Outcomes of the research showed that in order to achieve economic growth non-renewable and renewable consumption are the vital and critical factors. To explain the association, enlarged manufacturing function utilized in the research, revealed more effective. Data collected from 82 developing countries after classifying them into

regions, from the year 1990 to the year 2009, (Al-Mulali et al., 2015; Nawaz et al., 2019) examined the association amongst consumption of non-renewable and renewable energies also the gross-domestic products (GDP) as their constructs. They utilized the Kao cointegration examination and it found that all the economic sectors of all the regions are already associated in long term scenarios with both the non-renewable and the renewable energy consumptions.

Additionally, the FMOLS results showed that consumption of both the non-renewable and renewable energies has a long term direct and positive association with that of the economic sector of all-region. Although, outcomes also show that there is a more significant influence of the non-renewable energies on the economic sector as compared to renewable energies consumption in over all regions. The research was done after collecting data in panel form from 15 (EU) European Union countries from the year 1990 to the year 2011, (Okuy et al., 2014) examined the causal and long-run association amongst renewable and the non-renewable energy consumptions and economic development. Outcomes of research revealed that there a rise in the real (GDP) gross-domestic products leading by the rise in consumptions in renewable energy and there exists a direct and positive association amongst the emissions of (GHGs) greenhouse gases and real (GDP) gross-domestic products. Contrarily, consumption of non-renewable energies having an indirect and negative affect on the real GDP. This revealed that a rise in the consumption of non-renewable energies impacts negatively on the real GDP growth and declines it.

An association investigated amongst consumptions of the energy and (GDP) gross-domestic products by sector after collecting the data from 16 developing countries, (Al-Mulali and Ozturk, 2016) utilized the panel model from the time period 1980 to 2010. Results of the research showed that consumption of the energy from all sources and (GDP) gross-domestic products by sector having a cointegration amongst them. Additionally, Granger causality tests revealed a two-directional causal association amongst natural gas (NG), oil and the consumptions of renewable energy including worth productions, services also industrial sectors. Moreover, a two-directional causal effect association was also revealed the existence of association amongst the worth of the services sectors and the consumption of the coal.

### 3. METHODOLOGY

The study used Indonesia's annual data from 1980 to 2018. The WDI-World-Development-Indicators developed by the "World Bank" are the data source for this study. The data were collected on G.D.P, natural gas (NS) consumptions, actual exports, the capital stock also the labor force per capita. The main purpose of this research is to study whether the consumption of the NS-natural gas will have a positive impact on the implementation of the Indonesian plan by including export, labor and capital as a function of energy demands. The functional form of the energy-demands-function is following:

$$NG_t = f(GDPPC_t, EXPORT_t, CAPTL_t, LABR_t) \quad (1)$$

Where NG is natural gas consumption, EXPORT is export of the country, CAPTL is capital, and LABR is the labor force in Thailand. We already have transformed all series into the logarithms for the efficient-analysis. Also, the model could now be specified as follows:

$$\ln NG_t = \alpha_0 + \alpha_1 \ln GDP_{PC,t} + \alpha_2 \ln EXPORT_t + \alpha_3 \ln CAPTL_t + \alpha_4 \ln LABR_t + \varepsilon_t \quad (2)$$

Among them, “lnNG” is the natural-log of the NG natural-gas rent in GDP, “lnGDP” is the natural-log of G.D.P per-capita for the economic development, lnEXPORT. It is a natural log for export of the goods and the service % G.D.P., also “lnCAPTL” is the natural-log of capital % GDP. The total capital training as a percentage of GDP also lnLABR is a natural-log of the total labor-force participation rate. “ $\varepsilon_t$ ” is the residual-term. Let us now apply Pesaran et al. (Pesaran and Shin, 1998) ARDL limits testing methods. To implement the ARDL limit test procedure, an equation can be used. (1) Convert to the following Unconditional Error Correction Model (UECM).

