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A New Insight of the Existence of the Environmental Kuznets Curve in Indonesia

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Abstract. Natural resources play as vital inputs for economic activities, mainly in developing countries. However, massive use of natural resources puts more pressure on the environment and as the result, the quality of environment is deteriorating. The body of economic literature have shown income is associated with harm to the natural environment. The relationship between income and degradation of the environment is known as the Environmental Kuznets Curve (EKC) hypothesis. Previous studies of EKC hypothesis in Indonesia are still limited and the results are inconclusive due to different results. Therefore, the aim of this study is to present a new insight of the existence of EKC in Indonesia using different method. Most of previous studies of EKC in Indonesia employ Autoregressive distributed lag (ARDL) method, while this study uses data panel regression method from 33 provinces in Indonesia during 2012 to 2018. The result confirms the existence of EKC hypothesis in Indonesia. This study also estimates the turning point, a level of income that starts give positive impact on the environment. This result gives new insight to the existing literature. The policy implication for policymakers are straightforward, i.e. improve wealth of the society through higher income for the protection of the environment.

Keyword: Environmental Kuznets Curve, Environmental degradation, Income, Panel data.

1 Introduction

The degradation of environment has triggered the endless debates between the needs to protect environments against high economic growth. The awareness of environmental consequences of economic growth has put more attention to analyse the relationship between environment and socio-economic conditions.

Since decades ago, economists have made a significant amount of research linking income with environmental degradation and a vast body of economic literature have

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gested some evidence that show the impact of income on environmental degradation [1], which is known as the hypothesis of Environmental Kuznets Curve (EKC). The EKC hypothesis posits that at the first stage of development, environmental quality deteriorates with increasing income and at a certain level, environmental quality improves with the rise of the income.

EKC hypothesis has been widely tested in a large and growing literature. However, there are a lack of consensus of EKC hypothesis in previous studies [2, 3]. Previous studies suggest inconclusive results about the existence of the EKC hypothesis. The hypothesis has been tested in Indonesia and the conflicting evidence from EKC hypothesis is also found. In one side, some studies (for example, [2, 4]) support the existence of EKC hypothesis, while on the other side, several studies (for instances, [5 – 11]) do not support EKC hypothesis.

Since the relationship between income – environmental degradation is not clear in the case of Indonesia, this study is attempting to reinvestigate empirically its relationship with different method, i.e. panel data regression. This study adds a new insight of the presence of EKC hypothesis in Indonesia into the body of knowledge of environmental economics literature. This study is the first study that uses panel data regression approach to examine EKC in Indonesia. Finally, the central motivation for testing the relationship between income and environmental degradation under EKC hypothesis is that to give new references for policy makers to make a correct policy for the protection of the environment.

2 Literature review

As mentioned earlier, research investigation of EKC hypothesis in Indonesia results in inconclusive outcomes. One group of studies finds the existence of EKC hypothesis in Indonesia. [2] employ time series data with the Autoregressive Distributed Lag (ARDL) approach to examine EKC hypothesis for the period of 1970–2012 and imply that EKC exist in the cases of Indonesia. Similarly, a study by [4] tries to find the presence of the EKC the case of Indonesia using ARDL approach for the period of 1971- 2010 and confirms an inverted U-shaped EKC in Indonesia.

The other group of studies do not find any evidence to support the existence of EKC hypothesis in Indonesia. [5] uses ARDL method for the period of 1971–2007, and their study do not support the EKC hypothesis in Indonesia. [6] investigate the existing of EKC hypothesis using ARDL with period of 1990-2016 and they show that EKC hypothesis does not exist for a significance level of 5%. [7] also perform ARDL to check the existing of EKC hypothesis in Indonesia with period of 1981-2016 and their study do not find any evidence to support the EKC hypothesis. Other study by [8] uses Error Correction Model (ECM) method for the period of 1980-2004 and demonstrates that Indonesia is not consistent with the EKC hypothesis. [9] apply Toda and Yamamoto procedure with period from 1971 to 2007 and they show that the EKC hypothesis may not exist to Indonesia. [10] use the cointegration and Granger causality approach with period of 1971 to 2008 and they confirm that the EKC hypothesis is not valid in Indonesia. Last, [11] investigate the EKC hypothesis with vector error correction model (VECM) over the period 1980–2006 and they conclude that the EKC hypothesis is not supported in Indonesia.

