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The impact of investment on environmental quality: evidence from Indonesian Provinces

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Abstract: The impact of foreign direct investment (FDI) on environmental degradation has been a main issue in investment-environment nexus. FDI that is channelled to non-eco-friendly industry most likely will accelerate environmental degradation. In this research, we focus on investigating the effect of FDI on environmental degradation by studying FDI in Indonesia across provinces. We use two proxies of environmental degradation which are Environmental Quality Index and Air Quality Index to measure the severity of air pollution in each province. A panel data technique is applied to a panel of 34 provinces resulting in 164 observations province-year observations employed in the empirical estimation. We also disentangle investment as the main explanatory variable, not only FDI but also domestic investment. Our result show that both domestic investment and FDI are positively associated with environmental degradation implying that most of these investment are channelled into the sector with high negative externalities resulting the decline of environmental quality in particular province.

Keywords: FDI; foreign direct investment; domestic investment; environmental quality index; air quality index; Indonesia.

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1 Introduction

It has been widely known that investment is the key factor on driving the growth of both national and local economy. Many countries are pursuing to attract large influx of investment both domestically or internationally. While in the other hand, these investments are most likely channelled into non environmentally friendly industries particularly in emerging countries where natural resources are abundant leading into massive extraction and exploitation. Furthermore, the rapid growth of the industry fuelled by investment also leads into the expansion of electricity use and fossil fuels particularly for countries where green energy is limited or not readily available (Albulescu et al., 2019; Doytch and Uctum, 2016; Shahbaz et al., 2018).

Although FDI is widely regarded as the main contributor to the environmental degradation, the role of FDI and domestic investment depend on which industry the investment are channelled. In countries with strong commitment on reducing green gas emission and other types of pollution, these FDIs can bolster the growth of economics while reducing environmental degradation or even could also promote the improvement of environmental quality (Adeel-Farooq et al., 2021; Liu et al., 2021). Conversely, emerging economies particularly countries with low commitment to preserve environmental quality and lenient regulation in environmental protection. This area has become an important issue in investment-environment nexus. Hence our analysis attempts to provide an evidence related to the impact of investment (domestic and foreign) to environmental degradation.

To thoroughly conduct our analysis we focus on a single country Indonesia due to several reasons. First, Indonesia is ranked 6th most polluted countries in world based on air quality index in 2019, while environmental quality index does not seem to exhibit low environmental degradation. As a country with rapid growing industry, to meet the demand of electricity, Indonesia has a great reliance on non-renewable source of energy. Fossil fuel remains the biggest source of energy contributing approximately 85% of total

electricity production in 2020 with 71% of those are produced from coal power plants (Ministry of Energy and Mineral Resources, 2020).

Secondly, since 2009 all provincial government are required to submit environmental quality study to the ministry of environment and forestry. The study consists several aspect on environmental quality such as water quality, air quality and forestation to reflect how pronicial government are willing to preserve the environment quality particularly to be able to provide sustainable development plant by taking into account environmental ethic.

Thirdly, the influx of FDI in Indonesia is significantly increasing over the years, reaching 25 billions USD in 2019 (World Bank, 2020). With high reliance on fossil fuel, this further push the use of fossil fuel to meet the demand of electricity. Fourthly, creating a massive job opportunity has been the main agenda in Indonesian economy by the government. The enactment of Omnibus Law in 2020 will further attract many investment both domestically and foreignly. Although many jobs opportunity will emerge due to this law enactment, without stringent regulation on externality such as polution or a strong commitment to preserve environmental quality in the future, this will poses a threat and challenge to the ultimate sustainable development goals in Indonesia.

We use combined dataset from Ministry of Environment and Forestry, the Central Statistics Office and the Coordinating Agency for Investment on provincial level. We obtain 164 province-year observations ranging from period 2010–2020. We do not consider data before 2009 as environmental quality study has become an obligation to report starting 2009. As the study consist several aspect to be reported, water quality and forestry aspect indicators used to calculate the score has evolved over the period of time, therefore we test also the impact of invest to air quality as this aspect indicator remains unchange since the beginning.

