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Article

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Influence of the Renewable and Non-Renewable Energy Consumptions and Real-Income on Environmental Degradation in Indonesia

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ABSTRACT

The purpose of this research is to determine the effects of the income (GDP), renewable-energy consumptions and the non-renewable energy consumptions over the (CO_2) carbon dioxide emission for Indonesia by Kuznets Environmental Curve (EKC) model for the time span of 1980 to 2018 period. The study uses the time series data so in order to check the order of integration of the variables, the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) unit root test have been applied. Furthermore, the study has used the autoregressive-distributed lag (ARDL) methodology to estimate the cointegration in-between the model and also for long and short-run estimates of the model. ARDL Bound test confirms the cointegration among the CO_2, income, energy consumption, renewable and nonrenewable energy consumption. Long-term estimates obtained from ARDL. model show that increasing renewable energy consumptions reduces degradation of the environment while increasing nonrenewable energy consumptions boosts the level of CO_2 emissions. GDP has a negative while the square of GDP has a positive impact on CO_2 emission levels. Moreover, the EKC. assumption does not hold for Indonesia because the coefficient of income and income square are opposite, and the results of current studies are consistent and unbiased. This study suggested that in order to reduce the CO_2 emissions Indonesian government needs to: adopt renewable energy resources, encourage the industries to adopt clean technology and renewable energies, and raise public-awareness of healthy ways of energy-consumptions.

Keywords: Renewable Energy, CO_2 Emissions, Environmental Kuznets Curve, Autoregressive-Distributed Lag
JEL Classifications: O13, Q42, Q43

1. INTRODUCTION

Over the past few years, the level of carbon dioxide (CO_2) emissions has enormously raised. It is observed that CO_2 emissions have increased by up to 84% from 19.35 to 35.84 million kilotons during the time period 1980-2013, respectively (World Bank, 2020). Baek (2015); Dogan and Turkekul (2016); Soytas et al. (2007) proved that rise in the aggregate energy consumptions give carbon (CO_2) emission in Indonesia discuss by many researchers. Dogan and Seker (2016c); Farhani and Ozturk (2015); Farhani and Shahbaz (2014); Kais and Mbarek (2017); Pao and Tsai (2011); Shahbaz et al. (2015); Shahbaz et al. (2013); Tang and Tan (2015); Tiwari et al. (2013); Zhang and Gao (2016) found the same results from different regions and countries.

Although Indonesia has great importance in world affairs and energy markets, and is responsible for a significant share of the world emissions and production, to decrease the greenhouse gas emissions it has not accepted a commitment at a global context, Kyoto protocol also not joined by Indonesia. In this context, Interestingly, Indonesia has been experienced the significant portion of energy-uses from fossil fuel (petroleum, coal, oil and natural gas) such that almost 83% and 91% came from fossil fuels of total energy consumption in 1980 and 2013, respectively

(World Bank, 2020; Abadía and de la Rica, 2020; Bibi, 2020). Over the same time period, as in Indonesia, the number of fossil fuels total energy consumption in the EU's fallen from 92 to 72%. The carbon emissions decrease interestingly by almost 20% from 1980 to 2013. Here the first important point is the utilization of nonrenewable energies and the positive association between levels of emissions. The other significant point is that the EU as a whole, as different to Indonesia, with the commitment to diminish the level of CO_2 productions, joined the Kyoto protocol and upsurge the level of the renewable-energies in the energy-mix. Renewable energy consumptions on the carbon (CO_2) emission have an adverse effect on the EU established by (Dogan and Seker, 2016a; López-Menéndez et al., 2014). Our purpose is to inspect the influence of nonrenewable energies and use of renewable-energy on carbon productions. Table 1 displays the association among renewable energies and environmental degradation. The studies of Baek and Pride, (2014); Al-Mulali and Ozturk (2016); Al-Mulali et al. (2015); (Baek and Pride, 2014); Bölük and Mert (2014); Chiu and Chang (2009); Dogan and Seker (2016c); Jebli and Youssef (2015); Jebli et al. (2016); Shafiei and Salim (2014); Sulaiman et al. (2013) have explored that environment significantly related to renewable energy as it reduces the level of carbon emissions. Table 1 is showing the data gathered from World Development Indicators (WDI) from the year 2000 to 2018. Over time there is an increasing trend in the economic growth and carbon emission level. For example, in 2000, the growth rate is 3.48 and the carbon emission level is 1.24 metric ton and in 2018, growth increase to 3.98 and carbon emission level to 2.0 metric tons. While the data shows that the use of renewable-energy in Indonesia is decreasing over time. For example, in 2000, renewable consumption was 45.58% of total energy consumption, and in 2018,the usage of renewable-energy decreased by 39.87 % of total energy consumption.

