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The effect of economic development, income inequality and banking sector development on environmental quality: Empirical evidence in Indonesia

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Abstract

Our research explores how government expenditure, inequality, and bank lending could impact environmental quality. We assess the quality of the environment by utilizing the Environmental Quality Index, as supplied by the Ministry of Environment and Forestry. We use annual regional-level data from 2012 to 2021 gathered from the Indonesia Statistics Bureau (*Badan Pusat Statistik-BPS*), Bank Indonesia, and the environment reports of Indonesia provided by the Ministry of Environment and Forestry. Our final sample consists of 34 provinces across Indonesia. We use the human development index, the Indonesia democracy index, and the Gini index provided by the Indonesia Statistics Bureau to measure inequality. We use regional-level bank loan data provided by Bank Indonesia (BI) to measure bank lending. Lastly, we measure government expenditure using regional government expenditure data. This study uses the random effect model to estimate the empirical model. Hausman test is conducted to determine which model is appropriate between the fix and random effect models. These results imply that banking sector development, economic development proxied by government expenditure, and inequality proxied by the human development index and Indonesia democratic index negatively impact the environmental quality. Derived from the findings of the regression test, the overall expenditure at the regional level demonstrates a detrimental effect on environmental health. This is evident in the developmental trajectory of the state government, which has yet to be oriented towards environmental concerns. This is also supported by the results of subsample tests, which show that this linkage significantly affects regions with high inequality.

Keywords: Economic development; income inequality; environmental quality; Banking

1. Introduction

The belief is that economic development involves productive activities, wherein the transformation of inputs or factors of production into products is expected to affect the environment. Numerous investigations suggest that the byproducts arising from an economic entity's operational and consumption aspects are inevitable (Scheel, 2016). The increase in economic growth is linked to production and consumption methods recognized for their detrimental impact on the environment. In the Indonesian setting, characterized by an agrarian economy, the environment is viewed as a comprehensive entity that includes space, objects, forces, conditions, and living organisms. This encompasses humans and animals, along with their behaviors, influencing nature, human existence, and the overall welfare of all living beings. Beyond the internal consequences of growing inequality on social cohesion, questions arise regarding its impact on other pertinent aspects, such as environmental degradation. Environmental crises have become evident, particularly from the 1950s onward; there has

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been a notable and swift increase in environmental pressures (Steffen et al., 2011). Resulting in substantial modifications to natural ecosystems (Duraiappah et al., 2005). And contributing to climate change (Stocker et al., 2013).

In the developmental process of developing countries, there exists a disparity between rapid economic growth and advancements in other sectors, particularly environmental aspects. Nevertheless, the execution of this process in Indonesia has yet to reach its full potential. The inadequacy is evident in the discrepancy between economic indicators and other developmental benchmarks, particularly environmental-related ones (Fauzi and Oxtavianus, 2014). The imbalance between economic progress and environmental considerations in Indonesia becomes apparent when comparing Java to other islands (referred to as non-Javanese islands). The economic, social, and environmental development disparities are predominantly observed in Java, as reflected in the Environmental Quality Index. Several elements can impact the quality of the environment, such as Gross Domestic Product (GDP), energy usage, population expansion, literacy levels, the rate of urbanization, and foreign direct investment (FDI) (Fakher and Abedi, 2017; Fakher, 2019; Hao et al., 2018).

Several researchers have delved into the factors influencing environmental quality, particularly air quality. However, most research has centered on economic and societal factors, such as GDP per capita (or other indicators of economic development), the structure of industries, urbanization, and foreign investments (Hao and Liu, 2016; Fan et al., 2017). Recently, there has been a growing emphasis on examining the impacts of government policies, including fiscal, financial, and monetary measures (Hao et al., 2016; Omri et al., 2015; Zhang et al., 2017). Omri et al. (2015) specifically investigated the environmental consequences of financial development in Middle Eastern and North African (MENA) countries. Recent studies have presented evidence underscoring government expenditure as a pivotal factor influencing environmental quality (Halkos and Paizanos, 2013; López et al., 2011).