The reviews of the previous studies of EKC hypothesis in Indonesia reveal two causes of the different conclusion due to use of ADRL method. Firstly, five out of seven previous studies use ADRL methodology, but they do not have similar results. This is mainly because each study uses different optimum lags. Optimum lags are one of conditions required by the ADRL. The optimum lags can be obtained by the interaction of all independent variables in the models. Previous studies use various independent variables other than income variable and it causes different optimum lags. Secondly, the sample period of time series data in every study is different. So, it also may create different optimum lags. Therefore, it can be

concluded that ADRL method may be inappropriate to be used due to its inconsistency to get optimum lags with changes in additional independent variables and sample period.

Previous studies use time series data to examine the existence of EKC hypothesis in Indonesia and the results are mixed and inconclusive. Therefore, this study applies different method, i.e. panel data regression from 33 Provinces in Indonesia to investigate the presence of EKC hypothesis in Indonesia.

3 Research method

This study uses annual data from 2012 to 2018 and the data are secondary data of 33 Provinces in Indonesia (North Kalimantan Province is excluded) and were collected from Indonesia Central Statistics Agency and Ministry of Environment and Forestry Republic of Indonesia.

This study develops an empirical model to examine the relationship between income and environmental degradation in the case of Indonesia. In this study, Real Gross Domestic Regional Product (GRDP) Per Capita is used as a proxy of income and Environment Quality Index is used as a proxy of environmental degradation. In addition, the model also includes Consumption Expenditure Per Capita and Percentage of Household with Access to Electricity, and as independent variables. The econometrics model of the EKC hypothesis suggests that the relationship between income and environmental degradation should be in quadratic form. The empirical model is written as follow:

$$LOG(EQI)_{it} = \alpha_0 + \alpha_1 LOG(YCAP)_{it} + \alpha_2 LOG(YCAP^2)_{it} + \alpha_3 LOG(EXPEND)_{it} + \alpha_4 ELECTRIC_{it} + e_{it} \qquad (1)$$

Where, *LOG* indicates the natural logarithm, *EQI* is Environment Quality Index, *YCAP* is Real GRDP Per Capita, *EXPEND* is Consumption Expenditure Per Capita, *ELECTRIC* is Percentage of Household with Access to Electricity, *e* is the error term, *i* represents the observations based on provinces and *t* is the time. α_1, α_2, α_3, α_4 are the parameters. The dataset of EQI range from 0 (zero) to 100, where 0 is the worst quality of environment and 100 is the best quality of environment, so it has opposite direction than the common environment degradation dataset, where higher value means worse quality of environment.

Data panel methods require selection of the best model. The best model is selected from three models, i.e., Common Effect Model (CEM), Fixed Effect Model (REM) and Random Effect Model (REM). The best model is chosen via three tests: Chow test, Lagrange Multiplier test and Hausman test. Figure 1 shows the tests for choosing the best model.
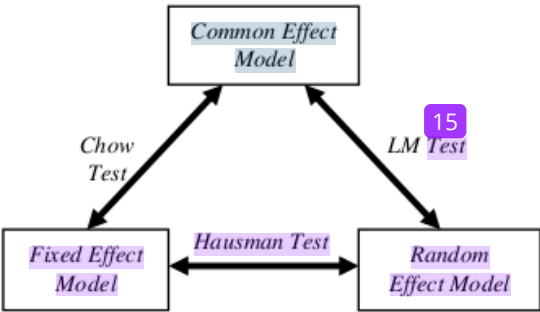
Fig 1. Selection of Best Model

4 Result and discussion

First step is to select the best model, and as presented in Table 1, it is concluded that the best model is Fixed Effect Model (FEM). Chow test and Hausman Test support the hypothesis that the best model is FEM.

Table 1. The Result of the Selection of Best Model

Tests	F-Stat Values	Results
Chow *Test*	38.99***	H₀ is rejected. It means FEM is better than CEM
LM *Test*	371.40***	H₀ is rejected. It means REM is better than CEM
Hausman *Test*	127.67***	H₀ is rejected. It means FEM is better than REM.
Conclusion	**FEM is the best model**	

Note: *** significant at $p \leq 0.01$

Table 2 presents the result of the fixed effect model. The model is estimated with White cross-section standard errors & covariance procedure to reduce heteroscedasticity problems. The output in table 2 indicates that YCAP has negative and statistically significant effects on EQI with $\alpha = 5\%$, This result indicates that if the real GDP per capita (YCAP) increases by 1%, the environmental quality index (EQI) decreases by 1.09%, ceteris paribus. This result confirms the first stage of economic development suggested by EKC hypothesis, where the environmental quality decreases when income increases. This study also shows that YCAP² has a positive and statistically significant effect on EQI with $\alpha = 10\%$. This result shows that that if the real GDP per capita squared (YCAP²) increases by 1%, the environmental quality index (EQI) increases by 0.05%, ceteris paribus. This result also confirms the second stage of economic development suggested by EKC hypothesis, where the environmental quality increases when income increases. In addition, this study shows that if consumption expenditure increases by 1%, the environmental quality index increases by 1.21%, ceteris paribus and if the percentage of household with access to electricity increases by 1%, the environmental quality index decreases by 0.003%, ceteris paribus.