Figure 1 is showing the association amongst CO_2 emission, the openness of trade, GDP Per Capita and also Renewable Energy-Consumptions. Moreover, graphs show that with the increase in time there is a positive trend in economic development and CO_2 emission levels which means that there is an increasing trend in economic expansion and CO_2 emission level while on the other hand there exists the inverse relationship between the carbon emission level and use of renewable energy consumption in Indonesia, which confirms that with the increase in time decrease the level of consumption with the increase in the level of carbon emission level in Indonesia.

On the bases of the findings of this study, recommendations would be made to the government of Indonesia to pay more attention to the renewable energy sources; to encourage and support the acceptance and use of clean technologies and renewable energy; and to raise awareness in the public regarding the use of renewable energy to protect the environment. Most of the present studies based on panel data that define the association amongst environmental development and renewable energy consumptions find out the same coefficient parameters between regions within the panel. Hence, one country's studies are of interest for scholars and policymakers to attain more precise and reliable results for specific countries. In the rest of the study, Section 2 discusses the literature review. Section 3 is about data and methodology. Section 4 consists of the empirical results and discussion. Finally, conclusion and policy recommendations are given in the last section.

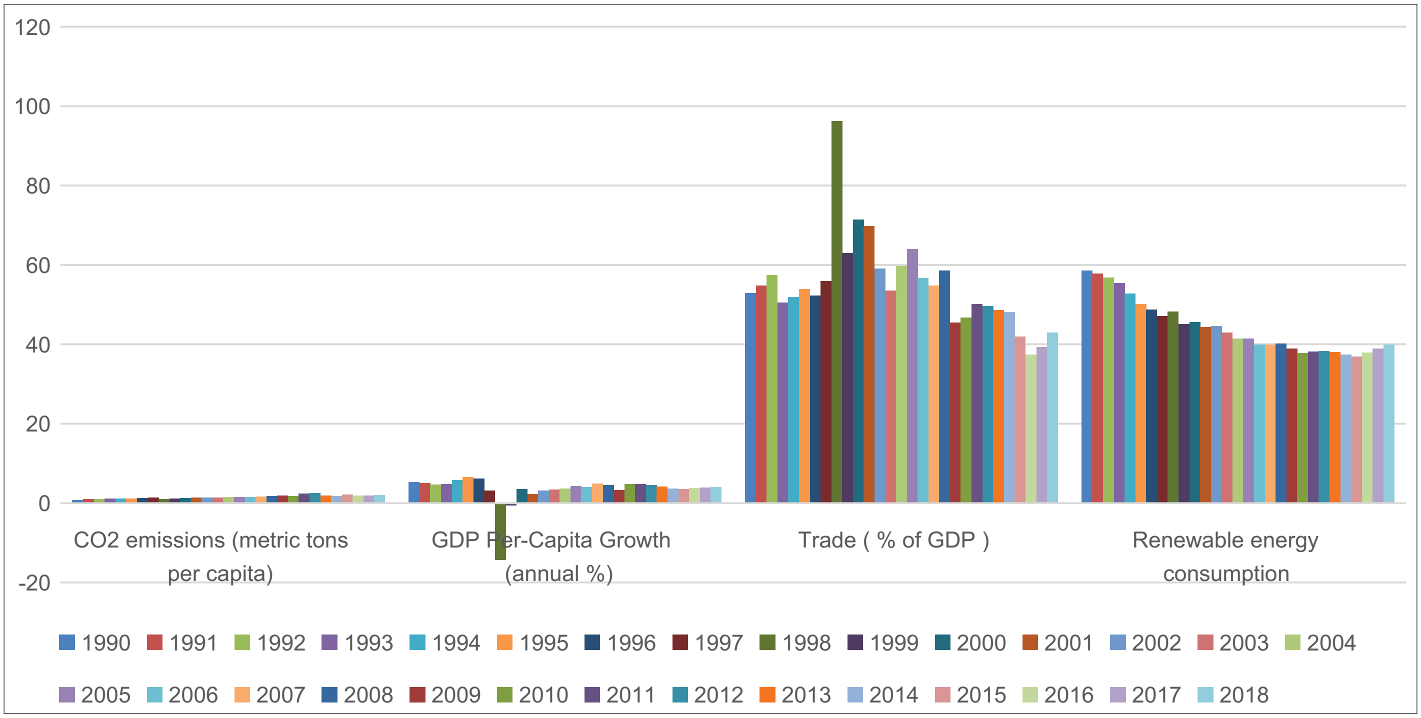
2. LITERATURE REVIEW

The amount of carbon emission is increased from the past years, so in the literature, several studies discuss and empirically estimate the reason and factors that boost the carbon emission level. The first cluster of researches converging the USA economy uses and estimates the effect of total energy consumption and therefore unable to find out the association between environment, nonrenewable energy and renewable energy (Baek, 2015; Dogan and Turkekul, 2016; Soytas et al., 2007; Bai et al., 2020; Chang and Huang, 2020; Abdulateef et al., 2020). The second cluster attempts to clarify the Environmental-Kuznets-Curve (EKC) significance of the energy consumptions (Koirala and Mysami, 2015). In the third cluster, the EKC and nonrenewable energy consumptions is consider in the study (Jaforullah and King, 2015; Carolina-Paludo, 2020). The last cluster examined causation amongst economic growth, the (CO_2) carbon emission and renewable energy. The study did not estimate the long-term coefficient. Hence, that is unable to recognize the influence of the consumption of renewable-energy on environmental degradation is either negative or statistically significant or not (Menyah and Wolde-Rufael, 2010; Payne, 2012). Most fundamentally, the selection of methodology is in these studies is found to be the weak. And most of these problem which is missed in the literature so, the results are not unbiased and will be spurious i.e. because of unexpected energy shocks experienced in countries (structural change), macroeconomic variables and environment, without a structural break the use of econometric methods (Bakhtyar et al., 2017; Dogan, 2016; Vaona, 2012; Aragonés-Jericó and Vila-lópez, 2020). Kais and Mbarek (2017) explained that carbon emission decreases as renewable energy consumption or trade increases. It recommends that a rise in renewable energy-consumptions or trade are effective policies to contest global warming in those nations.

Table 1: Carbon-dioxide emission, the GDP. PerCapita, trade and the renewable energy consumptions

Years	CO_2 emission (metric ton per-capita)	GDP PerCapita growth (annual%)	Trade (% of GDP)	Renewable energy consumption
2000	1.24539825	3.482209125	71.43687592	45.58150099
2005	1.511302112	4.289595233	63.98793587	41.44568581
2010	1.772951392	4.812281788	46.70127388	37.75342034
2015	2.110135466	3.555439566	41.93764024	36.8793481
2016	1.958784332	3.759693805	37.4213418	37.8793481
2017	1.962766059	3.83998242	39.36274549	38.8793481
2018	2.010561952	3.985604226	43.02166412	39.8793481