As Indonesia operates as a bank-centered country, its banking sector has expanded, witnessing a proliferation of banks increasing loans and advances (Demirguc-Kunt and Levine, 1999). Given the global challenges in ensuring fair energy access and mitigating carbon emissions, examining the interplay between banking sector development, the consumption of renewable energy, and overall energy consumption becomes crucial. The transition from fossil fuel-based energy production to alternative sources necessitates substantial investments in sustainable production and storage. Hence, a robust banking sector can play a pivotal role in promoting renewable energy consumption and reducing CO2 emissions. The banking industry plays a significant role in determining loan providers and investment directions.

2. Literature review

Economic development and environmental quality

The first Environmental Kuznets Curve (EKC) to be introduced was (Grossman and Krueger, 1991; Groosman and Krueger, 1995). This hypothesis explains that the connection between different markers of environmental decline and per capita income is evident. During the initial phases of economic development, there is a rise in emissions contributing to pollution and a decline in the overall quality of the environment. However, after a certain level of per capita income (which varies depending on different indicators), the trend is exactly the opposite; conversely, at elevated income levels, economic advancement results in a heightened enhancement of the environment. Next Kais and Sami (2016); Ameer et al. (2016); Shahbaz et al. (2013); Shahbaz et al. (2014); Ozcan et al. (2020), said many researchers are studying the existence of EKC relationships between GDP per capita and certain pollutants

The correlation extensive discourse in environmental economics literature has thoroughly examined the relationship between economic growth and the deterioration of the environment. For instance, Kais and Sami (2016), observed that a significant increase in economic growth has contributed to pollution in various regions, including Europe, North Asia, the Middle East, North Africa, and sub-Saharan Africa. The environmental degradation in these regions is attributed to insufficient protective measures, underdeveloped industrial sectors, and low environmental awareness. Similar impacts were documented by Ameer et al. (2016) in certain Asian nations, with Shahbaz et al. (2013) observing comparable patterns in South Africa and Shahbaz et al. (2014) in Indonesia. Conversely, Ozcan et al. (2020) argue that economic growth fosters improved environmental performance in OECD countries.

H1: Higher government expenditure tends to worsen environmental quality.

Income inequality and environmental quality

Another broad category in empirical research also investigates the correlation between income inequality and environmental quality by casting doubt on the validity of the EKC theory. Numerous studies that validate the influence of income inequality on environmental quality, utilizing an analysis of the Environmental Kuznets Curve (EKC) concept, include investigations conducted by (Hao et al., 2016; Knight et al., 2017; Zhu et al., 2018; Morse, 2018; Muller et al., 2018; and Grunewald et al., 2017).

In their investigation from 1995 to 2012, Hao et al. (2016) examined the association between the Gini index and CO2 emissions across 23 regions in China. The findings of their study supported the validity of the environmental Kuznets curve (EKC) hypothesis, indicating that a decrease in income distribution led to a rise in CO2 emissions in the region. Kasuga and Takaya (2017). They directed their research toward exploring the connection between income distribution and various pollution indicators in 85 cities in Japan from 1990 to 2012. They underscored that an escalation in the Gini coefficient was associated with increased emissions of SO2, NOx, and air pollution. Additionally, Knight et al. (2017) analyzed the relationship between income inequality and CO2 emissions from 2000 to 2010 in 26 developed countries.

The results suggest that increased income inequality contributes to environmental damage by exacerbating disparities in political and economic influence. In a study conducted from 1994 to 2013, Zhu et al. (2018) examined the impact of urbanization and income distribution on CO2 emissions in BRICS countries. The findings uncovered a significant positive correlation between income inequality and CO2 emissions, especially in nations with moderate to high emission levels. Analyzing the period from 1995 to 2014, Morse (2018) explored the relationship between environmental performance, income, and income inequality. The results illustrated that a rise in income levels and a reduction in income disparity can improve environmental performance. Additionally, Muller et al. (2018) scrutinized the connection between income distribution and environmental pollution in the United States from 2011 to 2014. Their study concluded that incomes adjusted for environmental degradation show greater inequality than market incomes.

