Does Economic Growth Efficient and Environmental Safety? The Case of Transportation Sector in Indonesia

by Priagus Priagus

Submission date: 27-Dec-2021 01:20PM (UTC+0700)
Submission ID: 1735842086
File name: IJEEP-DOES-ECONOMIC-11807-29156-1-PB.pdf (1,013.65K)
Word count: 5800
Character count: 32347

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2021, 11(6), 365-372.

Does Economic Growth Efficient and Environmental Safety? The Case of Transportation Sector in Indonesia

Priyagus Priyagus*

Department of Economics, Faculty of Economics and Busines, Universitas Mulawarman, Indonesia. *Email: priyagus@feb.unmul.ac.id

Received: 11 July 2021 **Accepted:** 19 September 2021 **DOI:** https://doi.org/10.32479/ijeep.11807

ABSTRACT

Business challenges in the transportation sector in Indonesia will be tough if they are only profit-oriented, without considering environmental aspects. A vital phenomenon that also motivated the author to investigate the environmental kuznets curve (EKC) hypothesis for the transportation sector in Indonesia for the period 2000-2019. We applied the analysis model using partial adjustment model (PAM) with control variable (labor) and without control variable based on least square (LS) and robust least square (RSL).This finding detects that it significantly proved the EKC hypothesis in the transportation sector for the estimation of emissions with short-term control variables. In energy estimation, the result is not significant. Economic activity and energy consumption in the transportation sector play an inefficient role in supporting GHG emissions because the actual maximum value of economic activity is still on the left or before it reached the maximum EKC value. The government must be consistent with regulations, cooperate between institutions, and require continuous public attention. This is certainly useful for encouraging investment and achieving more efficient economic growth by maintaining a quality environment in the long term.

Keywords: Environmental Kuznet Curve, Partial Adjustment Model, Least Square, Robust Least Square, Transportation Sector, Carbon Emissions, Indonesia

JEL Classifications: F18, C24, C12, L91, F64

1.INTRODUCTION

The transportation sector plays a vital role in the Indonesian economy. Although its contribution to the national gross domestic product (GDP) during 2000-2019 was less than optimal, where the average was only 4.5% per year, the average growth rate was up to 6.5% per year. This gain is higher than the national average of economic growth (Zainurossalamia et al., 2021). The crucial role of the transportation sector is to support the mobility of goods and services as a place to add value to these goods and services. Thus, an item can increase in value because it is in a different location, even though it does not experience any changes.

Naturally, goods and services are available unequally, abundantly in one place, and are cheap. Meanwhile, relatively few and expensive. The role of transportation that connects these two locations affects prices to achieve balance and lies between the prices of the two different locations (Anciaes et al., 2016). This condition has the potential for transactions between the two locations and stimulates added value in sectors related to transportation directly and indirectly (multiplier effects), such as the trade and telecommunications sectors.

Land transportation in Indonesia still dominated by private vehicles, because mass something did not well develop transportation facilities and infrastructure to remote areas. Subsidies for fuel oil (BBM) and the addition of goods delivery services from e-commerce activities also contribute systematically to energy in the transportation sector. Waste of energy consumption reduces the quality of the air environment, such as the phenomenon of greenhouse gases (GHG). As a result, it is very detrimental to the environmental, social, and economic dimensions (Shen et al., 2020). In 2014, the energy sector affected GHG by 31.93%, where this figure was the second largest after the agriculture, forestry, and other land use (AFOLU) sectors.

Greenhouse gases, according to the United Nations conventions and the UNFCCC, are gases in the atmosphere that can absorb and withstand solar radiation reflected by the earth, causing the earth's surface temperature to increase (Hertzberg et al., 2017). There are six types of gases classified as GHGs including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) hydro fluorocarbons (HFCs), per fluorocarbons (PFCs), and sulfur hexafluoride (SF6). Among the six types of gas, the largest is CO_2 reaching 383 parts per million (ppm) or about 0.03383% of the volume of the atmosphere (BPS, 2016). In 2014, it predicted CO_2 to be the highest contributor to GHG at around 81.80% (BPS, 2017). In this study, we focused GHG on energy consumption.

The overall energy consumption for the transportation sector in 2000-2019 was 254.05 barrels of oil equivalent (SBM), where the average emission was 104,868.90 GgCO2e. The average energy consumption growth is 6.0625% with an average emission increase of 5.5020% per year. In growth of energy consumption and emissions has the potential to become an environmental threat, so it needs to be controlled. The sustainable development goals (SDGs) agenda, highlighted by Suparjo et al. (2021) which explains that the transportation sector is one priority in reducing national emissions. Law No. 16 of 2016 strengthens the environment and also listed in the national planning. BPS (2017) Indonesia is targeting 2030 to reduce GHG emissions by 29 % are self-employed or up to 41 % are through international help.