$$\begin{aligned} NG_{it} = & \vartheta_0 + \sum_{i=1}^p \vartheta_1 \Delta NG_{i,t-1} + \sum_{i=0}^p \vartheta_2 \Delta GDP_{PC,i,t-1} + \\ & \sum_{i=0}^p \vartheta_3 \Delta EXPORT_{i,t-1} + \sum_{i=0}^p \vartheta_4 \Delta CAPTL_{i,t-1} + \\ & \sum_{i=0}^p \vartheta_5 \Delta LABR_{i,t-1} + \vartheta_6 NG_{i,t-1} + \vartheta_7 GDP_{PC,i,t-1} + \\ & \vartheta_8 EXPORT_{i,t-1} + \vartheta_9 CAPTL_{i,t-1} + \vartheta_{10} LABR_{i,t-1} + \varepsilon_{it} \end{aligned} \quad (3)$$

## 4. RESULTS AND DISCUSSION

Summary statistics are represented in Table 2; the mean value of natural gas rents is 0.191 with 32% of standard deviation. In contrast, GDP per capita mean value is 7.712 US dollar per capita and deviation around its mean value is 36.5% which is quite good, exports and gross capital formation mean value is 7.712, 3.310, 3.336 units % of GDP with a standard deviation of 20.4%, 15.9% and labor force participation rate mean value is 4.187 with 3.3% of standard deviation.

**Table 1: The data gathered from world-development-indicators (WDI) from the year 2014 to the year 2018**

Years	CO <sub>2</sub> emissions	Trade	GDP per-capita growth
2014	1.819378	48.08018	3.639143
2015	2.110135	41.93764	3.55544
2016	1.958784	37.42134	3.759694
2017	1.962766	39.36275	3.839982
2018	2.010562	43.02166	3.985604

**Table 2: The summary statistics**

Variables	Mean	Median	Maximum	Minimum	SD	Probability	Obs.
NG	0.791	0.752	1.403	0.035	0.324	0.762	39
GDP <sub>PC</sub>	7.712	7.705	8.363	7.116	0.365	0.420	39
LABR	4.187	4.194	4.241	4.063	0.033	0.000	39
EXPORT	3.310	3.287	3.970	2.949	0.204	0.013	39
GCF	3.336	3.371	3.557	3.038	0.159	0.245	39

### 4.1. The Unit-Root Test

The first step is to test the unit-root attribute of the variable to check the co-integrated association of long-term relationships. This research applies unit-root testing of A.D.F. and the P.P. to testing the unit root characteristics of the variable. Unit-Root test results of the A.D.F. are shown in the Table 3. The result shows that all-series are nonstationary at this level except labor force participation. This indicates that all constructs are integrated into I (1) at the levels of 5%, also 1% except the labor force which has I (0). The result of P.P. confirms the results reported by the A.D.F. unit's-root-test. Which means that the integration order of variables is I (1) and I (0).

### 4.2. Johansen-Cointegration Test

Table 4 illustrates Johnsen's cointegration test. In this analysis, the study found that in the use of the (NS) natural-gas consumptions, the economic development, the export, the capital, also labor were the indicators. Which reject null-hypothesis that there exists no co-integration between variables. We can conclude, as far as Indonesia is concerned, there was a long-term association among the (NS) natural-gas consumptions, the economic development, capital, exports, and the labor between 1980 and 2018.

