LPEM-FEBUI Working Paper - 010
July 2017

ISSN 2356-4008

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LPEM-FEBUI Working Paper 010

Chief Editor : Riatu M. Qibthiyyah
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LPEM-FEB UI Working Paper 010, July 2017
ISSN 2356-4008

Supporting National Commitment in Reducing GHG Emissions: A Painful Journey for Indonesian Local Government?

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Abstract
In 2009, Indonesian ex-President, Susilo Bambang Yudhoyono declared Indonesia's commitment to reduce its Green House Gas (GHG) emission. The commitment later being legalized in Government Regulation No. 61 2011 (PP 61 Tahun 2011) along with the legal establishment of RAN-GRK (National Action Plan for GHG Emission Reduction) and RAD-GRK (Local Action Plan for GHG Emission Reduction) Program. However, following five years after the implementation of both program, the effectiveness itself is still in question especially in the case of local government level. This paper aims to evaluate the effectiveness of GHG emission mitigation activities in provincial level from the budget perspective. On top of that, this paper also attempts to investigate the determinant factors of local government's effort to reduce GHG emission proxied by the total mitigation expenditure in the particular province. Using Panel data analysis for each province with timespan of 2010–2015, our results suggest that mitigation activities conducted by the local government are significant in reducing the GHG emission. Our result also shows that local government's fiscal capacity does determine the level of budget dedicated for reducing GHG emission although with a very low coefficient, suggesting that emission mitigation has not became a priority for the local government in Indonesia.

JEL Classification: Q54; Q58

Keywords
GHG Emission — RAN-GRK — Panel Data — Local Government — Mitigation Expenditure

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Contents

1. INTRODUCTION

In recent years, climate change has been a major concern for most of the countries worldwide, including Indonesia. Despite of having a positive economic growth and macroeconomic stability during the last decade, Indonesia is also one of top GHG emitters in the world due to land-use change and deforestation. Indonesia is generating almost 10% of the total sum of the world's greenhouse gases and represents the second largest greenhouse gas emitter among developing countries. Realizing those as emerging threat to the national and international development agenda, Indonesia has committed to achieve 26% reduction in carbon emissions from BAU by 2020.

In 2009, Indonesian ex-President, Susilo Bambang Yudhoyono declared Indonesia's commitment to reduce its Green House Gas (GHG) emission. The commitment later being legalized in Government Regulation No. 61 2011 (*PP 61 Tahun 2011*[1]) along with the legal establishment of RAN-GRK (National Action Plan for GHG Emission Reduction/*Rencana Aksi Nasional penurunan emisi Gas Rumah Kaca*) and RAD-GRK (Local Action Plan for GHG Emission Reduction) Program [2]. The establishment of RAD-GRK allows the local government to participate in reducing the GHG emissions to achieve national target of 26% emission reduction by 2020. RAD-GRK document contains multi-sector GHG emission reduction efforts conducted by local government by considering local characteristics, potential, and authority, and must be integrated into the local development plan (RPJMD and RKPD).

The implementation of RAD-GRK allows policy maker to observe mitigation efforts of each province in Indonesia, by looking at their annual emission reduction data as well as its mitigation budget. The data obtained from RAD-GRK is considered as unique since prior to the introduction of RAD-GRK data, Indonesia has never had a province level data sets on environment related efforts. We conduct this

study aiming to investigate the effectiveness of GHG emission mitigation activities in provincial level from the budget perspective. On top of that, this paper also attempts to investigate the determinant factors of local government's effort to reduce GHG emission proxied by the total mitigation expenditure in the particular province. To our best knowledge, this study would be the first study which investigates the relationship between CO2 emission reduction and emission mitigation expenditure using province level data in Indonesia.