1.1. Problems

The increasingly limited availability of non-renewable energy because of economic activity and the negative transformation of emissions encourages various parties to explore the relationship between economic activity and energy or economics on emissions. That way, there are additional facts about efficient and environmentally friendly energy utilization.

Sustainable development implies the need and agreement of the world, so that future generations will continue to use and enjoy natural resources for the production, consumption, and distribution of goods and services. Detection of economic activity (GDP) and energy consumption that have not and have achieved efficiency based on not damaging the environment, analyzed using the Environmental Kuznets Curve (EKC) approach with an "inverted U" pattern. This curve is a link between economic growth with energy and emissions. In the early stages, the relationship is positive, up to a certain point (maximum). The next position, the relationship between these variables becomes negative, in line with the exodus of economic activity with a trend of becoming more efficient and energy consumption does not reduce environmental quality.

Stren (2004) evaluated the EKC concept that first appeared in the studies of Grossman and Krueger (1991) and Shafik and Bandyopadhyay (1992). In fact, in the World's report Development Bank (1992), EKC is popular for debate. The basic idea is the need for economic growth with a quality environment to support sustainable development. EKC is a hypothesis about the relationship between environmental degradation indicators and per capita income (Ekins, 1997). It took the name EKC from the hypothesis of Kuznets (1955) about income inequality in the process of economic development.

1.2. Research Gap and Goals

Several approaches have highlighted relevant studies highlighting the relationship between economic growth on energy and emissions to examine EKC. Rezki (2011) reviews energy consumption and economic development in Southeast Asia through panel data based on fixed effect (FE) and random effect (RE). Interestingly, Kartiasih and Setiawan (2020) analyzed the impact of economic growth, energy consumption, and trade on CO_2 emissions in Indonesia through the ECM model.

Taguchi (2013) focused on the case of sulfur and carbon emissions in Asia using the PAM model, while Liu et al. (2007) calculated the effects of economic growth and environmental quality in China using multiple quadratic regression models, and Sun et al. (2012) identified economic growth and environmental pollution in Shandong, China through a multiple-squares regression model.

Tan et al. (2014) confirm that there is a strong correlation between economic growth and environmental quality in Singapore with a multiple-squares regression model. Then, Shaw et al. (2010) connected the relationship between economic growth and air quality in China with multiple quadratic regression models and dummy variables and Wu (1998) underlined economic development and environmental quality in Taiwan with linear, quadratic, cubic, and control variables models. Lastly, Alam et al. (2007) summarize the effect of energy consumption on environmental degradation in Pakistan-based on the VAR model.

Several studies have used the cubic model to predict the EKC hypothesis, such as Cialani (2007) which combines the relationship between economic growth and environmental quality in Italy, economic growth and pollution in Tunisia (Fodha and Zaghdoud, 2010), and economic growth and environmental pollution in Tangshan, China (Baoujan et al., 2011). It focused on the facts that were also explored in several cases on the discussion of economic growth and environmental quality in Africa using a regression model of quadratic, cubic, and control variables (Orubu and Omotor, 2011). Xu (2014) also showed its capacity to plan economic growth and environmental quality based on cubic regression models and control variables.

Meanwhile, dynamic models (ECM) to project EKC hypotheses such as fossil energy consumption and economic growth in Japan (Ishida, 2013), energy consumption in Malaysia (Saboori et al., 2016), and EKC analysis in Pakistan with cointegration and causality (Shahbaz et al., 2012).

Kasman and Duman (2015) on carbon emissions, economic growth, energy consumption, trade, and urbanization in new EU countries with cointegration and causality panel. The determination of energy consumption, economic growth, and emissions in the

United States (US) using the VAR method was reviewed by Sotyas et al. (2007). Saidi and Hammami (2015) summarized the impact of emissions and economic growth on energy consumption in 58 countries. The GMM method explains the significant and positive impact between carbon emissions and energy consumption. In fact, economic growth significantly positively related to energy consumption.

Simulations represent previous studies the models used grouped into static and dynamic, multiple regression quadratic and cubic static, and dynamic with several control variables. This research structured using a model (PAM) with no labor control variable, analyzes the relationship of GDP in the transportation sector with GHG emissions and energy consumption, and energy consumption on GHG emissions in the transportation sector to prove the EKC hypothesis with an "inverted U" pattern in Indonesia.

The strategy through empirical evidence needs to be applied because it contributes importantly to GHG emissions specifically in the transportation sector, which has become the national agenda. There are three first steps to accomplishing that. First, indications of inefficiency and degradation of economic activity and energy consumption in the transportation sector. Second, the maximum point of GHG emissions from economic activities and energy consumption in the transportation sector as the stage for the start of efficient and low-emission economic activities. Third, indications of economic activity and energy consumption in the transportation sector that are more efficient and do not damage the environment. The research structure comprises vital parts, including introduction, data and methods, results, discussions, and finally conclusions and follow-up agenda.