### 4.3. ARDL-Bond Test

Al-Mulali and Ozturk (2016); Bayer and Hanck (2013) used a co-integration method to provide effective empirical results when studying the co-integration between variables. This study used the ARDL-bound test methodology to estimate co-integration in the case of Indonesia which is similar to these research's (Farhani et al., 2014) and (Rafindadi, 2015). These authors' ARDL bound test is sensitive to choices of lag lengths. Besides, (Ghatak and Siddiki, 2001) have determined that compared to Johansen cointegration technology, the ARDL bound test method can also effectively process for small samples for co-integration. According to the authors, this development provides ARDL models with significant advantages over the other cointegrations technique. Consistent with current development, this research used the A.I.C. criterion in order to select the proper lag orders for indicators. Lütkepohl (2006) reports that dynamic links between sequences could be capture if the suitable lag lengths are selected. According to Johnsen, cointegration results show that in the presence of economic growth (GDP), natural-gas (NS) energy consumptions (ECON), gross capital formation (GCF), and labor (LABR) as exogenous variables, we accept the alternative hypothesis in both the trace and maximum eigenvalue test. Which means that there exists cointegration at most one equation in the above vectors. This indicates that the analysis of A.R.D.L-bound tests confirmed longterm association established amongst the series (Table 5).

**Table 3: A.D.F and P.P. unit-root test**

Variables	Augmented dickey-fuller test				Phillips perron test			
	t-Stat		Prob.		t-Stat		Prob.	
	Level		First Diff.		Level		First Diff.	
EXPORT	-2.406	0.371	-8.071***	0.000	-2.361	0.393	-8.540***	0.000
GCF	-2.045	0.559	-6.212***	0.000	-2.172	0.491	-6.211***	0.000
GDP	-2.272	0.438	-4.640**	0.004	-1.953	0.607	-4.636**	0.004
LABR	-4.919**	0.002			-5.886***	0.000		
NG	-2.625	0.272	-6.716***	0.000	-2.863	0.185	-10.318***	0.000

\*\*\*and \*\* 1% and 5% levels of the significance correspondingly

**Table 4: Johansen cointegration test**

Trace test				
No. of CE(s)	Eigenvalue	Statistic	Critical value	Prob.
None*	0.830	124.290	69.819	0.000
At most 1*	0.678	62.238	47.856	0.001
At most 2	0.346	22.571	29.797	0.268
At most 3	0.191	7.704	15.495	0.498
At most 4	0.008	0.272	3.841	0.602
Maximum eigenvalue test				
None*	0.830	62.052	33.877	0.000
At most 1*	0.678	39.667	27.584	0.001
At most 2	0.346	14.867	21.132	0.298
At most 3	0.191	7.432	14.265	0.439
At most 4	0.008	0.272	3.841	0.602

\*\*\*, \*\* and \*Show 1%, 5% and 10% levels of significance correspondingly

**Table 5: The ARDL-bound test**

F-statistics	4.311	
Critical value bounds		
Significance	I <sub>0</sub> Bound	I <sub>1</sub> Bound
10%	2.45	3.52
5%	2.86	4.01
2.50%	3.25	4.49
1%	3.74	5.06

**Table 6: ARDL long and short-run results**

Dependent variable: NG				
Long run coefficients				
Variable	Coefficient	Std. error	t-Statistic	Prob.
GDPPC	-0.445**	0.147	-3.025	0.005
GCF	1.177*	0.426	2.763	0.010
LABR	5.148**	2.484	2.072	0.048
EXPORT	0.618**	0.291	2.122	0.043
C	-22.326**	9.826	-2.272	0.031
Short run coefficients				
D(NG(-1))	0.293*	0.145	2.015	0.054
D(GDPPC)	-0.301**	0.132	-2.276	0.031
D(GCF)	0.312	0.425	0.735	0.469
D(LABR)	0.984	1.200	0.820	0.420
D(LABR(-1))	-1.672	1.133	-1.475	0.152
D(EXPORT)	0.418**	0.186	2.251	0.033
ECM(-1)	-0.675***	0.143	-4.715	0.000
Model diagnostics				
R-squared				0.810
Adjusted R-squared				0.747
Durbin-Watson				2.181
Ramsey RESET test				0.094
LM test				0.228
Heteroscedasticity test				0.197

\*\*\*, \*\* and \* show 1%, 5% and 10% levels of the significance correspondingly