Grunewald et al. (2017) examined the connection between the Gini index and per capita CO2 emissions from 1980 to 2008. Their study found an inverse relationship between income inequality and carbon emissions in low- and middle-income countries. Conversely, an inverse relationship was observed for economies classified as upper-middle-income and high-income countries.

H2: Income inequality tends to worsen environmental quality.

Bank lending and environmental quality

Multiple studies investigate the implications of financial market advancements on economic growth and energy consumption. For instance, references Beck et al. (2000); Wachtel (2001); Beck and Levine (2004); Aslan et al. (2014); Petkovski and Kjosevski (2014) explore the outcomes of financial development concerning economic growth rates. These investigations demonstrate that heightened private sector investment and borrowing increase energy consumption, leading to higher CO2 emissions. Hence, various studies indicate a substantial impact of financial sector development on CO2 emissions. Zhang (2011) scrutinized the connection between financial sector development, energy consumption, and carbon emissions, confirming that financial development significantly interacts with CO2 emission levels. Shahbaz et al. (2015) They are established that financial developments in India have repercussions on air quality. Haseeb et al. (2018) They have identified a positive correlation between financial development and CO2 emissions in South Africa, China, India, and Russia from 1995 to 2014, affirming that financial development positively influences carbon emission levels. Employing the ARDL experimental method, Mouris and Samour (2022) assessed the impact of Turkey's financial sector development on energy consumption in the UAE, suggesting that the ascent of Turkey's financial sector is the primary factor contributing to the increase in energy consumption.

Recent empirical investigations examining the connection between financial development and carbon emissions encompass studies such as Ibrahim and Vo (2021) focusing on industrialized country selection, Li and Wei (2021) concentrating on China, Paramati et al. (2021) studying major OECD countries, and Jahanger et al. (2022) considering multiple countries. Employing diverse methodologies and examining various periods, these studies concluded that financial development positively influenced carbon emissions in the analyzed nations. However, the research also indicated that financial

development significantly impacts economic activity, leading to heightened energy consumption and subsequent CO2 emissions. Despite these findings, limited exploration is specifically dedicated to investigating the relationship between carbon emissions and banking sector development as a variable. Notably, in this context, Samour et al. (2019) uncovered that the increased lending by banks to the private sector has a noteworthy impact on CO2 emissions. Additionally, Obiora et al. (2020) demonstrated a positive association between national loans to the private sector and CO2 emissions.
H3: Bank lending tends to worsen environmental quality.

3. Method

Empirical strategy

The analytical framework employed in this study utilizes a panel data regression model, seeking optimal estimation results through an augmentation in the number of observations and degrees of freedom. The study analysis integrates three methods: general effects model, fixed effects model (FEM), and random effects model (REM). These methods are used to evaluate the consistency of the relationship between each independent variable and the dependent variable.

$$IKLH = GEx + LLending + LGDP + HDI + IDI + GI \ldots (1)$$

This study uses the random Effect model in estimating the empirical model to determine the suitability of either the fixed effect or random effect model; a Hausman test was conducted. The outcome of the Hausman test indicates that the random effect model is more fitting for the analysis. We also analyze this empirical model using separate samples between the Java and non-Java regions.

Data and sample

Our research explores how government expenditure, inequality, and bank lending could impact environmental quality. We use annual regional-level data from 2012 to 2021 gathered from the Indonesia Statistics Bureau (*Badan Pusat Statistik-BPS*), Bank Indonesia, and the environment reports of Indonesia provided by the Ministry of Environment and Forestry. Our final sample consists of 34 provinces across Indonesia.

We consider several proxies to gauge economic development, inequality, and bank lending's effect on environmental quality. We measure environmental quality using the Environmental Quality Index provided by the Ministry of Environment and Forestry. We use the human development index, the Indonesia democracy index, and the Gini index provided by the Indonesia Statistics Bureau to measure inequality. We use regional-level bank loan data provided by Bank Indonesia to measure bank lending. Lastly, we measure government expenditure using regional government expenditure data.