2. DATA AND METHODS

Secondary data supported the research (time series) for the period 2000-2019. The data grouped into three aspects including emissions, energy, and GDP of the transportation sector compiled through the Ministry of Environment and Forestry–Republic of Indonesia (2021), Ministry of Energy and Mineral Resources–Republic of Indonesia (2016), and the Central Statistics Agency (2020).

The model applied and adopted from the Taguchi (2013) technique, where the Partial Adjustment Model (PAM) combined with control variables, standardized quadratic regression (Liu et al., 2007), and time-lag (dynamic). To get a consistent and stable estimation model, an analysis using least square (LS) and robust least square (RLS) formed. We interpret the data processing process through the EViews software with the following basic specifications:

$$Y = f(X_1, X_2^2; Yt\text{-}2) \quad (1)$$

$$Y = f(X_1, X_2^2, Z, Yt\text{-}2) \quad (2)$$

The estimated model (PAM) without control variables translated into the functions of the third equation, fourth equation, and fifth equation.

$$Emissions = a1 + b1\,GDPtrans + c1\,(GDPtrans)^2 + d1\,Emissions_{t-2} + e \quad (3)$$

$$Energy = a2 + b2\,GDPtrans + c2\,(GDPtrans)^2 + d2\,Energy_{t-2} + e \quad (4)$$

$$Emission = a3 + b3\,Energy + c3\,(Energy)^2 + d3\,Emission_{t-2} + e \quad (5)$$

Where, *Long-term constants/coefficients are (a1-c1)/(1-d1); (a2-c2)/(1-d2); (a3-c3)/(1-d3). The model estimation (PAM) with the labor control variable (Z) tuned into the following form or formulation:

$$Emissions = a4 + b4\,GDPtrans + c4\,(GDPtrans)^2 + d4\,Labor + e4\,Emissions_{t-2} + e \quad (6)$$

$$Energy = a5 + b5\,GDPtrans + c5\,(GDPtrans)^2 + d5Labour + e5\,Energy_{t-2} + e \quad (7)$$

$$Emissions = a6 + b6\,Energy + c6\,(Energy)^2 + d6\,Labor + e6\,Emissions_{t-2} + e \quad (8)$$

Where, maximum point = Emissions/δGDPtrans = 0; Energy/δGDPtrans = 0; Emissions/δEnergy = 0; there is an inverted U pattern if: b1-b6 = positive and c1-c6 = negative, and long-term constant/coefficient = (a4-d4)/(1-e4); (a5-d5)/(1-e5); (a6-d6)/(1-e6).

Table 1 displays five variables with different limits and units. These data components have certain calculations that are supported by three Government Institutions of the Republic of Indonesia such as the Ministry of Environment and Forestry, Ministry of Energy and Mineral Resources, and the Central Statistics Agency. Specifically, for energy, data information is proxies in 2016-2019.

3. RESULTS

3.1. Descriptive Analysis

In this session, we summarize the descriptive analysis for the variables in Table 2. The Skewness value appears to be relatively small, which shows that the data is relatively normal. The Jarque-Bera test also supported this with a probability of over 5%, so the assumptions on the research data are workable to estimate.

Table 1: Data demarcation

Variables	Information	Unit
Emissions	GHG emissions in the transportation sector	Gg CO_2e
Energy	Final energy consumption in the transportation sector	Million SBM
GDPtrans	Value of GDP in the transportation sector at current prices	Rp Million
GDPtrans2	Value of GDP in the transport sector squared	Rp Million
Labor	Number of workers in the transportation sector	Person

Source: Author own

3.2. Estimated of PAM

3.2.1. Relationship of GDP in the transport sector with GHG emissions

Table 3 presents the projection results in relation to GDP in the transportation sector with GHG emissions in the first and fourth equations.

In Figure 1a, there is an inflection point (maximum) for emissions that occur in GDPtrans of 925.75, while 1,239.19 is specifically in Figure 1b. Both achievements were greater than the actual maximum GDPtrans values (881.66 <925.75) and (881.68 <1,239.19). Economic activity in the transportation sector is on the left at the maximum point, EKC occurs in the short term significantly with the control variable, and does not occur without the control variable.

3.2.2. The relationship of GDP in the transport sector with energy

It illustrates the results of the estimation of the relationship between GDP in the transportation sector and energy consumption for the transportation sector by equation two and equation five (Table 4).