Our findings show that both foreign and domestic investment are detrimental to environmental quality as they will increase the exploitation over the land and fossil fuel use to sustain electricity demand for industrial production. This will result an increase of greenhouse gas emission and deforestation. We also observe negative significant effect of agriculture to environmental quality indicating that there is perhaps deforestation particularly for agriculture industry related to palm oil which has become one of the major export commodities in Indonesia. This paper therefore has several contribution to the literature. Firstly, this paper contribute to the literature of investment-environment nexus by disentangling source of investment (domestic and foreign investment) and providing evidences that these invesments are associated with environmental degradation regardless the source of funds (Aust et al., 2020; Bildirici and Gokmenoglu, 2020; Liu et al., 2021; Zheng, 2021). Secondly it contributes to the literature on sustainable development by showing in emerging economies particularly countries with heavy reliance on non-green energies influx of invesment may result in more devastating environmental degradation (Aust et al., 2020; Kul et al., 2020; Singhania and Saini, 2021). Our findings are of interest to policymakers in countries with more linient regulation on environmental protection and heavy reliance on fossil fuel especially in emerging economies.

This rest of the paper is structured as follows. Section 2 present the related literature and hypothesis development. Section 3 describes our sample and defines our variable of interest including employed methodology. Section 4 present the empirical results. Section 5 concludes the paper.

2 Background and hypotheses development

The effect of foreign direct investment (FDI) towards environment degradation varies across many research papers. There are two scenarios where FDI could result in positive externalities or negative externalities that ultimately will affect environmental quality. In one hand, an influx of foreign direct investment may generate positive externalities and direct capital support through technology transfer and managerial skills (Lee, 2013). Several empirical papers also provide an evidence that FDI could improve the environmental quality by investing in green energies (Lee, 2013; Liu et al., 2021). This is only if FDI is channelled into environmental friendly industry such as green energy. In the other hand many have considered FDI could lead into more CO₂ emission (Cole et al., 2017; Mohsin et al., 2022; Muhammad and Khan, 2019) and as a major contributor to the environmental degradation (Bildirici and Gokmenoglu, 2020; Paziienza, 2019; Rafindadi et al., 2018; Yin et al., 2021). Moreover, if FDI is channelled into non-environmental friendly industry will result in excessive amount of negative externalities such as pollution.

Although FDI could be channelled into eco-friendly industry, many FDIs in emerging economies are concentrated into industries with high negative externalities output. In Indonesia, most of the FDI is channelled into non-environmental friendly industry where 15% of FDI in 2018 is channelled to Electricity, Gas and Water industry while property and mining becomes the second and the third most popular industrial sector for FDI accounting for 14.5% and 10.37% respectively from total FDI (Investment Coordinating Board of Republic of Indonesia, 2019). Hence, we expect that environmental degradation will be positively affected by the presence of FDI.

H1: Foreign Direct Investment is detrimental to the environmental quality.

Similar to FDI, domestic investment (PMDN) are also concentrated in non eco-friendly industries such as transportation, gas, electricity, and construction where these industry are notoriously known for their negative externalities. However in contrast with FDI, domestic investments are less likely to bring technological transfer or managerial skills hence, it less likely to have positive externalities. We therefore expect that similar to FDI, domestic investment (PMDN) is positively associated with environmental degradation.

H2: PMDN is detrimental to the environmental quality.

The impact of investment to environmental quality may be different between poor and rich province. Rich provinces tend to be more developed and adopt more and less intensive environmentally friendly technology into their productions. In the otherhand poor provinces are accelerating their industrialisation to increase their regional income at the cost of environmental quality. Thus, poor provinces tend to adopt more pollution-intensive technology and host more polluting firms which are considerably cheaper (He et al., 2020; Zilio and Recalde, 2011). While poor provinces pursue higher regional income that may be detrimental to their environmental quality, influx of investment to poor region faces less surveillance and more relaxing regulation on environmental preservation. While in the other hand, in rich provinces externalities emerging from pollution tend to be more heavily regulated. Therefore, the investment either FDI and PMDN may brings better benefit or less detrimental to environmental quality in provinces with higher GDP compare to the provinces with lower GDP.

H3: FDI is more detrimental to environmental quality in province with lower GDP.

H4: PMDN is more detrimental to environmental quality in province with lower GDP.