The ARDL short-run and long-run results are shown in the Table 6;

This study points out that long-term result remains consistent. The long-term result listed in the Table 6. Results indicate that, the economic growth having a significant and negative impact on the (NS) natural-gas consumptions. It is found from these empirical-results that, 1% change in economic growth will lead to a 0.445% decrease in the natural gas rents, while other conditions remain unchanged (Apergis and Payne, 2010; Demirbas, 2009). Therefore, this means that natural gas-NS will not-directly increase the development of the Indonesian economy. Contrary to this, developing study found out how the exports are positively and importantly linked to natural gas consumption. Subsequently, for every 1% increase in exports, Indonesia's natural gas-NS consumptions will increase by 0.618%.

The influence of the capital on (NS) natural-gas leasing also remains positive, with a statistical significance of 1%. The results show that physical capital increased by 1% and natural-gas (NS) consumption increased by 1.177%. In another development, the research found that this work also had a significant and positive influence on Natural gas consumption in Indonesia. On the other

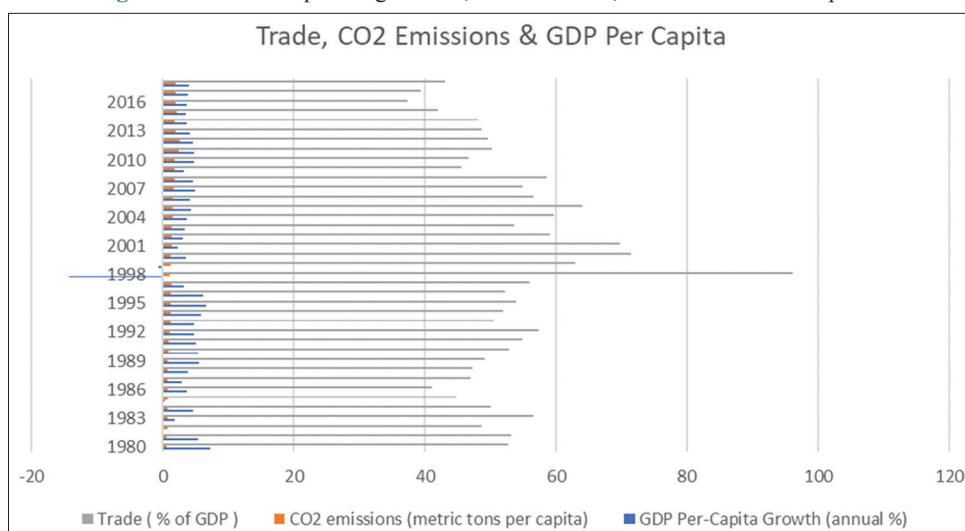
hand, exports have significantly boosted the use of NG in the case of Indonesia. Which means if there is an increase in the one unit of exports, it will enhance the energy use by 0.618% which is also verified from (Arora and Cai, 2014)

The result of the short-term analysis shown in the Table 6 (bottom half). The result showcased that there is a negative correlation between economic development also natural-gas consumptions. In the short term, 1% of the economic development will reduce natural-gas consumptions by 0.301%. There is a positive correlation amongst exports and natural-gas, which is statistically at 5%. It turns out that capital also natural-gas (NS) having a positive also insignificant connection. The influence of the labor over the natural-gas (NS) consumptions is positive, but in the short term, it is insignificant statistically. The value of the error correction term is statistically significant and negative. This estimated ECM for the lag is the 0.675. This indicates that, in natural gas (NG) consumption function, the long-term short-term deviation will be corrected by 67.5% annually. Diagnostic test results show that the R-square value is 0.810 which is almost 81 %. This means that the taken indicators explain that NG is 81% which is quite good. DW statistics are used for the model is good or not, so its value is 2.181 which is