Figure 2a describes the inflection point (maximum) of energy occurring at GDPtrans of 1,284.63 and 2,255.25 in Figure 2b. Both values are greater than the maximum actual GDPtrans (881.66 <1,284.63) and (881.68 <2,255.25). Economic activity in the

Table 2: Summary of descriptive analysis (obs. 20)

Components	Emissions	Energy	Energy 2	GDPtrans	GDPtrans2	Labor
Mean	104868.9	254.0515	72619.61	389.3858	210938.6	5316.426
Median	98845.00	240.2250	57943.52	364.5228	132993.1	5157.928
Maximum	157771.0	416.8600	173772.3	881.6626	777328.9	6179.503
Minimum	59659.00	139.1800	19371.07	65.01210	4226.573	4448.279
Std. Dev.	35723.03	92.20942	49559.99	249.8785	227127.1	496.6983
Skewness	0.154373	0.281831	0.565078	0.409171	1.156294	0.061850
Kurtosis	2.337238	1.863279	1.896308	1.252413	4.547149	0.642007
Jarque-Bera	0.310796	0.393907	0.387456	0.534616	0.102944	0.725421
Sum	2097378.	5081.030	1452392	7787.717	4218772	106328.5
Sum Sq. Dev.	2.42E+10	161549.0	4.67E+10	1186346	9.80E+11	4687475

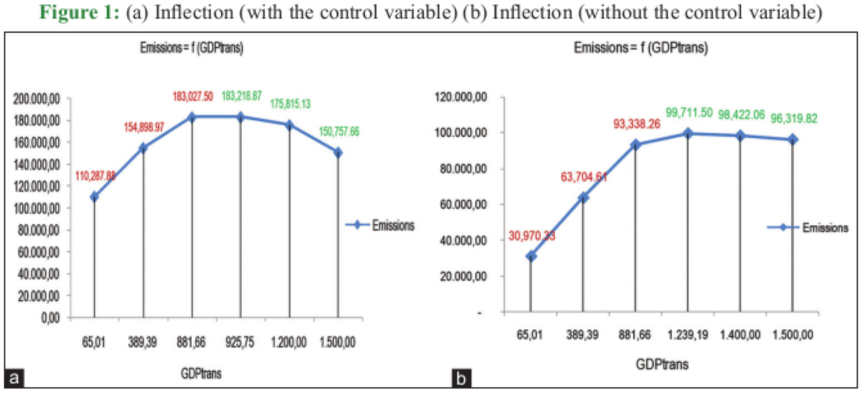
Source: Calculation from EViews

Table 3: The relationship of GDPtrans with emissions

Variables	Coef.(LS)	Prob.(LS)	Coef.(R)	Prob.(R)	Coef.(R1)	Prob.(R1)
C	101090.0	0.0186	98854.81	0.0074	23147.42	0.0820*
GDPtrans	182.0761	0.0066***	182.2604	0.0010***	123.5716	0.0471**
GDPtrans2	−0.104410	0.0524*	−0.098439	0.0405**	−0.049860	0.3740
Labor	−14.95088	0.0378**	−14.30357	0.0243**		
Emissions(-2)	0.368170	0.0556	0.336081	0.0507	0.452844	0.0202**
R-squared: 0.935248			R-squared: 0.809248		R-squared: 0.749387	
Adjusted R-squared: 0.915324			Rw-squared: 0.953100		Rw-squared: 0.933782	
F-statistic: 46.94118			Adjusted R-squared: 0.750555		Adjusted R-squared: 0.695685	
Prob (F-statistic):0.000000			Adjust Rw-squared: 0.953100		Adjust Rw-squared: 0.933782	
Durbin-Watson stat: 1.633207			Prob (Rn-squared stat.):0.000000		Prob (Rn-squared stat.):0.000000	

Source: calculation from EViews. Where, (LS) = Least Square, (R) = Robust with control variable, (R1) = Robust without control variable, ** = 5%, and *** = 1%

Figure 1: (a) Inflection (with the control variable) (b) Inflection (without the control variable)



transportation sector is to the left of the maximum point and EKC occurs in the short term and is not significant.

3.2.3. Relationship between energy consumption and GHG emissions

The results of the estimation of the relationship between energy consumption in the transportation sector and GHG emissions in equation 3 and equation 6 are in Table 5.

The inflection point (maximum) in emissions occurs at energy consumption reaching 579.04 and 970.41 (Figure 3a and b). Both achievements are higher than the maximum value of actual energy, where 416.86 <579.04 and 416.86 <970.41. We concluded that the energy consumption of the transportation sector with the control variable was to the left of the maximum point and the EKC was significant in the short and long term without the control variable.