3 Data and methodology

We use combined dataset from various sources to thoroughly conduct our investigation. We obtain the data on environmental quality index and air quality index from Ministry of Environment and Forestry of The Republic of Indonesia. Since 2009, provincial governments are required to conduct environmental quality study regularly under Regulation No. 32 Tahun 2009, to ensure local development plan is in accordance with sustainable development. The index consists three key element such as: water quality, air quality, and forestation. We further use also air quality as dependent variable to capture fossil fuel impact on air quality due to the increasing demand on electricity. On average provincial environmental index exhibit adequate level of environmental quality with the lowest 31.97 is DKI Jakarta the capital city, which suffers a heavy environmental degradation and is widely known for their notorious air pollution.

In the other hand air quality index shows a better performance on average in preserving air quality. We obtain data on direct investment (FDI) and domestic investment (PMDN) from Coordinating Agency for Investment. We end up with 168 year-province observation for the period of 2010 to 2020.

To evaluate the effect of investment to environmental degradation, we conduct pooled and static data analysis through OLS and Random Effect regression. Based on the correlation matrix shown by Table 2, we are not able to include FDI and PMDN into a single model due to high correlation. We run these two types of investment into two separate models. Therefore to be able to do so, we employ the econometric specification below:

$$KLHSIndex_{it} = \beta_0 + \beta_1 FDI_{it} + \sum_m \theta_m Control_{it} + \varepsilon_{it} \quad (1)$$

$$KLHSIndex_{it} = \beta_0 + \beta_1 PMDN_{it} + \sum_m \theta_m Control_{it} + \varepsilon_{it} \quad (2)$$

$$Airquality_{it} = \beta_0 + \beta_1 FDI_{it} + \sum_m \theta_m Control_{it} + \varepsilon_{it} \quad (3)$$

$$Airquality_{it} = \beta_0 + \beta_1 PMDN_{it} + \sum_m \theta_m Control_{it} + \varepsilon_{it} \quad (4)$$

Where *FDI* is the total foreign direct investment to a province divided by 1 million and *PMDN* is total domestic investment to a province divided by 1 million. To be inline with the hypothesis, We expect FDI and PMDN will be negatively associated with environmental quality index and air quality index. We also employ set of control variables in equations (1)–(4) All variables are defined in Table 1 with corresponding descriptive statistic. We include regional GDP growth (*RGDPgrowth*) and expect negative sign as regional economic growth is associated with environmental degradation. We include also total population (*population*) and expect negative sign as large population require more electricity, water and land, therefore detrimental to environment

quality. We include also land size of agriculture (*ln_agriculture*) and expect negative sign as the increasing area for agriculture could lead into deforestation. We control also for the size of area (*ln_region*) of the province and expect positive sign as larger province could reduce the pace of environmental degradation by having able to provide land for forestation. Last, we include also human development index (*HDI*) and expect positive sign.

Table 1 Descriptive statistics

<i>Variable</i>	<i>Definition</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. dev</i>	<i>Min</i>	<i>Max</i>
KLHSIndeks	Environmental Quality Index	300	66.79953	10.5057	31.97	91.5
Airquality	Air Quality Index to measure the severity of air pollution in each province	164	86.34018	7.473832	50.65	96.2
FDI	Foreign direct investment	374	0.7862638	1.220065	0.0002285	7.124881
PMDN	Domestic investment	372	6.169091	10.2664	0	62.09484
RGDPgrowth	Regional GDP growth	337	4.926706	3.377705	-15.75	21.76
Population	Total population	374	928745.2	2686549	7653	14700000
ln_agriculture	Land size of agriculture	170	11.64538	1.43041	7.106606	14.0681
Ln_region	Size of province	371	10.40295	1.201939	6.498297	12.67306
HDI	Human development index	371	68.56663	4.482865	54.45	80.77

Table 2 Correlation matrix

	<i>KLHSIndeks</i>	<i>Airquality</i>	<i>FDI_r</i>	<i>PMDN</i>	<i>RGDP growth</i>	<i>Population</i>	<i>ln_agriculture</i>	<i>ln_region</i>	<i>HDI</i>
KLHSIndeks	1								
Airquality	0.6082	1							
FDI_r	-0.4752	-0.5988	1						
PMDN	-0.5061	-0.5345	0.7294	1					
RGDP growth	0.0681	-0.0368	0.0467	-0.12	1				
Population	-0.0107	-0.0148	-0.0277	-0.0115	-0.0259	1			
ln_agriculture	-0.49	-0.439	0.4345	0.5101	0.0938	0.176	1		
ln_region	0.5887	0.376	-0.207	-0.1683	-0.0317	0.1772	0.0083	1	
HDI	-0.4668	-0.3136	0.2751	0.3678	-0.0822	0.067	0.1365	-0.6115	1