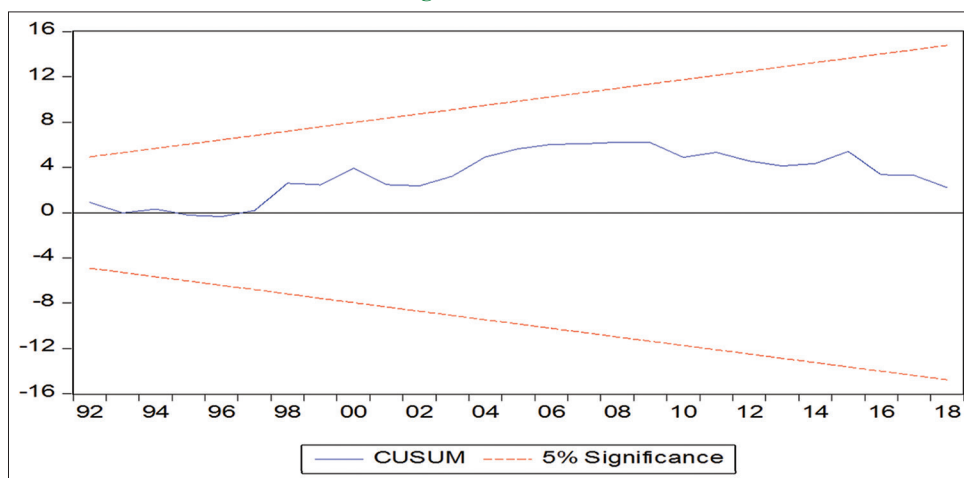
higher than 1.65, so it also confirms the model is the best fit. LM test is used to check the sequence correlations problem in the regression and there does not exit the problem of no sequence correlations.

On the other hand, there does not exit the problem of heteroscedasticity which is confirmed from the ARCH test. When looking for the stability of the long-term and the short-term parameter of the natural gas (NG) consumptions-function, we

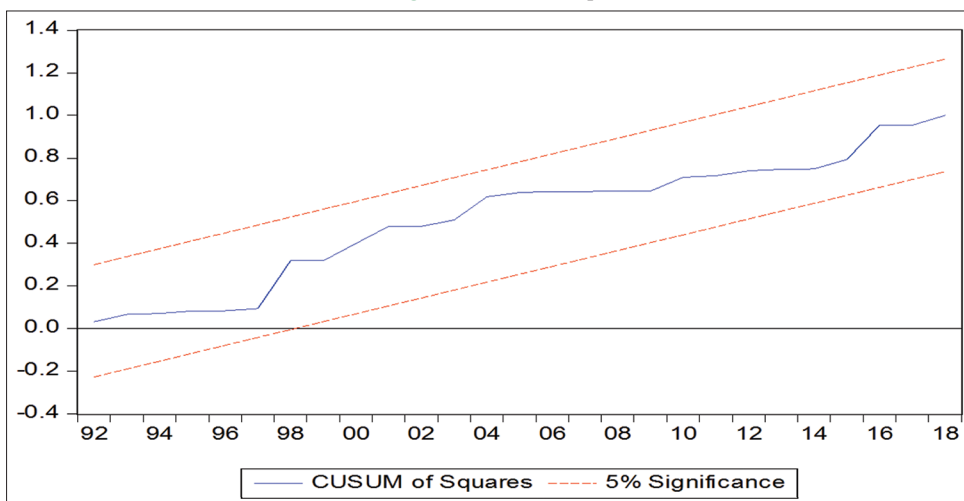
**Figure 1:** Relationship amongst Trade, CO2 emission, and economic development



**Figure 2:** CUSUM



**Figure 3:** CUSUMsq



used the CUSUM and CUSMUSq test. The plots of each test shown in Figures 2 and 3; they appear to be with-in this line also significant over the 5% levels. Which implies that the natural gas (NG) consumptions-function show consistent also valid parameter in long the short term, which has been confirmed by the all the model diagnostics tests.