Figure 1: CO_2 emission, GDP per capita, trade and renewable energy consumptions



A group of the OECD-Countries described an increasing influence of trade on GDP per capita by using an reversed U shaped Environmental Kuznets Curve (EKC). There are some other studies which explained that tourism is an essential factor for environmental conditions. Jebli and Youssef (2015) explained the situation of Tunisia by proving a dynamic causal affiliation among output, waste consumptions, (CO_2) carbon discharge, and flammable renewables and international-tourism. The finding of the study showed that carbon emission increases due to waste consumption, international tourism and combustible renewables. Kula (2014) researched the relationship amongst GDP. growth and renewable energy-consumptions by considering panel data. The research obtained unidirectional causality between these variables while (Apergis and Payne, 2010; Nawaz et al., 2019; Shahbaz et al., 2015) disclosed a bi-directional causality linkage amongst them. Bhattacharya, Churchill, and Paramati (2017) influenced the economic development and renewable-energy over the (CO_2) carbon emission is extensive heterogeneity in different economies. Moreover, some researchers examined the impression of use on renewable energy on environmental deprivation in the BRICS region but mostly failed to find out the heterogeneity effect and cross-sectional-correlations.

Ummalla and Samal (2019) inspected causal relationships amongst the economic growth, renewable energy-consumptions and the (CO_2) carbon emission in India and China, and also discovered that variable concern has the long-term equilibrium-association. Nguyen and Kakinaka (2019) discovered how the relationship amongst the carbon emission and renewable energy-consumptions is related with a stage of development by using a panel of 107 countries for panel cointegration analysis from 1990 to 2013. The result found that there is a clear difference between high and low-income groups. In the low-income economies, the use of renewable-energy-have a damaging impression on the outputs and positive on carbon emissions. Though, for the high-income economies, renewable energy-consumptions are positively effecting output and negatively with the carbon-emission. Dong et al. (2018) explained the connection among economic growth, (CO_2) carbon emission, the renewable energies and population growths, and unbalanced panel-data of 128 economies from the time period from 1990–2014 across regions. The findings of the research revealed that the economic development and population size significantly and positively impacting on CO_2 emissions in both the regional and global levels.

To investigate the relationship amongst economic growth also of the emission of CO_2 in the United States of America by using of the time series data range from the 1980 to 2010. Findings of the investigation proved that the presence of EKC assumption in the USA through trade openness, gross domestic product GDP per capita of individuals also other households and consumption of the energy found having a direct positive and significantly impact on to the environment. However, the income square having an inverse and statistically significant association (Hamed et al., 2014). In Brazil, an investigation was done over a period from the year 1975 to the year 2014 to examined the association among per capita incomes of individuals and the phenomenon of deforestation (Xu and Lin, 2015). Findings of the research done in Brazil were related to those of the (Cen, 2015; Dogan and Turkekul, 2016; Fazli and Abbasi, 2018; Ogundari et al., 2017; Polomé and Trotignon, 2016; Rafiq et al., 2016; Raheem and Ogebe, 2017; Sehrawat et al., 2015; Shahbaz et al., 2016; Xu and Lin, 2015; Zambrano-Monserrate et al., 2018).

Numerous studies explained the association amongst degradation of the environment and economic development by using inverted-U shaped Environmental-Kuznets-Curve (EKC). In the initial phases of development, economic-growth cause degradation of the environment (Grossman and Krueger). After the beginning level of development, the environment improves due to economic activity which improves environmental awareness(Baltagi et al., 2000). The current study justifies the gaps described in the existing literature. It investigates the influence on (CO_2) carbon emission of renewable also non-renewable energy use and the real GDP .of Indonesia by applying the (EKC) Environmental-Kuznets-Curve assumption. The research uses the Augmented Dickey-Fuller and Phillips Perron Unit-Root tests adding structural-break, for long run estimation, the Autoregressive-Distributed lag (ARDL) model and for checking the cointegration amongst the model use the ARDL bound test.