4. Results and discussion

Descriptive statistics of variables and correlation matrix

Table 1. presents the descriptive statistics for all samples, and Table 2. reports descriptive statistics for Java and non-Java samples. The average environmental quality index is 59.97, while the average human development index, Indonesia democratic index, and Gini index are 69.37, 72.07, and 0.36, respectively. The log of government expenditure average is 15.58, and the average log of regional GDP is 10.40. Lastly, the average log of regional-level bank loans is 12.28.

In addition, variable statistics are also available for Java and non-Java samples Table 2. On average, the human development index, Indonesian democracy index, gini index, government expenditure log, regional GDP log, and non-Java sample regional bank loan log were lower than the Java sample. In addition, the average environmental quality of non-Java samples is higher than that of Javanese samples.

Table 3. shows the variable correlation matrix. The environmental quality index negatively correlates with government spending logs, regional GDP logs, regional-level bank loan logs, human development index, and Indonesia's democracy index. In addition, this variable is also positively correlated with the gini index.

Table 1. Statistic descriptive – total sample

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max
IKLH	Environmental Quality Index	340	59.97	23.04	0.00	91.50
GEx	Log of Government Expenditure	330	15.58	0.88	13.79	18.25
LLending	Log of regional-level bank Loan	264	10.57	1.30	8.08	14.29
LGDP	Log of regional GDP	339	10.40	0.56	9.21	12.07
HDI	Human Development Index	339	69.37	4.31	55.55	81.11
IDI	Indonesian Democracy Index	337	72.07	6.85	52.61	89.21
GI	Gini Ratio Index	337	0.36	0.04	0.25	0.46

Table 2. Statistic descriptive – Java and non-Java

	Java					Non-Java				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std.Dev.	Min	Max
IKLH	60	48.21	18.13	0.00	68.27	280	62.49	23.23	0.00	91.50
GEx	60	16.75	0.90	14.72	18.25	270	15.32	0.63	13.79	16.74
LLending	48	12.28	1.23	9.83	14.29	216	10.19	0.96	8.08	13.40
LGDP	60	10.54	0.65	9.91	12.07	279	10.37	0.54	9.21	11.81
HDI	60	73.18	4.44	66.74	81.11	279	68.55	3.82	55.55	76.88
IDI	60	74.28	7.65	54.99	89.21	277	71.60	6.59	52.61	83.94
GI	60	0.40	0.03	0.36	0.45	277	0.35	0.04	0.25	0.46

Table 3. Correlation matrix

	IKLH	GEx	LLending	LGDP	HDI	IDI	GI
IKLH	1						
GEx	-0.2522	1					
LLending	-0.3046	0.8658	1				
LGDP	-0.1125	0.4816	0.4413	1			
HDI	-0.3089	0.4302	0.5263	0.5167	1		
IDI	-0.2785	0.2453	0.2652	0.2395	0.5845	1	
GI	0.0606	0.1368	0.0942	0.0637	-0.0442	-0.0417	1

Empirical results

In this segment, we examine the influence of economic development, inequality, and advancements in the banking sector on environmental quality in Indonesia through a panel regression model. The baseline regression results are presented in Table 4. Our dependent variable is the environmental quality index. The independent variables are government expenditure, regional GDP, regional level bank loan, human development index, Indonesia's democracy index, and Gini index show the impact on our dependent variables.

In Table 4., column (1) presents the estimation results using the ordinary least squares model, while column (2) displays the outcomes from the random effect model. According to the findings in Table 4., government expenditure exhibits a substantial negative influence on the environmental quality index. Similarly, the coefficients for regional-level bank loans, the human development index, and Indonesia's democratic index are negative and statistically significant. These outcomes suggest that the development of the banking sector, economic progress represented by government expenditure, and inequality proxied by the human development index and Indonesia democratic index collectively negatively impact environmental quality. Lastly, the results are consistent between OLS and REM models.