## 5. THE CONCLUSIONS AND POLICY IMPLICATIONS

This research explains the association amongst natural-gas (NG) consumptions with the help of economic growth by incorporating the capital, exports, and labor into the increased neoclassical production function. Its primary purpose is to determine whether the natural-gas (NG) consumptions, capital, exports, and labor can provide a clue to the prospect of Indonesia's plan. The research utilized the yearly data from the year 1980 up-to year 2018. In order to ensure reliable results, applied the Augmented Dickey-Fuller and Phillips Perron unit root test and Johansen cointegration test used to determine the comprehensive nature of indicators. ARDL bound methodology used to estimate the long-term and short-term dynamic amongst the constructs while using VECM-framework to determine the causal association amongst variables, also use innovative solutions.

The outcomes showed that the (NG) natural-gas consumptions, economic growth, capital, exports, and labor are integrated into the long-run. The results of this study indicate that the economic development has reduced Indonesia's gas consumption. This means that the consumption of the (NG) natural-gas will not lead to Granger's economic growth in Indonesia. Contrary to this conclusion, the study found that exports are having a significant and positive impact on the (NG) natural gas consumption. Additionally, the capital found to have a significant and stimulating effect over Indonesia's natural gas (NG) consumptions. The research also found that how Indonesia's labor force has a significant impact on gas-consumptions. Contrarily to this, the results of the causal analysis revealed a feed back association amongst the (NG) natural-gas consumptions also the economic development. This means that Granger's economic-developments leads to natural gas (NG) consumptions, so natural-gas (NG) consumptions caused by Granger's economic development. The association amongst the exports and the natural-gas (NG) consumptions has been found to have a two-way impact. Also, the same deductions for the capital and the natural gas (NG) consumptions can be derived.

In the other development, the causal association amongst labor with natural gas (NG) consumptions was discovered. Based on previous developments and to ensure realistic results, this study supports the development of realistic results to make Indonesia's labor force more reliable contribution. This is because the study found that the 5.14% contribution of Indonesia's labor force is not enough to make the country eliminate the contribution of foreign experts; therefore, more rigorous economic-efforts also the strategic unity of all the economic factor would be promoted to achieve a significant-economic level. The results of this study are precise, When the Indonesian economy achieves its idealized

vision, there is no doubt that the pressure on labor and energy demand will be enormous, and it may put more pressure on the required energies also the innovations. To support the high-state income of the country, that is because a close replacement for the demand for energies and work can-not be observed. In the sense of achieving significant and sustainable economic growth, communications, education, transportation, industrial operations and health require the utilization of energy and qualified Labor to ensure the large-scale operation of the system. Also, as any development plan points out, to improve the quality of life, it is necessary to continue to increase food production, increase industrial production, access to hospitalizations, better health care and alternative human services; therefore, for each of these and to flourish. As far as an actual development plan for the development is concerned, the use of energy and specialized labor is entirely inevitable. After that, the high energy demand required to reach the desired economic growth position in Indonesia will increase significantly beyond normal-industrial also household consumptions, especially if require levels of economic development must be kept up to date. Dynamic changes in the quality of life and optimal-industrial needs.

In order to reduce those mentioned above major political influences, the study suggests the need for advanced industrial technologies that will not only be attractive to Indonesia's energy supplies but it will also address environmental-degradations and also reduce pressure. Regarding possible energy consumption, it will also support the well-being of Indonesian citizens by reducing carbon dioxide ( $\text{CO}_2$ ) emission by the natural-gas (NG) emissions because it has less-emission than the rest of the energy structure used in the country. At household-levels, substantial investment energy infrastructure would be encourage, which may help to meet the need for efficient use of energy simultaneously. In this way, economic performance and environmental quality can be maintained and balanced. If implemented, this development will bring Indonesia in line with Kyoto-Protocol, will also make sure of the advancement of its citizens' social status, and achieve the best realization of production optimization, thereby achieving efficient use of capital. In turn, all things being equal, efforts to accelerate the country's GDP growth prospects will ultimately be supported by the infrastructure development that already exists in high-income countries.