2. LITERATURE REVIEW

2.1 The Development of Climate Change Mitigation Activity in Indonesia

Despite being a one of biggest GHG emitters in the world, Indonesia has a strong political commitment to the environment and climate change. While concern on such issues has surfaced years before the 2005–2025 RPJPN (or the National Long-Term Development Plan), the clear commitment is found from the specific target on reducing GHG emission stated by former Indonesia President Yudhoyono during the G20 summit in Pittsburgh, USA in 2009. Accordingly, the target was integrated into such legally binding document plans as Perpres 61/2011 of National Action Plan for Reducing Greenhouse Gas Emission (RAN GRK), followed since by all provinces a year after with the enactment of the Regional Action Plan (RAD GRK). At both national and local level, on paper, the planning and budgeting process are relatively clear and systematic. From current planning process, national target for mitigating GHG emission can be translated not only to national development plans, but also to sub-national or regional development plans, meaning that there is local engagement in achieving the target.

The Presidential Regulation (Perpres) 11/2011 on National Action Plan for Reducing Greenhouse Gas Emission (RAN-GRK) is used as main reference to provide direction of policy framework for regional government to formulate the similar action. Formulation of Regional Action Plan for Reducing Greenhouse Gas Emission (RAD-GRK) is a mandate from the Perpres of RAN GRK that must be completed by provincial government within a year since the Perpres stipulation. Despite of the fact that source of GHG emission in every region may differ, the RAN GRK has identified five key sector priorities, namely forestry and peat land, agriculture, energy and transport, industry, and waste management. By October 2015, RAD GRK documents have been formulated and implemented by 33 provinces in Indonesia.

In 2016, the national secretariat of RAN-GRK, under National Planning Agency (Bappenas), compiled activity report of all provinces in Indonesia on climate change mitigation (PEP-RAD GRK) to verify the available data and publish current condition of climate change mitigation in Indonesia using province level data. The data of this report consists of the actual CO2 emission reduction from mitigation activity and its mitigation budget for five designated sectors in each province Indonesia.

After five years of implementation of RAD-GRK, this study intends to evaluate whether local governments effort on reducing greenhouse gas emissions, in this case, CO2 emission, has been successfully achieved through their mitigation expenditure. In addition to that objectives, this study is trying to explain the behaviour of local governments in Indonesia in terms of its mitigation expenditure.

2.2 Socio-Economic Indicators, Emission Reduction and Environmental Expenditure

The amount of reduction in GHG emission in a region is closely related to its socio-economic indcators. [3], discover how per capita income had a unique inverted U relation with environmental degradation. The study shows that the relationship between per capita income and environmental degradation was positive, until certain point when an increase in per capita income will lead to a decrease in environmental degradation. This theory later confirmed by [4], [5], and [6], and famously investigated by environmental economists worldwide.

Population growth also among the most important factors in causing environmental degradation. [7] stated that population growth, along with technological advance, contributed to CO2 emission and other greenhouse gases. Aside the growth itself, the composition population also affects the quality of environment. [8] prove that aging population is likely to reduce long term emission, while study by [9] shows how urbanization is positively related to emission in China's agricultural sector. Aside from the quantity of population, the quality of individuals in the country is also believed as contributor of the environmental quality of a country. Several studies found a positive relationship between education and pro-environmental behavior ([10]; [11]; [12]).

Aside of macroeconomic indicators and socio-economic indicators, fiscal aspect such as government expenditure is also known as an important determinant of environmental quality ([13]). Study by [14], shows a negative impact of government expenditure to per capita emission. The similar study by [15] also confirmed previous findings. On the other hand, since environmental protection is an area with little incentives for private sector to invest ([16]), the role of government to fund environmental activities is emerged. [13] noted that reallocation of government spending composition towards public expenditures, including environmental expenditure reduces pollution.

3. DATA

The dataset that were used in the analysis of this paper is a panel dataset in provincial level from 2010 (the beginning of RAN/RAD- GRK implementation) up to 2015. The dataset itself consisted of several variables that were obtained from RAN-RK Secretary for the emission related data and from Indonesian Central Bureau of Statistic for provincial characteristic data. The details of each variables are presented in the Table 1.