Table 4. Baseline regression results

Variable	(OLS) IKLH	(REM) IKLH
GEx	**-4.279****	**-4.279*****
	(-2.11)	**(-2.79)**
LLending	-0.780	**-0.780***
	(-1.21)	**(-1.80)**
LGDP	**5.147***	**5.147***
	(1.72)	**(1.93)**
HDI	**-1.040*****	**-1.040*****
	(-2.75)	**(-4.64)**
IDI	**-0.470*****	**-0.470*****
	(-2.78)	**(-2.62)**
GI	33.996	**33.996***
	(1.03)	**(1.69)**
_cons	**173.705*****	**173.705*****
	(5.98)	**(7.15)**
Nbr. of obs.	297	297
R-Squared	0.162	
r2_a	0.145	

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5. Sub-sample Test

Variable	(High Inequality) IKLH	(Low Inequality) IKLH	(High GDP) IKLH	(Low GDP) IKLH
GEx	**-7.285*****	0.903	-3.118	-3.901
	(-3.07)	(0.25)	(-1.04)	(-1.49)
LLending	-0.168	-1.157	**-1.928***	-0.476
	(-0.21)	(-1.23)	**(-1.66)**	(-0.64)
LGDP	**7.563****	5.548		
	(2.21)	(0.84)		
HDI	**-1.080****	-1.558	0.207	**-1.068****
	(-2.45)	(-1.31)	(0.32)	**(-2.03)**
IDI	**-0.402***	**-0.540****	**-1.303*****	-0.208
	(-1.80)	**(-2.12)**	**(-3.27)**	(-1.14)
GI			64.941	25.294
			(1.10)	(0.51)
_cons	**199.182*****	**147.157*****	**184.188*****	**203.431*****
	(6.34)	**(3.17)**	**(3.89)**	**(4.92)**
Nbr. of obs.	146	151	139	158
R-Squared	0.281	0.073	0.184	0.136
r2_a	0.255	0.041	0.153	0.108

t statistics in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

Our results align with the outcomes of studies conducted by Hossain and Chen (2021); Maji (2019); and Van Tran et al. (2019), all demonstrating a negative correlation between the human

development index and carbon dioxide emissions. However, our findings deviate from the research conducted by Azam et al. (2015), which observed a significant and positive connection between human development indices and environmental quality in Thailand, Indonesia, and Malaysia. Adekoya et al. (2021) also found a positive response from the human development index to carbon dioxide emissions in countries such as Mena and South America.

Furthermore, our findings are consistent with the studies conducted by You (2011), and Rachdi and Saidi (2015), validating that democracy hurts economic growth. On the other hand, our findings are not in line with the research of Torras and Boyce (1998), who found evidence of positive impacts on environmental quality when they estimated the Environmental Kuznets Curve (EKC).

Table 5. shows the estimated results with dependent variables divided into high and low inequality and high and low GDP. In Table 5., government expenditure shows a significant negative influence on the environmental quality index in the high inequality sample. In addition, GDP shows a significant positive influence on the environmental quality index. Moreover, the human development index significantly negatively influences the environmental quality index. Lastly, Indonesia's democracy index negatively correlates with the environmental quality index. Meanwhile, in the low inequality sample, the determinant of the environmental quality index is only the Indonesia democracy index, which shows a negative significance coefficient.

In addition, this study also divides the sample into high and low GDP samples. In the high GDP sample, bank loans and the Indonesia democracy index show a negative significant relationship with the environmental quality index. Meanwhile, in low GDP sample, the human development index shows a negative significance relationship with the environmental quality index.