4 Empirical result

Our results as shown by Table 3 indicate that both FDI and PDMN are negative significant implicating that both domestic and foreign investment are detrimental to the environmental quality. The government effort in creating more job to reduce unemployment by attracting more investment may be beneficial to the economy, however, it also lead into the reduction of environmental quality. The results in Table 3

are consistent both using OLS and Random Effect technique. Furthermore, we find similar yet consistent result when investigating the effect of investment on air quality as shown by Table 4. Both domestic investment and foreign investment lead into environmental degradation implicating that these investment will require more electrical power where the nation major source of electricity is fossil fuel leaving more air pollution. These result are also consistent both by OLS and Random Effect technique.

Table 3 Regression on the effect of investment on environment quality index

	(OLS)	(OLS)	(RE)	(RE)
	KLHSindeks	KLHSindeks	KLHSindeks	KLHSindeks
FDI_r	-1.495*** (-3.58)		-1.504** (-2.18)	
PMDN		-0.182*** (-3.39)		-0.158* (-1.77)
RGDPgrowth	0.357*** (3.00)	0.270** (2.48)	0.308*** (2.71)	0.240** (2.38)
Population	-0.001 (-1.30)	-0.001 (-1.55)	-0.001* (-1.87)	-0.001* (-1.86)
ln_agriculture	-2.929*** (-7.36)	-2.747*** (-6.03)	-1.941* (-1.73)	-1.932* (-1.67)
ln_region	4.666*** (9.59)	4.871*** (9.45)	5.461*** (6.68)	5.747*** (7.40)
HDI	0.0138 (0.09)	0.103 (0.63)	0.326 (1.45)	0.435* (1.87)
_cons	53.09*** (3.77)	43.18*** (2.80)	11.98 (0.55)	1.587 (0.07)
N	168	167	168	167
N_g	34	34	34	34
r2	0.624	0.625	0.5931	0.5935

t statistics in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

This negative sign from both FDI and PMDN on Environmental quality index are explained by the concentration of the investment influx to the region to non-eco friendly industry that is harmful to the environment. Thus eventhough FDI may brings advance techonology that is less pollution intensive, the output of these industries still harmful and lead into environmental degadration (Cole et al., 2017; de Pascale et al., 2020; Yin et al., 2021). Furthermore, Table 4 shows also that both FDI and PMDN are negatively correlated with the air quality of their hosting provinces implicating that both investment types leads into higher carbon emission.

Table 4 Regression on the effect of investment on air quality

	(OLS)	(OLS)	(RE)	(RE)
	<i>Airquality</i>	<i>Airquality</i>	<i>Airquality</i>	<i>Airquality</i>
FDI_r	-2.620*** (-5.88)		-1.926*** (-2.98)	
PMDN		-0.243*** (-4.74)		-0.184*** (-4.14)
RGDPgrowth	0.0227 (0.24)	-0.0887 (-0.83)	-0.0253 (-0.34)	-0.110 (-1.24)
Population	-0.001 (-0.85)	-0.001 (-1.01)	-0.001 (-1.17)	-0.001 (-1.30)
ln_agriculture	-1.273*** (-4.51)	-1.298*** (-4.20)	-1.307*** (-5.53)	-1.271*** (-4.03)
ln_region	1.998*** (3.44)	2.348*** (3.84)	2.315*** (2.80)	2.748*** (2.80)
HDI	0.0843 (0.62)	0.173 (1.23)	0.157 (0.78)	0.311 (1.36)
_cons	76.91*** (5.61)	67.54*** (4.85)	68.59*** (3.31)	53.16** (2.33)
N	164	163	164	163
N_g	34	34	34	34
r2	0.473	0.433	0.4616	0.4171

t statistics in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

This evidences support findings of previous empirical research that FDI particularly in the emerging economies whose economies are driven by energy from non-renewable resources increases carbon emission alongside with the growth of the economy itself (Muhammad and Khan, 2019; Pazienza, 2019). Hence, strong environmental protection policy alongside with the country's willingness to adopt greener and more renewable energy is necessary to reduces such high output of pollution. However, this policy will be deemed hard to implement particularly in emerging economies due to the cost they beared should the shift their source of energy. Polution is regarded as necessary for their production and it has been their necessary input as it tends to be cheaper to be able to compete in the market (Pethig, 1976). Hence, to compensate for such growht in the economy the society needs to find the balance of environmental degradation and economic growth (Arrow et al., 1995).