ER is the total of emission that has been successfully reduced by the local government in the particular year. Meanwhile, M_Exp is the total of expenditure that has been disbursed for mitigating GHG emission in the particular year for each province. Both of the data was obtained through institutional request from LPEM to the RAN-GRK secretary since until the study was conducted, the data was not available publicly. As for the rest of the data that characterise the

Table 1. List of Dataset

Variable	Unit of Measurements	Source
	Emission Related Data	
Total Emission Reduction	Ton CO2 Equivalent (tCO2eq)	RAN-GRK Secretary (the data was unavailable to public and obtained through institutional request)
GHG Mitigation Expenditure	Million IDR	RAN-GRK Secretary (the data was unavailable to public and obtained through institutional request)
	Provincial Characteristic	
GDP	Billion IDR	Indonesian Central Bureau of Statistics (BPS)
Inflation Rate	%	Indonesian Central Bureau of Statistics (BPS)
Unemployment Rate	%	Indonesian Central Bureau of Statistics (BPS)
Population Rate	Thousands of people	Indonesian Central Bureau of Statistics (BPS)
Total Expenditure	Billion IDR	Ministry of Finance
Own Source Revenue (*Pendapatan Asli Daerah*/PAD)	Billion IDR	Ministry of Finance
Auditor Opinion	WTP (Unqualified Opinion) WTP-DPP (Unqualified Opinion with explanatory paragraphs) WDP (Qualified Opinion) TW (Adversed Opinion)	BPK

province namely GDP, inflation rate, unemployment rate and total expenditure was obtained from Indonesian Central Bureau of Statistics ([17]) and was available publicly.

4. ECONOMETRIC METHODOLOGY

Prior to estimating our model, a test of overidentifying restriction will be performed to determine whether we should employ Fixed Effect or Random Effect in our estimation in our panel data. In essence, a test of fixed vs. random effects can also be seen as a test of overidentifying restrictions. This is due to the fact that the fixed effects estimator uses the orthogonality condition that the regressors are uncorrelated with the idiosyncratic error e_{it}, in other words $E(X_{it}e_{it}) = 0$. Where X is a vector of regressors. Meanwhile the random effects estimator uses the additional orthogonality conditions that the regressors are uncorrelated with the group-specific error u_i thus $E(X_{it}u_i) = 0$ ([18]).

If the orthogonality condition of $E(X_{it}u_i) = 0$ hold, both estimator will be consistent. However, the RE estimator will be more efficient since it exploit more moment conditions. Nonetheless, if it does not hold, then RE estimator will be biased and inconsistent. The most common test to test such overidentifying restriction is the [19] test. Hausman test is a vector of contrast test as follows:

$$H = n(\tilde{\beta} - \hat{\beta})'(V(\tilde{\beta}) - V(\hat{\beta}))^{-1}(\tilde{\beta} - \hat{\beta}) \quad (1)$$

Where $V(\tilde{\beta})$ and $V(\hat{\beta})$are estimators of the asymptotic variances of the unrestricted estimator $\tilde{\beta}$ (in our case is FE estimator) and restricted $\hat{\beta}$ estimator, respectively. The main idea of the test is, if the additional orthogonality condition $(E(X_{it}u_i) = 0)$ is valid then both estimator $\tilde{\beta}$ and $\hat{\beta}$should be consistent and close to each other, thus statistically H will statistically equal to 0. On the other hand if $E(X_{it}u_i) \neq 0$ then $\tilde{\beta}$ and $\hat{\beta}$ should be different and H will statistically unequal to 0.

After obtaining the result of overidentifying restriction test, we begin our analysis by estimating our first model to explore the effectiveness of the mitigation expenditure in reducing the GHG emission as shown in Equation (2).

$$er_{it} = \alpha_0 + \alpha_1 m\_exp_{it} + \gamma_0 X_{it} + \varepsilon_{it} \quad (2)$$

er_{it} is the total emission that successfully reduced in province i in year t. m_exp_{it} is the total expenditure disbursed by local government for mitigation activity of province i in year t. Meanwhile X_{it} is a vector of provincial characteristics such as income level, population and Human Development Index. And finally, ε_{it} is a random, idiosyncratic error term. It is expected that m_exp_{it} is positively correlate with er_{it}, implying that mitigation mitigation activity funded by local government are indeed effective in reducing the level of GHG emission in its territory.