3. DATA AND METHODOLOGY

According to the recent empirical researches (Bölük and Mert, 2014; Farhani and Shahbaz, 2014) used the EKC hypothesis, which is expressed in equation 1. Among them, the CO_2 productions have been depending on the GDP, a square of the GDP, the consumption of renewable energies (REC) also the consumption of nonrenewable energies (NREC):

$$CO_2 = f(GDP, GDP^2, RENG, NRENG) \quad (1)$$

The use of intercept expresses the EKC hypothesis γ_o with the error term ε_t. Furthermore, which is expressed in equation 2.

$$CO_{2t} = \gamma_o + \gamma_1 GDP + \gamma_2 GDP^2{}_t + \gamma_3 RENG_t + \gamma_4 NRENG_t + \epsilon_t \quad (2)$$

According to equation 2, where, the CO_2 emission (kilo-tons); the GDP is gross-domestic products(constants 2010 US-$); REC. is the Renewable-energy consumptions share of the renewable-energy (total of the final energy-consumptions); NREC Renewable-energy consumptions is share of the renewable-energy (total of the final energy-consumptions). Data for analysis taken from the World Development Indicators (WDI) (World Bank, 2020).

Annual time-series data from 1980 up-to 2018 is used for the estimation. Since natural log ($\gamma_k$where, k = 1, 2, 3, 4) is taken for the entire data to interpret the elasticities for the (CO_2) carbon emission is the endogenous indicator with economic growth, a square of economic growth, RENG, and NRENG are the exogenous indicators. Expected sign of γ_1 is positive and γ_2 is negatively, then the EKC assumption become effective for Indonesia. Expected signs of γ_3 and γ_4 are positively and negatively signifying the renewable-energy arises from ecological-friendly source whereas, nonrenewable energies are the unfavorable ecological resource of energy.

3.1. Methodology

This section explores the stationary characteristics of time-series variable, co-integration level, and relationships of carbon production with long-term estimates of the renewable and nonrenewable energy-consumptions in GDP, GDP2, and carbon emission.

3.2. The Unit-Root test

The primary aim of utilizing the unit-root tests to check either the series has the unit root or not. While if the series has the unit root and analyzed, the results are not unbiassed and regression is spurious instead of determination of coefficient R^2 (the model is well adapted) is significant. Moreover, if the series has cointegration with nonstationary at the level the results are also biased and not consistent. In order to overcome this highlighted issue Augmented-Dickey Fuller and Phillips Perron (PP) unit root test used in this study. Moreover, the results of both tests are given in Table 2. We discard null-hypothesis which is: (GDPSQ), carbon (CO_2) emanations, renewable GDP. and non-renewable-energies consumptions remain stationary at level. On the other side, we have sufficient indication in order to determine that their first differences are stable at a 5% significance level.

3.3. Johansen-Cointegration

To ensure the co-integration amongst the carbon (CO_2) emanation, the GDP, square of GDP and the renewable also the nonrenewable energy-consumptions, this research uses the Johansen co-integration test and the findings are displayed in Table 3,

The results of the Johansen cointegration test are presented in Table 3. There we have used two tests first is trace test and the second one is the Eigen-values test. Both tests have the same assumption, and according to both of them, we reject the null hypothesis until the 3rd lag. That is there exit more than 3 co-integration equations in the model. Results ensure that there exits more than three co-integration equation in the above system. Hence Johansen co-integration confirms that there exists the co-integration among in the model which is further verified from the ARDL and ARDL bound test. So in this study applied the ARDL technique to co-integration which is introduced by (Pesaran et al., 2001) in order to approve further results revealed ARDL bound test results presented in Table 4 and ARDL short and long-run empirical results explain in Table 5. Bound test followed the linear model which follows the specification which is given by (Pesaran and Pesaran, 2009), so according to (Pesaran et al., 2001) the ARDL model will become like in equation 3;

Table 2: Unit-Root test

Tests	ADF test				PP test				Result
Variables	t-Statistic	Prob.	t-Statistic	Prob.	t-Statistic	Prob.	t-Statistic	Prob.	I(1)
CO_2	−2.369	0.389	−6.259	0.000	−2.369	0.389	−7.208	0.000	I(1)
GDP	−2.206	0.472	−4.609	0.004	−2.012	0.577	−4.639	0.004	I(1)
NRENG	−0.726	0.963	−8.406	0.000	−0.908	0.945	−17.313	0.000	I(1)
RENG	−0.828	0.954	−5.325	0.001	−1.291	0.875	−5.409	0.000	I(1)