4. DISCUSSIONS

The estimates for the emission equation with GDPtrans (independent) summarized in Table 3, the estimation of the energy equation with GDPtrans (independent) in Tables 4 and 5 highlights the estimation of the emission with energy equation (independent). Through two different methods (LS and RLS), we showed that each estimation result is relatively the same and consistent. Values in the Adjusted R-Squared and coefficient tests simultaneously applied with the F-test, where the methods for both models were also

Table 4: Estimation of the relationship of trans GDP with energy

Variables	Coef.(LS)	Prob.(LS)	Coef. (R)	Prob. (R)	Coef. (R1)	Prob.(R1)
C	118.0053	0.0836	115.4634	0.0866	48.36815	0.0297**
GDPtrans	0.264802	0.0138**	0.267202	0.0073***	0.220563	0.0201**
GDPtrans2	−0.000115	0.1562	−0.000104	0.2019	−4.89E-05	0.5540
Labor	−0.015743	0.1559	−0.014337	0.1999		
Energy(-2)	0.623013	0.0011***	0.586096	0.0003***	0.568611	0.0002***
R-squared: 0.974922			R-squared: 0.828887		R-squared : 0.784496	
Adjusted R-squared: 0.967206			Rw-squared: 0.980329		Rw-squared: 0.983236	
F-statistic:			Adjusted R (squared): 0.776237		Adjusted R-squared: 0.738317	
Prob (F-statistic):0.000000			Adjust Rw-squared: 0.980329		Adjust Rw-squared : 0.983236	
Durbin-Watson stat:			Prob (Rn-squared s.): 0.000000		Prob (Rn-squared stat.): 0.000000	

Source: calculation fromEViews. Where, (LS) = Least Square, (R) = Robust with control variable, (R1) = Robust without control variable, ** = 5%, and *** = 1%

Figure 2: (a) Inflection (with the control variable) (b) Inflection (without the control variable)

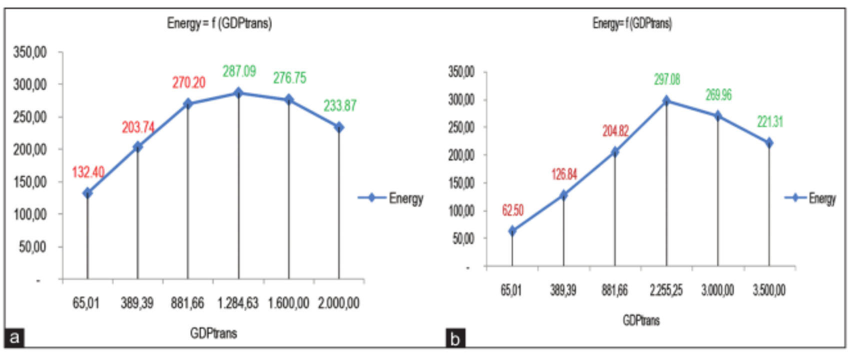


Figure 3: (a) Inflection (with the control variable) (b) Inflection (without the control variable)

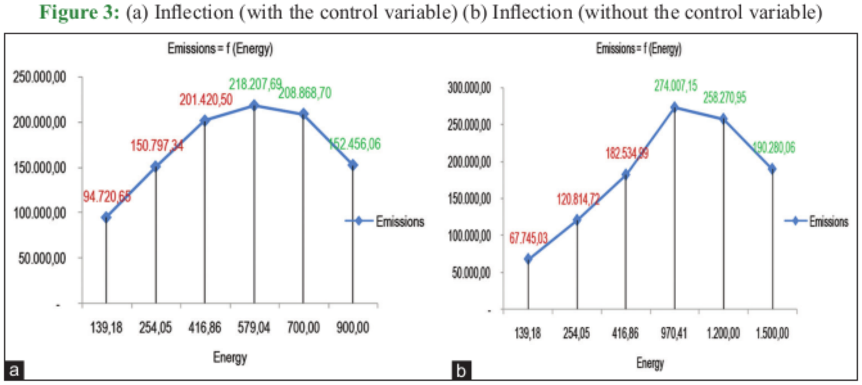


Table 5: Highlightof relationship between energy and emissions

Variables	Coef.(LS)	Prob.(LS)	Coef (R)	Prob (R)	Coef (R1)	Prob. (R1)
C	5499.389	0.7577	4209.142	0.8226	-7110.493	0.1444
Energy	760.2460	0.0000***	739.1528	0.0000***	579.3812	0.0000***
Energy2	−0.652571	0.0035***	−0.638260	0.0012***	−0.298525	0.0000***
Labor	−7.116323	0.0143**	−6.755850	0.0126**		
Emissions(−2)	−0.087263	0.4015	−0.049113	0.6499	−0.155536	0.0001***
R-squared: 0.988083			R-squared: 0.864471		R-squared: 0.663615	
Adjusted R-squared: 0.984416			Rw-squared: 0.990406		Rw-squared: 0.999056	
F-statistic: 269.4665			Adjusted R-quared: 0.822770		Adjusted R-squared : 0.591532	
Prob (F-statistic):0.000000			Adjust Rw-squared: 0.990406		Adjust Rw-squared : 0.999056	
Durbin-Watson: stat: 1.476920			Prob (Rn-squaredstat):0.000000		Prob (Rn-squared stat.):0.000000	

Source: Calculation from EViews. Where, (LS) = Least Square, (R) = Robust with control variable, (R1) = Robust without control variable, ** = 5%, and *** = 1%

relatively high and highly significant. Therefore, the projections got are valid for estimation.