Afterwards we move to our next model to address our second objective of this research to explore the determinants factor of total budget allocated for mitigation activity as a proxied of local government's effort in reducing GHG emission. The model could be mathematically written as follows:

$$m\_exp_{it} = \alpha_0 + \alpha_1 g\_size_{it} + \gamma_0 Z_{it} + \varepsilon_{it} \quad (3)$$

Where m_exp_{it} is the total expenditure disbursed for mitigation activity program of province i in year t. g_size_{it} is the size of government's fiscal space of province i in year t. As for Z_{it} is a vector of selected provincial characteristics namely population, unemployment rate, and inflation rate while ε_{it} is as mentioned before, a random and idiosyncratic error term.

5. EMPIRICAL RESULTS

5.1 Effectiveness of Mitigation Expenditure

As mention in the previous section, before begin estimating our model, we should perform a test to check the validity of the orthogonality condition of $E(X_{it}u_i) = 0$. In order to do this task we employed both the traditional [19] test and the robust version of Hausman test ([20]) that allow for

heteroscedasticity and serial correlation within group and Robust Hausman test that will allow arbitrary heteroscedasticity and within-group serial correlation.

Based on the model in Equation (2), the robust Hausman statistic was not significant at level 1, 5, or 10%, hence we cannot reject the $H0 : E(X_{it}u_i) = 0$. However we believed that an unobserved heterogeneity in our model (u_i) such as the view and perspective of the head of province regarding the importance of GHG emission reduction will correlate to one of the regressor such as the total budget disbursed for mitigating those emission. Therefore, we took a conservative way and employed fixed effect model to avoid the odds of biased in our estimator. The estimation result is presented in the first (1) column in the Table 2.

From the result we could see that additional 1% budget for mitigation expenditure is associated with an increase in GHG emission reduction for around 0.11%. However, from our in-depth interview that we conduct in four selected provinces namely NTB, NTT, Jambi and West Sulawesi, it is known that none of the mitigation activity was specially designed to reduce the GHG emission, instead it was merely selected by an ongoing activity that considered could reduce the emission based on criteria established by National Planning Agency (Bappenas).

The reason behind this situation is because the planning document (RPJMD) was already made when that local government was mandated to produce RAD-GRK document, thus local government cannot deviate from the province main targets and activities stated in the RPJMD. If that is the case, then how such poorly designed activities and program could significantly reduce the GHG emissions? One possible explanation is this result imply that the selection criteria created by Bappenas is developed properly, therefore regardless the lack of quality in planning process of mitigation activity, the activity still able to reduce the amount of GHG emissions. Nevertheless it is believed that if the missing link between RPJMD and RAD-GRK document could be addressed, it will boost the effectiveness of the mitigation expenditure in term of reducing GHG emissions.

One solution that proposed to overcome this issue is by revising the RPJMD of each province, in which emission reduction should be one of the target and priority to achieve by each local government. Local government could also take a higher measure by putting emission reduction in part of their vision and/or mission. By doing so, local government will legally able to design and carry out such activities that specially designed to reduce the level of GHG emission in its territory.

From the result in Table 2. population variable has a significant and negative relationship with emission reduction. From our estimation 1% population growth will reduce the emissions reduction achieved by local government around 3.45%. This negative relationship is expected as province with more people will have more government spending especially in public sector and infrastructure which not only reduce the available budget allocated for mitigation activity but also sometimes those spending will increase the emission when do not carried out with such standards. This result is accordance with [21], which he found a negative correlation between population and environmental expenditure in 7 states in US.

Another interesting result from our estimation is level of GDP per capita in a province is associated with lower level of emission reduction. From our model 1% growth in GDP per capita will decrease the emission reduction by 3.37%. From environmental Kuznet curve analysis point of view, this result gave an early indication that Indonesia is still in the left-side part of environmental Kuznet-curve in which an advancement in economic activity will lead to an increase in emission and environmental degradation. This finding support evidences found by [22], that found a positive relationship between income level and CO2 emission in Indonesia.

On the other hand Own Source Revenue (PAD), as proxy of government's fiscal size does not seem to have a significant relationship with the performance of local government in reducing GHG emission. Conflicting with several studies such as [14] or [15] that argued government size and expenditure have a negative direct effect with total emission.