Table 2. Result of the FEM data panel

Dependent Variable: Log of Environment Quality Index (EQI)	
LOG (YCAP)	-1.094582 (-1.986932)**
LOG (YCAP^2)	0.046834 (1.871985)*
LOG (EXPEND)	1.216245 (10.88194)***
ELECTRIC	-0.003723 (-6.404055)***
Constant	-0.346984 (0.103604)
Adjusted R^2	0.924907

Note: *** significant at $p \leq 0.01$; ** significant at $p \leq 0.05$; * significant at $p \leq 0.10$. t-statistics are reported in parentheses.

From the estimation result in Table 2, the coefficient of determination (R^2) value is 0.924. This result suggests that 92.4 per cent of the variation in the EQI variable can be explained by the variation of the set of independent variables, and the other 7.6% of the variation is explained by other variables outside the model. The significance of t-statistics of YCAP and YCAP^2 profoundly confirms the presence of EKC hypothesis in Indonesia. Based on the FEM result, this study supports previous studies [2] and [4] that EKC is exist in Indonesia.

Furthermore, this study also calculates the income threshold and finds that the turning point is estimated to be around IDR 9 Million. The estimation point is quite small in comparison to [4] study, in which they find the turning point is USD7,729 per capita. [4] claimed that the estimated turning point is make sense. However, when [4] version of turning point value is converted to IDR with current exchange rate (USD1 = IDR 14,600), it becomes about IDR113 Million. It means that a level of income of Indonesian that starts give positive impact on the environment is when they earn IDR113 Million per year or about IDR9 Million per month.

Data from World Bank website show that the GDP per capita in 2018 (with constant 2010 US$) is 4,284.653 (or about IDR63 million per capita per year). The [4] estimation becomes implausible while the highest value of GDP per capita in their sample is USD1,570 [4, page 195]. They argue that turning points is fine although it lies outside the observed sample period, just like other research, for examples: [12 -14]. If the Indonesia's GDP per capita in 2018 is USD4,284.653 and the estimated turning point is USD7,729, then it can be concluded that the [4] claims of the presence of EKC is wrong because the turning point has not been reached yet.

5 Conclusion and policy implications

The objective of this paper is to give a new insight of the presence of the EKC for the case of Indonesia by controlling consumption expenditure and access to electricity, respectively, using data panel regression method from 33 provinces in Indonesia during 2012 to 2018. This study applies quadratic model to examine the EKC hypothesis. From the estimation results, it is evidence that the EKC hypothesis is exist for the case of Indonesia, supporting two previous studies.

Based on the findings, the policy implication for policymakers are straightforward, i.e. improve wealth of the society through higher income for the protection of the environment. It can be argued that people with higher income will have the tendency to have more concern about the protection of the environment. They will demand more on the eco-friendly products.

References

1. R.S. Kinda, Eco. Bulletin. **30**, 2612-2626 (2010)
2. M.M. Alam, M.W. Murad, A.H.M. Noman, I. Ozturk, Ecol. Ind. **70**, 466–479 (2016)
3. N.N. Minh, Int. J. of Enrgy. Econ. and Pol. **10**, 76-83 (2020)
4. Y. Sugiawan, S. Managi, Enrgy. Pol. **98**, 187–198 (2016)
5. B. Saboori, J. Sulaiman, Int. J. Econ. Financ. **4**, 243 (2012)
6. Darwanto, N. Woyanti, P.B. Santosa, H. Sasana, I. Ghozali, Int. J. of Enrgy. Econ. and Pol. **9**, 339-345 (2019)
7. Azwar, J. BPPK. **12**, 42-52 (2019)
8. P.K. Narayan, s. Narayan, Enrgy. Pol. **38**, 661–666 (2010)
9. Y. Jafari, J. Othman, A.H.S.M. Nor, J. Pol. Model. 34, 879-889 (2012)
10. V.G.R. Chandran, C.F. Tang, Renew. Sustain. Enrgy. Rev. **24**, 445–453 (2013)
11. H.H. Lean, R. Smyth, Appl. Energy. **87**, 1858–1864 (2010)
12. B. Saboori, J. Sulaiman, Enrgy. Pol. 60, 892–905 (2013)
13. G. Bölük, M. Mert, Renew. Sustain. Energy. Rev. **52**, 587–595 (2015)
14. H. Iwata, K. Okada, S. Samreth, Enrgy. Pol. **38**, 4057–4063 (2010)

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