Table 3: The Johansen-cointegration test

Trace test				
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical value**	**Prob.**
None*	0.789	135.295	69.819	0.000
At most 1*	0.720	79.320	47.856	0.000
At most 2*	0.499	33.556	29.797	0.018
At most 3	0.213	8.688	15.495	0.395
At most 4	0.002	0.071	3.841	0.790
Eigenvalue test				
None*	0.789	55.976	33.877	0.000
At most 1*	0.720	45.763	27.584	0.000
At most 2*	0.499	24.868	21.132	0.014
At most 3	0.213	8.617	14.265	0.319
At most 4	0.002	0.071	3.841	0.790

Table 4: The ARDL bond test

Test Stats	Value	k
F-stats	5.511635	4
Critical limits		
Sig.	**I_0 Bound**	**I_1 Bound**
5%	2.86	4.01
1%	3.74	5.06

$$CO2_t = \theta_o + \sum_{i=1}^{p}\theta_1 \Delta CO2_{t-1} + \sum_{i=0}^{p}\theta_2 \Delta GDP_{t-1} + \sum_{i=0}^{p}\theta_3 \Delta GDP^2_{t-1} + \sum_{i=0}^{p}\theta_4 \Delta RENG_{t-1} + \sum_{i=0}^{p}\theta_5 \Delta NRENG_{t-1} + \theta_6 CO2_{t-1} + \theta_7 GDP_{t-1} + \theta_8 GDP^2_{t-1} + \theta_9 RENG_{t-1} + \theta_{10} NRENG_{t-1} + \epsilon_t \quad (3)$$

According to equation 3, Δ shows that the indicators used in this study are first differenced. While intercept of the equation is represented by the θ_o, short-run estimates of the equation are given by θ_1 to θ_5. And long-run estimates are given by θ_6 to θ_{10} in the last ε_t characterizes the error term of the equation. To approximation the long-run association among (CO_2) carbon emission, GDP, GDP^2, RENG, and NRENG, joint F-statistic is used.

3.4. ARDL Bond Cointegration Test

Table 4 shows the "F" statistic achieved from bound tests of the cointegration. There is sufficient indication to rejects null-hypothesis (no co-integration) in-favor for the alternative hypothesis (co-integration), between data analyzed with 5% levels of the significance as F-statistic remains greater as compared to the critical values of 95%. The findings of the ARDL-bound test specify that there exists long-term association amongst carbon-emission, the GDP, quadratic GDP, RENG and NRENG for Indonesia.

4. ARDL RESULT AND DISCUSSION

The long-run relationship exists in the above-given model, which is verified from both Johansen Cointegration and ARDL-bound test. The ARDL econometrics technique estimates equation 2 depends on the EKC theory, and that. Long-run estimations of GDP^2, GDP and the renew-able and nonrenewable energies on the (CO_2) carbon emission are showed in Table 5.

Table 5: ARDL results

Short-run results				
Variable	**Coeff.**	**Standard error**	**t-Stats**	**Prob.**
D(CO2(−1))	0.735	0.349	2.108	0.052
D(CO2(−2))	0.259	0.272	0.952	0.356
D(CO2(−3))	0.582	0.215	2.706	0.016
D(GDP)	109.723	35.527	3.088	0.008
D(GDP(−1))	−1.677	0.937	−1.790	0.094
D(GDP(−2))	0.132	0.839	0.158	0.877
D(GDP(−3))	−1.090	0.533	−2.045	0.059
D(GDPSQ)	−2.000	0.658	−3.039	0.008
D(NRENG)	−3.216	1.017	−3.162	0.006
D(NRENG(−1))	2.276	1.095	2.078	0.055
D(NRENG(−2))	2.970	1.074	2.765	0.014
D(NRENG(−3))	1.458	1.221	1.194	0.251
D(RENG)	0.267	1.056	0.252	0.804
D(RENG(−1))	2.196	1.230	1.784	0.095
D(RENG(−2))	−0.804	0.831	−0.968	0.349
ECM(−1)	−1.231	0.370	−3.326	0.005
Long-run results				
GDP	89.842	36.844	2.438	0.028
GDPSQ	−1.625	0.672	−2.417	0.029
NRENG	9.680	3.954	2.448	0.027
RENG	−2.493	0.657	−3.797	0.002
C	−1179.002	486.167	−2.425	0.028
Model Diagnostics				
R-square				0.992
Adj. R-square				0.983
Durbin-Watson				2.518
LM Test				0.212
Heteroskedasticity Test				0.348
Ramsey Reset test				0.087