5.2 Determinant Factor of Mitigation Expenditure

We start our discussion of our second objective regarding the determinant factor of local government's mitigation expenditure. As our first analysis, before began our estimation, we conduct a robust Hausman test of our model as described in Eq. (3) we found the robust Hausman statistic of 13.952 that significant in the level of 5%, thus rejecting the random effect model.

From our estimation, it is found that the size of government budget proxied by own source revenue (PAD) is associated positively with the total mitigation expenditure, however the coefficient seems to be very small. Our model suggest that for each additional billion in the size of local government expenditure will only increase mitigation expenditure by 4.48 million IDR.

The significance of the size of fiscal space to the mitigation expenditure disbursed by the local government indicates that province with smaller fiscal space will have less capacity to allocate budget dedicated for reducing GHG emission. Therefore one suggestion that arise is, such low-budget sized provinces perhaps should be assisted by central government to increase their mitigation expenditure. The assistance itself could be in many form such as incentive scheme or direct transfer. On the other hand the small coefficient suggest that emission mitigation has not became a priority for the local government, thus when there is an additional revenue generated by local government, only a tiny fraction of it that will be allocated to tackle environmental issue.

Local governance quality proxied by auditor's opinion regarding the provincial budget report does not seem to have a significant relationship with the mitigation expenditure. Provinces that obtained WTP status (unqualified opinion) does not differ statistically with those provinces who failed to obtained WTP status, implying that quality of local government apparatus may not play a significant role in determining the mitigation expenditure. This result may not be surprising since as mentioned before, due to the missing link between RPJMD and RAD-GRK document, local government cannot create a new activity that specifically designed for reducing GHG emissions. Therefore the role of government officer in designing the appropriate pro-

Table 2

VARIABLES	(1) Emission Reduction	(2) Mitigation Expenditure
PAD		4.481**
		(1.846)
Poverty Rate		-263,528**
		(119,826
Inflation		-77.35
		(848.2)
Unemployment		71.13
		(1,363)
Population		-18.98**
		(8.450)
WTP	0.202	6,254
	(0.279)	(3,775)
Mitigation Exp (ln)	0.111**	
	(0.0510)	
GDP per capita (ln)	-3.372*	
	(1.825)	
Population (ln)	-3.449*	
	(1.889)	
PAD (ln)	0.742	
	(0.587)	
Constant	45.78**	208,497**
	(19.04)	(90,043)
Observations	149	137
Number of prov	25	23
Province Fixed Effects?	Yes	Yes

Note: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

gram to achieve certain target of emission reduction become irrelevant.

Even though in the case of the mismatch issue between RPJMD and RAD-GRK document has been addressed successfully in the future, the quality of local government apparatus still may not significantly affect the mitigation expenditure. This is due to the fact that there is a high turnover rate for the local officer who has been assigned to manage the RAD-GRK activities. Local government officer admit that this issue hamper the learning process of the local government officer to have a high competencies in managing climate change and environmental issues.

Another interesting finding is the province's population seems to have a significant negative relationship with the total mitigation expenditure of the local government. Based on our estimation, for each additional thousands of people is associated with reduction in mitigation expenditure around 18.9 million IDR. One way to explain this result is the higher population of a province will induce higher needs of expenditure for certain people-based spending such as health expenditures or social transfer. As a result there would be less budget left for the government to be utilised for mitigation activities. This reasoning is supported by negative and significant relationship between poverty rate and mitigation expenditure, implying there is a dilemma faced by local government due to the trade-off between reducing poverty and preserving environmental quality.

On the other hand Inflation does not seem too significantly associated to total mitigation expenditure. However, it has negative sign as expected since higher inflation will disincentive local government to allocate mitigation expenditure from at least two channels. First is higher inflation means higher unit cost for reducing emission, and second, higher inflation means higher cost for other priority expenditure thus less remaining budget for emission mitigation expenditure.

5.3 Robustness Check

In order to test the robustness of our results, we provide two regressions where first we re-estimate Equation (3) by using total expenditure as the proxy of government size instead of PAD. Later, we control further the dummy variable of WTP into each category of opinion (WTP, WTP-DPP, WDP, TW) with TW as our constant.