We also find that regional economic growth is positive significant implicating that province with higher growth of economic experience an improvement towards their environmental quality. However this result is not significant in affecting the air quality. We next find that land size of agriculture has negative significant impact on environmental quality and air quality. This implicates that the more land exploitation for agriculture purposes leads into massive deforestation that will ultimately lead into environmental degradation. We also find that the size of the province is positive

significant implicating that larger province will have more area reserved as a green area designated to preserve environmental quality and forestation. Lastly we find that human development index and population are not significant in explaining the variation of both air pollution and environmental quality index. Taken altogether, our result therefore confirms our hypotheses that both foreign and domestic investment are detrimental to the environmental quality where it promotes more land exploitation, potential pollution from production and increasing use of fossil fuel for electricity production to power up the industries and for goods transportation purposes.

Table 5 Regression on the effect of investment on environmental quality index based on regional GDP

	(1)	(2)	(3)	(4)
	<i>KLHSIndeks</i>	<i>KLHSIndeks</i>	<i>KLHSIndeks</i>	<i>KLHSIndeks</i>
FDI_r	0.508 (0.45)		-0.979 (-0.93)	
DRGDP	-1.412 (-0.62)	-4.574* (-1.95)	-5.710** (-2.26)	-5.943** (-2.02)
DRGDP*FDI_r	-1.815 (-1.36)		0.470 (0.35)	
Population	-0.001 (-0.75)	-0.001 (-1.33)	-0.001 (-1.19)	-0.001 (-1.37)
ln_agriculture	-2.681*** (-5.88)	-2.249*** (-4.50)	-1.502 (-1.37)	-1.464 (-1.41)
ln_region	4.489*** (8.35)	5.279*** (9.62)	5.471*** (5.92)	5.802*** (7.15)
HDI	0.0141 (0.09)	0.231 (1.19)	0.289 (1.20)	0.468* (1.65)
PMDN		-0.539** (-2.57)		-0.302 (-1.32)
DRGDP*PMDN		0.413* (1.97)		0.193 (0.83)
_cons	53.09*** (3.45)	26.96 (1.41)	11.29 (0.44)	-4.250 (-0.14)
N	168	167	168	167
N_g			34	34
r2	0.618	0.627		

t statistics in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

We extend our analysis by looking into the different effect of investment type according to provinces' wealth. To conduct this analysis, we employ a dummy variable *DRGDP* that takes value one if the regional GDP is higher than the median value and zero otherwise. We then mimic equations (1)–(4) and interact our main variable of interest with *DRGDP*. As shown by Table 5 we do not observe consistent or robust result on the

relationship between both investment types and environmental quality index when we try to divide the effect based on regional GDP on each provinces. A plausible explanation for this result is as explained before that both investment types are concentrated to non-eco friendly industries which are most likely to be pollution intensive. Therefore, even though in high GDP region the environmental issues has become important and there is constant pressure of reducing pollution, given that the country itself is still in the emerging economies, environmental degradation is offset by the economic growth. Poorer provinces are also willing to accept this degradation in order to bolster their economic growth. Regional self-autonomous regulation also exacerbates this by creating incentives for regional government to attract more industry to increase their regional income.