The analysis on the relationship of GDPtrans with emissions (Table 3) explains that the EKC curve occurs significantly or supports the hypothesis of an "inverted U" curve over the short term with the control variable. However, without a control variable, the results are not significant. From Table 4, the relationship between GDPtrans and Energy focuses on the EKC curve that is not significant, while the relationship between energy and emissions in Table 5 represents the existence of a significant EKC curve in the short and long term by excluding control variables. Referring to these calculations, the EKC hypothesis occurs significantly in the short term.

The "inverted U" EKC was significant (Figure 1a). Increased economic activity in the transportation sector appreciates GHG emissions, because the actual maximum value of GDP is on the left (before) with the maximum point of emission. If we expected that economic activity in the transportation sector without increasing emissions, then the actual value must increase to reach Rp. 925.75 trillion or grow at least 5% per year assuming other variables do not change (ceteris paribus).

Energy consumption in the transportation sector is inefficient, although not significant, because the actual maximum GDP value is to the left (before) the energy maximum point, so that the increase in economic activity accompanied by an increase in energy consumption (Figure 2a). Energy efficiency occurs after economic activity in the transportation sector reaches more than IDR 1,284.63 trillion (ceteris paribus).

Energy consumption in the transportation sector causes GHG emissions significantly (Figure 3) because the maximum actual energy consumption produces 416.86 million BOE, right to the left (before) the maximum emission point, so that the increase in energy consumption accompanied by an increase in GHG emissions. The existence of energy consumption it actually reduces emissions. We should note that if the minimum energy consumption is 579.04 million BOE or a minimum accumulation of 38.9051%, we conclude that ceteris paribus. The increase in GDP in the transportation sector with technological improvements will increase the efficiency of energy consumption, so that environmental degradation will not occur.

This study has supported several previous studies that revealed the existence of an "inverted U" shaped EKC. For example, Cialani (2007), EKC occurs in the short term. Xu (2014) correlates economic growth with an impact on environmental quality. Most of the environmental pollution indicators are in line with the EKC hypothesis. The existence of EKC for solid particles in water pollution (organic pollutants in water) was studied by Orubu and Omotor (2011). Economic growth is important to reduce pollution. Shaw et al. (2010) regarding EKC occurred with CO2 and not for deposited particles (DP).

Taguchi (2013) presents sulfur emissions following the EKC pattern, while carbon changes in the short and long term. Liu et al. (2007) suggested the EKC pattern for the pollutant induced production, whereas for consumption it was not. Xuemi et al. (2011) discussed EKC for sulfur dioxide and vice versa, industrial solid waste is not. Then, Wu (1998) confirmed that the EKC for some pollutants in the aggregate showed by Y2 (negative) and Y (positive). In line with these explanations, Shahbaz et al. (2012) and Kasman and Duman (2015) prove that the existence of EKC is only limited to the short term.

Specifically, for EKS that is transformed in the long term, described by Fodha and Zaghdoud (2010), Saboori et al. (2016), Shahbaz et al. (2012), Tan et al. (2014), Kasman and Duman (2015), and Soytas (2007). The impact of EKC for carbon and sulfur emissions on the environment, energy has a positive and long-term relationship to CO_2 emissions. In terms of CO2 emissions, EKS for energy plays an important role. Case study in Singapore, the EKC is still on the left of the 'inverted U' curve. It negatively related electrical energy to emissions, while total energy positively related. Especially in the short term, there is indeed a causal unidirectional from energy to emissions and GDP to energy. EKC also applies in America and the long-term cause of emissions is energy consumption, where there is no trade-off between growth and emission reduction.

Indications of the absence of EKC (such as Alam et al., 2007) in Pakistan and the use of energy is not yet efficient, because of high emissions because of urbanization. Baoujan et al. (2011) presented an unclear relationship between environmental indicators and per capita income, so the EKC is not clear. Indeed, there is no sign of EKC because economic activity in Indonesia is still pursuing an increase in income and less attention to the environment (Kartiasih and Setiawan (2020). In the long term, there may be a relationship between economic growth and energy to emissions.

The search that needs to be exposed to this discovery, there is a diversity of EKC "inverted U" pattern according to each country's economic activity, type of pollutant, method, and analysis period (short and long). An evidence has also clarified that Indonesia's EKC in economic activities in the transportation sector, energy consumption is not yet efficient and causes significant short-term GHG emissions (Priyagus, 2018). The consistency of development programs, coordination between state institutions, and community support have not fully supported environmental sustainability.