Table 6. Sub-sample Test

	(Java) IKLH	*(Non-Java)* IKLH
GEx	-3.119	-1.585
	(-0.63)	(-0.52)
LLending	0.656	**-1.302***
	(0.69)	**(-1.69)**
LGDP	-2.739	3.332
	(-0.35)	(0.87)
HDI	0.687	-0.640
	(0.59)	(-1.31)
IDI	-0.906	**-0.501*****
	(-1.55)	**(-2.73)**
GI	-115.263	**74.502***
	(-0.99)	**(1.88)**
_cons	**182.119****	**117.424****
	(2.38)	**(2.48)**
Nbr. of obs.	54	243
R-Squared	0.173	0.114
r2_a	0.067	0.092

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6. shows the estimation results divided by Java and non-Java regions. In the non-Java region, our result finds that bank loans are associated negatively with the environmental quality index. Moreover, Indonesia's democracy index significantly negatively influences the environmental quality index. In Addition, the gini index shows a positive relationship with the environmental quality index.

Discussion

Based on the regression test results, total regional spending negatively affects environmental health. This reflects the provincial government's development direction, which has not been oriented towards environmental issues. This is reinforced by the results of sub-sample testing, which proves that this relationship is significantly impactful in areas with high inequality. Ravallion et al. (2000); Heerink et al. (2001); Eni et al. (2012); Qu and Zhang (2011); Guo (2014); and Hübler (2017) Demonstrate that a negative association exists between inequality and environmental health. This suggests a trade-off scenario where fostering equality is linked to enhancing environmental quality. Another study that is not in line with the findings made by Boyce (1994) says that inequality positively impacts environmental health.

As a rapidly developing country, catching up and inequality are challenges for local governments. In areas with small inequality, local governments have been able to start tackling environmental impacts, considering that the general welfare of the community is relatively evenly distributed. In areas with high inequality, the government's development orientation focuses not on environmental issues but on poverty alleviation. This is in line with previous research findings, which also indicate that high disparities in economic growth among regions are often observed in areas categorized as both advanced but pressured regions and underdeveloped regions facing socio-economic issues such as poverty, unemployment, and job opportunities Hermayeni et al. (2015), mahardiki and Santoso, (2013), Umiyati, (2013).

Bank loans do not show a significant impact on environmental health. Previous research stated that there was no direct impact between banks and the wheels of the national economy. Although banks are a crucial sector for a country, they are passive parties in the demand-supply system. Similarly, banks have the potential to enhance their reputation and image, expanding their market share and profitability through their engagement in lending to socially and environmentally responsible companies (Vaughan, 1994). Loans provided by banks to industry can only necessarily be justified by the impact of worsening environmental health, with further reviewing the purpose and designation of the debt supplied by banks. This aligns with research that states that banks contribute to environmental conservation by extending financial support to environmentally responsible businesses (Thompson, 1998).

5. Conclusion

In this study, we used annual regional data from 2012 to 2021 from various sources, including the Indonesian Bureau of Statistics, Bank Indonesia, and environmental reports provided by the Ministry of Environment and Forestry in Indonesia. This study focuses on a sample of 34 provinces spread throughout Indonesia. Indicators used to evaluate the impact of economic development, income inequality, and bank lending on environmental quality include the Environmental Quality Index, Human Development Index, Indonesian Democracy Index, Gini Index, local banking loan data, and local government spending data.

Economic growth and environmental conditions are related, where increased economic activity often contributes to environmental degradation. This phenomenon is manifested in Indonesia, a country with significant economic growth but unbalanced development in various regions, including the environment. Environmental quality variables encompass GDP, energy consumption, population growth, literacy, urbanization, and foreign direct investment. The connection between economic growth and environmental conditions has been a subject of comprehensive investigation, primarily emphasizing economic and social dimensions. Nonetheless, this study uniquely examines the influence of government policies, encompassing fiscal, tax, and monetary policies. In the Indonesian context, the expansion of the banking sector holds the potential to promote the adoption of renewable energy sources and mitigate CO2 emissions.

Income inequality also impacts environmental quality, with most studies suggesting that higher income inequality can result in environmental degradation. This phenomenon is caused by inequalities in political and economic power, which can result in inadequate protection policies and low environmental awareness. Despite the limitations of research on the correlation between CO2 emissions and banking sector development, some studies note that increased bank credit to the private sector and domestic lending to the private sector significantly impact CO2 emissions.

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