Table 6 Regression on the effect of investment on air quality based on regional GDP

	(1)	(2)	(3)	(4)
	<i>Airquality</i>	<i>Airquality</i>	<i>Airquality</i>	<i>Airquality</i>
FDI_r	-0.0514 (-0.05)		-0.0694 (-0.06)	
DRGDP	-2.307 (-1.24)	-8.209*** (-2.69)	-1.221 (-0.35)	-6.156 (-1.58)
DRGDP*FDI_r	-2.267** (-2.06)		-1.990 (-1.34)	
PMDN		-0.552*** (-3.44)		-0.531*** (-3.34)
DRGDP*PMDN		0.465** (2.44)		0.440** (2.43)
Population	0.001 (0.07)	-0.001 (-0.01)	-0.001 (-0.72)	-0.001 (-0.79)
ln_agriculture	-1.028*** (-3.24)	-0.812** (-2.48)	-1.130*** (-3.59)	-1.057*** (-4.10)
ln_region	2.049*** (3.18)	3.143*** (4.35)	2.291** (2.54)	3.485*** (3.11)
HDI	0.205 (1.36)	0.437** (2.59)	0.259 (1.12)	0.580** (2.09)
_cons	64.79*** (3.93)	36.73* (1.95)	59.38** (2.31)	25.63 (0.85)
N	164	163	164	163
N_g	34	34	34	34
r2	0.509	0.494	0.4904	0.413

t statistics in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

However we obtain different result when we look the effect from the perspective of air quality. As shown by Table 6, similar to Table 5, we do not find any significant effect of

FDI on air quality regardless the regional GDP level. In the other hand we observe that the impact of PMDN is different when we split based on the level of regional GDP. The impact of PMDN to carbon emission is less in the region with high GDP compare to the poorer region. Many PMDN investment are government investment that is gradually shifting to more environmentally sustainable investment particularly in reducing carbon emission. Furthermore, poorer regions normally do not have sufficient infrastructure for transportation, hence PMDN investment on transportation are more concentrated in poorer regions compare to richer regions. This result support partially the evidences from previous empirical literature that poorer region tend to accept more pollution intensive firms in order to be able to promote their economic growth. Indeed, without having any incentives that may emerge from central government policy or regulation, in the long run these regions tend to behave same and reluctant to shift to and embrace greener and more environmentally sustainable industry or technology. Taken altogether our result do not support hypothesis 3 but support hypothesis 4.

5 Robustness checking

To account for potential different impact towards environmental quality we do not only proxy the environmental quality using KLHS Index but also using air quality. Not every investment went into widely deemed as environmentally damaging industries, in particular in areas with less extractable natural resources. However as the investment enter the area, it will increase economic activity which increases distribution of the logistic leading into air quality deterioration. As the KLHS Index is an index composed by many ecological aspects that broadly examines environmental quality, it may not capture better if the investment itself only increases the air pollution. Thus, we also proxy the environmental quality using air quality to capture negative externalities due to the investment. Our results as shown previously by Tables 3 and 4 hold the same for KLHS Index and Air Quality.

6 Conclusion

Bolstering economic growth has been a major goal for the government both in emerging or developed countries. One of the biggest challenge particularly for emerging economies is lack of domestic fund to finance. Hence, many governments are trying to attract foreign investment to provide more economic opportunity in the country. This foreign investment will increase the productivity and job opportunity that will benefit the country as a whole by promoting growth and reducing unemployment. Although it seems beneficial, the fact that there is scarcity in terms of land and resources poses a bigger threat and challenge to the environmental quality. When green energy is limited and not readily available across the nation, the easiest and cheapest way is to rely on fossil fuel. Furthermore, some of the industries may require more land for their production also poses a threat to deforestation.

Using Indonesian dataset on provincial level we focus on investigating the impact of Investment on environmental quality by disentangling the investment based on their source of fund, domestic and foreign investment. Indonesia as an emerging economies pursues to attract investment from domestic and foreign by enacting new regulation the

omnibus law in 2020 that focus on creating more job opportunity by attracting more investors. The country economies has great reliance on fossil fuel to produce electricity and rapid growing palm oil industry over the past few decades may endanger environment further especially with the large influx of invesment that goes directly to these industries.

Our results provide an evidence that investment is positively associated with environmental degradation where province receiving large influx of investment expereince decrease on their environmental quality. Our results therefore have important policy implication to the regulator that regardless the source of fund, improving nation economies still costing environmental quality. Hence it is important for the government to consider green energy as well as forestation as a solution to improve environment quality. Moreover our evidences also show that poorer region in Indonesia has strong incentives to attract pollution intensive industries to promote the growth. Hence government attention is necessary to provide more incentives for poorer area to shift into greener and more environmentally sustainable investment.

Declarations

All authors declare that they have no conflicts of interest.

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