Ideally, the EKC model is still relevant to current conditions, because the world's attention to sustainable economic development and environmental sustainability is getting bigger with the sustainable development goals (SDGs) program until 2030. Indonesia certainly plays a vital role and as the country that is committed and has the potential to control GHG emissions. Indonesia has ratified several international agreements, included in several regulations (such as laws), and programs related to environmental conservation.

5. CONCLUSION AND FOLLOW-UP AGENDA

The research seeks to determine how and test the EKC hypothesis in the transportation sector in Indonesia for 20 years. This finding yields four important points. First, the PAM model with and without labor control variables for emissions and energy for the transportation sector in Indonesia during 2000-2019 showed to be consistent and stable. The direction of the coefficients and their significance are relatively the same, although with different methods (LS and RLS). Second, the EKC for GDP in the transportation sector with significant emissions in the short term, while energy consumption with emissions appears significant in the short and long term. EKC GDP in the transport sector with energy is not significant. Third, all estimation models produce a peak (maximum) as evidence of an EKC with an 'inverted U' pattern. The coefficient values are X_1 (positive) and X_2^2 (negative). Fourth, sectoral economic activity and energy consumption (transportation GDP) are inefficient and GHG emissions increase, because the maximum actual values of economic activity are on the left or right before it reached the maximum EKC value. Economic activities will be efficient and low in emissions, after a minimum capacity of Rp 925.75 trillion with a minimum energy consumption of 579.04 million BOE.

Labor in the transportation sector has a positive and significant impact on emissions in the short term. Every increase in labor in economic activities will increase emissions significantly, but not in the long term. The government must consistently revitalize regulations and cooperation from each institution to play an active role in order to achieve investments that encourage long-term economic growth while maintaining a quality environment.

REFERENCES

Alam, S., Fatima, A., Butt, M.S. (2007), Sustainable development in Pakistan in the context of energy consumption demand and environmental degradation. Journal of Asian Economics, 18(5), 825-837.

Anciaes, P.R., Boniface, S., Dhanani, A., Mindell, J.S., Groce, N. (2016), Urban transport and community severance: Linking research and policy to link people and places. Journal of Transport and Health, 3(3), 268-277.

Baoujan, S., Rongrong, Z., Ying, Z. (2011), Empirical analysis of Tangshan economic growth and environmental pollution. Energy Procedia, 5, 2392-2396.

BPS. (2016), PDB Lapangan Usaha, Harga Berlaku (2000-2014) Jakarta: Badan Pusat Statistik. Available from: https://www.bps.go.id/statictable/2009/07/02/1199/-seri-2000-PDB-atas-dasar-harga-berlaku-menurut-lapangan-usaha-miliar-rupiah-2000-2014.html

BPS. (2017), Environment statistics of Indonesia, 2017. Jakarta: Badan Pusat Statistik. Available from: https://www.bps.go.id/publication/2017/12/21/4acfbaac0328ddfcf8250475/statistik-lingkungan-hidup-indonesia-2017.html

BPS. (2020), PDB Lapangan Usaha, Harga Berlaku (2013-2019). Jakarta: Badan Pusat Statistik. Available from: https://www.bps.go.id/linkTableDinamis/view/id/827

Cialani, C. (2007), Economic growth and environmental quality: An econometric and a decomposition analysis. Management of Environmental Quality, 18(5), 568-577.

Ekins, P. (1997), The Kuznets Curve for the environment and economic growth: Examining the evidence. Environment and Planning A: Economy and Space, 29(5), 805-830.

Fodha, M., Zaghdoud, O. (2010), Economic growth and pollutant emissions in Tunisia: An empirical analysis of the environmental Kuznets curve. Energy Policy, 38(2), 1150-1156.

Grossman, G.M., Krueger, A.B. (1991), Environmental Impacts of a North American Free Trade Agreement. NBER Working Papers, No. 3914. Cambridge, Massachusetts: National Bureau of Economic Research, Inc.

Hertzberg, M., Siddons, A., Schreuder, H. (2017), Role of greenhouse gases in climate change. Energy and Environment, 28(4), 530-539.

Ishida, H. (2013), Causal relationship between fossil fuel consumption and economic growth in Japan: A multivariate approach. International Journal of Energy Economics and Policy, 3(2), 127-136.

Kartiasih, F., Setiawan, A. (2020), Aplikasi error correction mechanism dalam analisis dampak pertumbuhan ekonomi, konsumsi energi dan perdagangan internasional terhadap emisi CO_2 di Indonesia. Media Statistika, 13(1), 104-115.

Kasman, A., Duman, Y.S. (2015), CO_2 emissions, economic growth, energy consumption, trade and urbanization in new EU member and candidate countries: A panel data analysis. Economic Modelling, 44(C), 97-103.

Kuznets, S. (1955), Economic growth and income inequality. The American Economic Review, 45(1), 1-28.