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

As predictable, the rises in the use of renewable-energies inversely affect releases carbon level; on another side, the increase in the consumption of non-renewable energies cause air-pollutions. Most specifically, a 1% rise in the REC decreases (CO_2) carbon emission by 2.49% and a 1% rise in the NREC rises pollutions by 9.680%. Results are reliable as per (Al-Mulali and Ozturk, 2016; Bento and Moutinho, 2016; Bilgili et al., 2016; Chiu and Chang, 2009; Dogan and Seker, 2016a, 2016b; Jebli et al., 2016; López-Menéndez et al., 2014; Nawaz and Hassan, 2016; Shafiei and Salim, 2014; Sulaiman et al., 2013). From the results that conclude that to reduce the emission levels which promote the use for renewable-energy resources, on the other hand, it also demotivates the usage of non-renewable energies source in Indonesia. Moreover, pollution control policies should be implemented so that institutions, factories and electric companies are forced to meet environmentally friendly standards. So, the Indonesian government should motivate its public to maintain environmental quality and leave a clean world for upcoming generations. We can say public-awareness for renewable energy-sources is needed for the time and can play a vital role in this regard.

Negative sign of the elasticity for CO_2 emission with-respect to the GDP and positive sign that of the GDP squared, representing that EKC assumption does not valid for Indonesia. Most specifically, marginal (partial) effects of the GDP on (CO_2) is 89.842%. Therefore, the marginal (partial) consequence of the GDP over

Figure 2: CUSUM stability-test

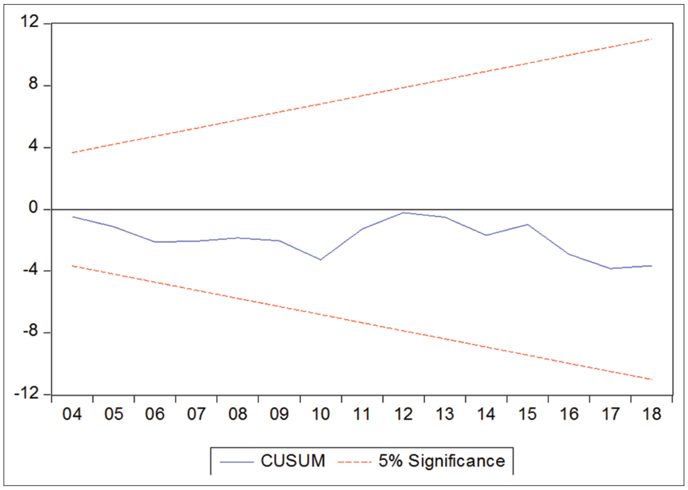
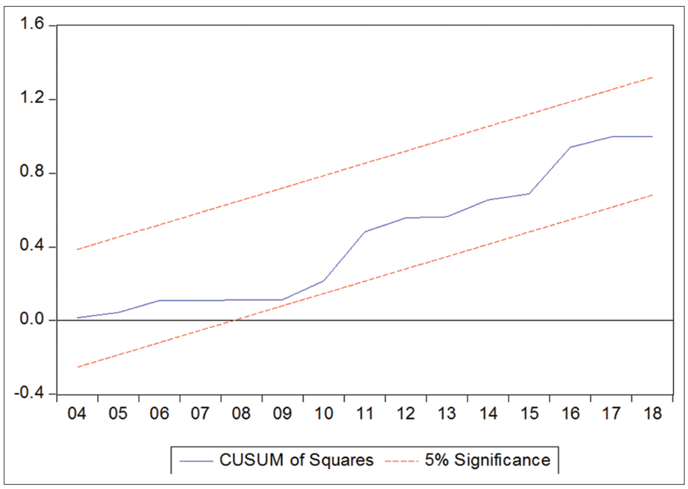