## REFERENCES

- Akbar, F.H., Pasiga, B.D., Samad, R., Rivai, F., Abdullah, A.Z., Awang, A.H., Pasinringi, S.A., Saleh, L.M., Irwandy, Pratiwi, D. (2020), The relationship between service quality, culture similarity to satisfaction and loyalty of medical (dental) tourism. *Systematic Reviews in Pharmacy*, 11(12), 19-30.
- Al-Blooshi, H., Al-Shami, S.A., Adil, H., Sidek, S. (2020), A review paper on mhealth continuous intention among diabetes users in the developing countries. *Systematic Reviews in Pharmacy*, 11(12), 150-159.
- Al-Mulali, U., Ozturk, I. (2016), The investigation of environmental Kuznets curve hypothesis in the advanced economies the role of energy prices. *Renewable and Sustainable Energy Reviews*, 54, 1622-1631.
- Al-Mulali, U., Saboori, B., Ozturk, I. (2015), Investigating the

- environmental Kuznets curve hypothesis in Vietnam. *Energy Policy*, 76, 123-131.
- Apergis, N., Payne, J.E. (2010), Natural gas consumption and economic growth: A panel investigation of 67 countries. *Applied Energy*, 87(8), 2759-2763.
- Apergis, N., Payne, J.E. (2012), Renewable and non-renewable energy consumption-growth nexus: Evidence from a panel error correction model. *Energy Economics*, 34(3), 733-738.
- Arora, V., Cai, Y. (2014), US natural gas exports and their global impacts. *Applied Energy*, 120, 95-103.
- Asghar, Z. (2008), Energy-GDP relationship: A causal analysis for the five countries of South Asia. *Applied Econometrics and International Development*, 8(1), 1-14.
- Bakhtyar, B., Kacemi, T., Nawaz, M.A. (2017), A review on carbon emissions in Malaysian cement industry. *International Journal of Energy Economics and Policy*, 7(3), 282-286.
- Bayer, C., Hanck, C. (2013), Combining non-cointegration tests. *Journal of Time series analysis*, 34(1), 83-95.
- Burgos, A.L., Bocco, G. (2020), Contributions to a theory of rural innovation. *Cuadernos de Economía*, 39(79), 219-247.
- Carranza, R.J.E., González, E.C.G., Bocanegra, O.G.E. (2020), The effect of economic activity on homicidal violence: New evidence for Colombia based on panel data. *Cuadernos de Economía*, 39(79), 355-388.
- Chen, J., Liu, J., Wang, Y., Li, P. (2020), Behavioral psychology analysis of individual decision, strategic interaction and climate governance. *Revista Argentina de Clínica Psicológica*, 29(1), 423-434.
- Chen, L., Zhen, J., Dong, K., Xie, Z. (2020), Effects of sanction on the mentality of information security policy compliance. *Revista Argentina de Clínica Psicológica*, 29(1), 39-49.
- Codina, N., Pestana, J.V., Stebbins, R.A. (2020), Fitness training as a body-centered hobby: The serious leisure perspective for explaining exercise practice. *Journal of Sport Psychology*, 29, 73-81.
- Das, A., McFarlane, A.A., Chowdhury, M. (2013), The dynamics of natural gas consumption and GDP in Bangladesh. *Renewable and Sustainable Energy Reviews*, 22, 269-274.
- Demirbas, A. (2009), Political, economic and environmental impacts of biofuels: A review. *Applied Energy*, 86, S108-S117.
- Dihor, V., Alekseeva, A., Lomtadze, O. (2020), Комплексная психофизиологическая оценка эмоционального состояния футбольных фанатов : Динамика в условиях саморегуляции. Критерии и Индикаторы, 29, 213-219.
- EIA. (2011), *International Energy Outlook*. Washington, DC: US Energy Information Administration.
- Ewing, B.T., Sari, R., Soytaş, U. (2007), Disaggregate energy consumption and industrial output in the United States. *Energy Policy*, 35(2), 1274-1281.