Liu, X., Heilig, G.K., Chen, J., Heino, M. (2007), Interactions between economic growth and environmental quality in Shenzhen, China's first special economic zone. Ecological Economics,62(3-4), 559-570.

Ministry of Energy and Mineral Resources Republic of Indonesia. (2016), Data Inventory Emisi GRK Sektor Energi. Jakarta: Pusat Data dan Teknologi Informasi Kementrian ESDM.

Ministry of Environment and Forestry Republic of Indonesia. (2021), Laporan Inventarisasi Gas Rumah Kaca (GRK) dan (MPV). Jakarta: Direktorat Jenderal Pengendalian Perubahan Iklim and Direktorat Inventarisasi GRK dan MPV.

Orubu, C.O., Omotor, D.G. (2011), Environmental quality and economic growth: Searching for environmental Kuznets Curves for air and water pollutants in Africa. Energy Policy, 39(7), 4178-4188.

Priyagus, P. (2018), Impact of foreign investment and natural resources sharing funds against environmental degradation in Indonesia. KnE Social Sciences, 3(10), 347-358.

Rezki, J.F. (2011), Energyconsumtion and economic development in South East Asia. Jurnal Ekonomi dan Pembangunan, 12(1), 31-38.

Saboori, B., Sulaiman, J., Mohd, S. (2016), Environmental Kuznets curve and energy consumption in Malaysia: A cointegration approach. Energy Sources, Part B: Economics, Planning, and Policy, 11(9), 861-867.

Saidi, K., Hammami, S. (2015), The effect of energy consumption and economic growth on CO_2 emissions: Evidence from 58 countries. Energy Reports, 1(C), 62-70.

Shafik, N., Bandyopadhyay, S. (1992), Economic Growth and Environmental Quality: Time Series and Cross-Country Evidence. Washington, DC: World Bank Working Paper WPS No. 904.

Shahbaz, M., Lean, H.H., Shabbir, M.S. (2012), Environmental Kuznets Curve hypothesis in Pakistan: cointegration and granger causality. Renewable and Sustainable Energy Reviews, 16(5), 2947-2953.

Shaw, D., Pang, A., Lin, C.C., Hung, M.F. (2010), Economic growth and air quality in China. Environmental Economics and Policy Studies, 12(3), 79-96.

Shen, M., Huang, W., Chen, M., Song, B., Zeng, G., Zhang, Y. (2020), (Micro) plastic crisis: Un-ignorable contribution to global greenhouse gas emissions and climate change. Journal of Cleaner Production, 254, 120138.

Sotyas, U., Sari, R., Ewing, B.T. (2007), Energy consumption, income, and carbon emissions in the United States. Ecological Economics, 62(3-4), 482-489.

Stren, D.I. (2004), The rise and fall of the environmental Kuznet Curve. World Development, 32(8), 1419-1439.

Sun, X.M., Chu, Y., Fan, J., Yang, Q. (2012), Research of simulation on the effect of suspension damping on vehicle ride. Energy Procedia, 17(A), 145-151.

Suparjo, S., Darma, S., Kurniadin, N., Kasuma, J., Priyagus, P., Darma, D.C., Haryadi, H. (2021), Indonesia's new sdgs agenda for green growth emphasis in the energy sector. International Journal of Energy Economics and Policy, 11(3), 395-402.

Taguchi, H. (2013), The Environmental Kuznet curve in Asia: The case of sulphur and carbon emissions. Asia-Pacific Development Journal, 19(2), 77-92.

Tan, F., Lean, H.H., Khan, H. (2014), Growth and environmental quality in Singapore: is there any trade off? Ecological Indicators, 47, 149-155.

World Bank. (1992), World Development Report 1992: Development and the Environment. Washington, DC: The World Bank. Available from: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/995041468323374213/world-development-report-1992-development-and-the-environment

Wu, P.I. (1998), Economic development and environmental quality: Evidence from Taiwan. Asian Economic Journal, 12(4), 395-413.

Xu, X. (2014), The research on temporal and spatial econometric analysis of environmental quality and economic growth. Advanced Materials Research, 926-930, 4398-4401.

Xuemi, H., Mingliang, Z., Su, L. (2011), Research on the relationship of economic growth andenvironmental pollution in Shandong province based onenvironmental Kuznets Curve. Energi Procedia, 5, 508-512.

Zainurossalamia, S., Amalia, S., Darma, D.C., Azis, M. (2021), Spurring economic growth in terms of happiness, human development, competitiveness and global innovation: The ASEAN case. ASEAN Journal on Science and Technology for Development, 38(1), 1-6.

Does Economic Growth Efficient and Environmental Safety? The Case of Transportation Sector in Indonesia

ORIGINALITY REPORT

15%	10%	12%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

MATCH ALL SOURCES (ONLY SELECTED SOURCE PRINTED)

4%

★ ideas.repec.org

Internet Source

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		