Figure 3: CUSUM square stability test



carbon-emission is negative in the early stage of the economic growths. However, this increase also eventually becomes positive when Indonesia moves to advanced levels. In other words, the increase in production levels leads to ecological degradation after a certain edge. The same findings are confirmed by (Dogan and Turkekul, 2016; Soytas et al., 2007) by using global energy consumption for Indonesia. Additionally, absence of EKC is found in case of China (Du et al., 2012), Vietnam (Al-Mulali et al., 2015), Turkey (Ozturk and Acaravci, 2010), Russia (Pao et al., 2011), Tunisia (Farhani and Ozturk, 2015), Europe (Bölük and Mert, 2014), ASEAN (Chandran and Tang, 2013) and OECD countries (Dogan et al., 2017). General acceptance for renewable energy use and safe technologies in production is necessary for a safe and healthy environment. Moreover, the production of renewable-energy sources is comparatively expensive than that of nonrenewable-energy sources. It should be the concern of the Indonesian government to encourage those institutions and policies which are introducing low-cost energy sources and boosting environmentally friendly protections.

The outcomes of estimation are valid because it passes all the model diagnostics significantly, Firstly, use the R-square which tells the coefficients of determination its value is 0.99, that is 99%, which means that exogenous indicators used in this study 99% explained the carbon emission level which is quite good. Secondly, use the adjusted R-square which is used to confirm the R-square and that is almost 98% and indicates that results are valid and consistent. Thirdly and fourth, DW statistics around 2, representing that, the residues are not-linked. Along with the DW statistic, the residual-serial-correlation test LM recommends that we can-not reject null-hypothesis of any serial homoscedasticity correlations with a significance level of 5% from the associated p-value is 0.212. Fifth, use the Heteroskedasticity test - that also validates the model is a good fit because there does not address the problem of heteroskedasticity in the estimated model. Moreover, finally, use the Ramsey rest test which is use to checked the model stability and outcomes confirm the mode is stable. Further, that is also confirmed by CUSUM and CUSMsq test. Which are sown in Figures 2 and 3, which also confirm that the model is stable as the estimated line lies in between the standard deviation line that confirms that the model is stable and coefficients are valid.

5. CONCLUSION AND POLICY RECOMMENDATION

Indonesia has recently joined the Kyoto Protocol or an international framework for increasing carbon emanations. The aim of this study is to highlight attention of Indonesian government in-to this issue. Therefore, this research considers impact of the income, the renewable-energy consumptions and the nonrenewable energy consumptions for Indonesia in EKC model. Results are:

Firstly, used the ADF and PP unit tests because this study has time series data which needs to confirms the order of integration. Results indicates that indicators have unit root at level and they convert to stationary at first difference. The use the Johansen-Cointegration and ARDL-bound tests that show that income, quadratic income, and use of non-renewable and renewable energies are co-integrated. Results obtained from ARDL model direct that, increased consumption of renewable-energy attenuates carbon (CO_2) emission while increasing the consumption of the nonrenewable energy contributes to (CO_2) carbon emission. Furthermore, validity of the EKC assumption is not applicable in case of Indonesia because the estimated coefficient are opposite signs as sign of real-incomes also on quadratic-incomes are negative and positive correspondingly.

Findings of the study, the hopeful policy implications are as follow; availability and utilizations of the renewable-sources would be improved where as that of nonrenewable sources would be reduced. Monitoring strategies plays a significant part in managing the increase in (CO_2) carbon emission. Instead, of private and public buildings, factories, businesses and the electricity industry would be forced via regulation to progressively rise the use of renewable energy instead of nonrenewable energy in Indonesia, because intention of this legislation improved the enviormental quality of Indonesia.

The establishments of the public responsiveness for renewable energies also a clean environment plays an important role in the lowest emission level. The adoption for the renewable energy-sources and ecologically friendly mechanisms at every stage of the productions processes is important for improving the environment.

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