We start our analysis by examining the second (2) column of Table 3 where we control further our proxy of local governance quality. From the table we could see that there is a consistent result with our previous result in 5.1. in which PAD as the proxy of government's fiscal size has a significant and positive relationship while poverty rate and population have significant and negative relationship with the mitigation expenditure. However regardless now we have controlled further for our proxy of local governance quality, the variables still do not show significant relationship for every opinion status. Suggesting that the total amount of mitigation expenditure indeed has nothing to do with the quality of the local governance.

Afterwards we re-estimate Equation (2) using total expenditure (APBD) as the proxy of government fiscal size instead of PAD. From the table we could see an interesting result where now the government's fiscal size (proxied by APBD) does not statistically significant in affecting the amount of mitigation expenditure. This result may be due to the fact that source of fund in the total expenditure consist of other element other than PAD such as transferred fund from central government, loan or other fund from other parties. In many case the utilisation of such fund is already determined by the grantor therefore it cannot be allocate for

Table 3

VARIABLES	(1) Mitigation Expenditure	(2) Mitigation Expenditure
PAD		4.574***
		(1.618)
Poverty Rate	-191,891*	-273,617**
	(93,775)	(120,993)
Inflation	-27.75	-36.44
	(834.7)	(746.9)
Unemployment	84.92	96.32
	(1,348)	(1,167)
Population	-13.52**	-19.61**
	(6.496)	(8.457)
WTP		-6,728
		(12,848)
WTP-DPP		-8,871
		(13,161)
WDP		-12,855
		(11,979)
APBD	1.542	
	(1.210)	
WTP or WTP-DPP	5,845	
	(3,789)	
Constant	152,692**	227,949**
	(69,160)	(96,502)
Observations	137	137
R-squared	0.026	0.039
Number of prov	23	23
Province Fixed Effects?	Yes	Yes

Note: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

other purpose including mitigation expenditure.

6. CONCLUSION

In this paper we aim to evaluate the effectiveness of GHG mitigation expenditure in reducing the GHG emission. Our result found that there is a statistical evidence that mitigation expenditure have a positive effect in reducing the GHG emission. This result indicate the success of the central government (BAPPENAS) in developing screening and selection criteria for mitigation activity in local government level. However we believed that the synchronization between planning document (RPJMD) of each province with RAD-GRK document will boost the effectiveness of the mitigation expenditure in term of reducing GHG emissions even more.

Our proposal is due to the fact that at the moment there is none of mitigation activities that specially designed to achieve particular amount of GHG emission reduction. In fact those activities are merely an ongoing activities that perceived as relevant by local government in reducing GHG emission.

As our second objective of this paper, we found that the size of fiscal space is significantly associated with the total mitigation expenditure although with a very small coefficient. The small coefficient suggest that emission mitigation has not became a priority for the local government. As a result an only a tiny fraction of an additional revenue generated by local government that will be allocated to tackle environmental issue. Therefore we proposed that central government should provide an assistance scheme for the provinces with low level of budget to increase their mitigation expenditure.

References

[1] Republic of Indonesia. *Presidential Regulaton No. 61/2011 on National Action Plan for Reducing Greenhouse Gas Emissions (RAN-GRK)*. 2011.

[2] National Secretariat of RAN-GRK. *Report on the Implementation of RAD-GRK*. Sekretariat RAN-GRK, 2017. http://www.sekretariat-rangrk.org/.

[3] Gene M. Grossman and Alan B. Krueger. Environmental impacts of a North American Free Trade Agreement. In Peter M. Garber, editor, *The Mexico-U.S. Free Trade Agreement*, pages 165–177. MIT Press, Cambridge, 1992.

[4] Thomas M. Selden and Daqing Song. Environmental quality and development: Is there a Kuznets curve for air pollution emissions? *Journal of Environmental Economics and management*, 27(2):147–162, 1994.