- Farhani, S., Shahbaz, M., Arouri, M., Teulon, F. (2014), The role of natural gas consumption and trade in Tunisia's output. *Energy Policy*, 66, 677-684.
- Fatai, K., Oxley, L., Scrimgeour, F.G. (2004), Modelling the causal relationship between energy consumption and GDP in New Zealand, Australia, India, Indonesia, The Philippines and Thailand. *Mathematics and Computers in Simulation*, 64(3-4), 431-445.
- Ghatak, S., Siddiki, J.U. (2001), The use of the ARDL approach in estimating virtual exchange rates in India. *Journal of Applied statistics*, 28(5), 573-583.
- Grossman, G.M., Helpman, E. (1989), *Comparative Advantage and Long-Run Growth*: National Bureau of Economic Research.
- Hornung, J.J. (2020), Comments on "Ornithocheirus hilsensis" Koken, 1883-one of the earliest dinosaur discoveries in Germany. *Palarch's Journal of Vertebrate Palaeontology*, 17(1), 1-12.
- Hosseini, S.E., Abdul, W.M. (2014), The role of renewable and sustainable energy in the energy mix of Malaysia: A review. *International Journal of Energy Research*, 38(14), 1769-1792.
- Ighodaro, C.A. (2010), Co-integration and causality relationship between energy consumption and economic growth: Further empirical evidence for Nigeria. *Journal of Business Economics and Management*, 1, 97-111.
- Janssen, R. (2020), The pleated dress of nywt. *Palarch's Journal of Archaeology of Egypt/Egyptology*, 17(1), 1-11.
- 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.
- Loganathan, N., Subramaniam, T. (2010), Dynamic cointegration link between energy consumption and economic performance: Empirical evidence from Malaysia. *International Journal of Trade Economics and Finance*, 1(3), 261-267.
- Lütkepohl, H. (2006), Structural vector autoregressive analysis for cointegrated variables. *Allgemeines Statistisches Archiv*, 90(1), 75-88.
- Nawaz, M.A., Azam, M.A., Bhatti, M.A. (2019), Are natural resources, mineral and energy depletions damaging economic growth? Evidence from ASEAN countries. *Pakistan Journal of Economic Studies*, 2(2), 37-54.
- Okuy, U., Aricioglu, E., Yucel, F. (2014), Energy consumption and economic growth nexus: Evidence from developed countries in Europe. *International Journal of Energy Economics and Policy*, 4(3), 411-419.
- Pesaran, M.H., Shin, Y. (1998), An autoregressive distributed-lag modelling approach to cointegration analysis. *Econometric Society Monographs*, 31, 371-413.
- Rafindadi, A.A. (2015), Could the expanding economic growth and trade openness of the United Kingdom pose a threat to its existing energy predicaments. *International Journal of Energy economics and policy*, 5(1), 121-137.
- Shahbaz, M., Lean, H.H., Farooq, A. (2013), Natural gas consumption and economic growth in Pakistan. *Renewable and Sustainable Energy Reviews*, 18, 87-94.
- Siddiqui, R. (2004), Energy and economic growth in Pakistan. *The Pakistan Development Review*, 43, 175-200.
- 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.
- Tugcu, C.T., Ozturk, I., Aslan, A. (2012), Renewable and non-renewable energy consumption and economic growth relationship revisited: Evidence from G7 countries. *Energy Economics*, 34(6), 1942-1950.
- Yu, E.S., Choi, J.Y. (1985), The causal relationship between energy and GNP: An international comparison. *The Journal of Energy and Development*, 10, 249-272.
- Zin, R.H.M. (2017), Malaysian development experience: Lessons for developing countries. *Institutions and Economics*, 6, 17-56.