[5] Marzio Galeotti, Alessandro Lanza, and Francesco Pauli. Reassessing the environmental Kuznets curve for CO2 emissions: A robustness exercise. *Ecological Economics*, 57(1):152–163, 2006. doi:https://doi.org/10.1016/j.ecolecon.2005.03.031.

[6] Behnaz Saboori, Jamalludin Sulaiman, and Saidatulakmal Mohd. Economic growth and CO2 emissions in Malaysia: A cointegration analysis of the environmental Kuznets curve. *Energy Policy*, 51:184–191, 2012. doi:https://doi.org/10.1016/j.enpol.2012.08.065.

[7] Thomas C. Schelling. Some economics of global warming. *The American Economic Review*, 82(1):1–14, 1992.

[8] Michael Dalton, Brian O'Neill, Alexia Prskawetz, Leiwen Jiang, and John Pitkin. Population aging and fu-

ture carbon emissions in the United States. *Energy Economics*, 30(2):642–675, 2008. doi:https://doi.org/10.1016/j.eneco.2006.07.002.

[9] Bin Xu and Boqiang Lin. Factors affecting CO2 emissions in China's agriculture sector: Evidence from geographically weighted regression model. *Energy Policy*, 104:404–414, 2017. doi:https://doi.org/10.1016/j.enpol.2017.02.011.

[10] Scott J. Callan and Janet M. Thomas. Analyzing demand for disposal and recycling services: A systems approach. *Eastern Economic Journal*, 32(2):221–240, 2006.

[11] Bradford Mills and Joachim Schleich. Residential energy-efficient technology adoption, energy conservation, knowledge, and attitudes: An analysis of European countries. *Energy Policy*, 49:616–628, 2012. doi:https://doi.org/10.1016/j.enpol.2012.07.008.

[12] William A. Clark and James C. Finley. Determinants of water conservation intention in Blagoevgrad, Bulgaria. *Society and Natural Resources*, 20(7):613–627, 2007. doi:http://dx.doi.org/10.1080/08941920701216552.

[13] Ramon Lopez, Gregmar I Galinato, and Asif Islam. Fiscal spending and the environment: Theory and empirics. *Journal of Environmental Economics and Management*, 62(2):180–198, 2011. doi:https://doi.org/10.1016/j.jeem.2011.03.001.

[14] George E. Halkos and Epameinondas A. Paizanos. The effects of fiscal policy on CO2 emissions: Evidence from the U.S.A. *Energy Policy*, 88:317–328, 2016. doi:https://doi.org/10.1016/j.enpol.2015.10.035.

[15] Adeolu O. Adewuyi. Effects of public and private expenditures on environmental pollution: A dynamic heterogeneous panel data analysis. *Renewable and Sustainable Energy Reviews*, 65:489–506, 2016. doi:https://doi.org/10.1016/j.rser.2016.06.090.

[16] Partha Dasgupta. The economics of the environment. *Environment and Development Economics*, 1(4):387–428, 1996. doi:https://doi.org/10.1017/S1355770X00000772.

[17] Bureau of National Statistics Indonesia. *Statistics Indonesia*. 2017.

[18] Mark E. Schaffer and Steven Stillman. *XTOVERID: Stata module to calculate tests of overidentifying restrictions after xtreg, xtivreg, xtivreg2, xthtaylor*. Oct 2006. Retrieved from https://ideas.repec.org/c/boc/bocode/s456779.html (Accessed 2017).

[19] Jerry A. Hausman. Specification tests in econometrics. *Econometrica: Journal of the Econometric Society*, 46(6):1251–1271, 1978. doi:10.2307/1913827.

[20] Jeffrey M Wooldridge. *Econometric analysis of cross section and panel data*. Cambridge, MA: MIT press, 2002.

[21] Robert P. Blauvelt. State environmental expenditures and their correlation with seven econometric factors. *Journal of Environment and Ecology*, 5(2):172–185, 2014. doi:https://doi.org/10.5296/jee.v5i2.6374.

[22] Yogi Sugiawan and Shunsuke Managi. The environmental kuznets curve in Indonesia: Exploring the potential of renewable energy. *Energy Policy*, 98:187–198, 2016. doi:https://doi.org/10.1016/j.enpol.2016.08.029.

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