THE INFLUENCE OF FINANCIAL DEVELOPMENT ON EMISSIONS IN INDONESIA WITH ECONOMIC GROWTH AS A MODERATING VARIABLE

Muhammad Risal Tawil[1], Emi Yulia Siska[2], Muhammad Lucky[3], Subur Harahap[4], Melinda[5]
Politeknik Baubau, Indonesia[1] Universitas Islam Negeri Raden Fatah Palembang, Indonesia[2]
UIN Sunan Kalijaga Yogyakarta, Indonesia[3] Institut Bisnis Nusantara, Indonesia[4]
Universitas Bung Karno, Indonesia[5]
Corresponding Author: risaltawil@gmail.com

Abstract

This research aims to examine the influence of financial development on emissions in Indonesia in 2015-2023 by adding economic growth as a moderating variable. The data is panel data, which was tested with the help of SmartPLS software. The research results show that financial development has a significant and positive effect on emissions. Economic growth is able to moderate the relationship between economic growth and emissions disclosure. It is hoped that this research will become a basis for consideration for investors in making investment decisions, especially in companies.

Keywords*: Economic Growth, Emissions, Financial Development.*

1. INTRODUCTION

Climate change is a problem that threatens the future of the world, so society must anticipate it. The issue that is of public concern is carbon emissions originating from global industry, where emissions result from industrial sector activities such as the energy, raw materials and utilities sectors (Luo et al., 2013). Therefore, it is necessary to disclose the carbon emissions of companies in the industrial sector. The compilation of information on the amount of carbon emissions and a company's financial relationship to climate change is known as carbon emissions disclosure (Najah, 2012).

According to (Andrian & Kevin, 2021)Indonesia, it produces around 15-20 million tons of carbon emissions per day. This makes Indonesia ranked 6th in the country producing the largest carbon emissions (Larasati et al., 2020). If an increase in carbon emissions occurs in the long term, companies around the world will experience a decline in profitability, investment and productivity (Rezai et al., 2018). Reducing carbon emissions has become a focus of researchers and policymakers due to international environmental protection requirements, which have the potential to hinder economic development (Zafar et al., 2019).

In an effort to achieve rapid economic growth, many countries often use large amounts of conventional fossil fuel energy sources, leading to increased carbon dioxide emissions (Jahangir Alam et al., 2012). Due to deteriorating ecosystems and increasing awareness to improve and protect environmental quality, many researchers have focused on the determinants of environmental degradation. One factor that is still being debated is financial development due to mixed results.

Financial development refers to the choices a country makes to stimulate activities, including stock markets, banking, and foreign and domestic investment. While a developed financial system can make it easier to access capital to improve living standards and increase economic development, it also leads to higher energy consumption and greenhouse gas

emissions (Saud et al., 2020). Thus, the provision of financial resources may increase economic growth but have an adverse impact on environmental quality (Saud et al., 2018).

The Indonesian government has committed to efforts to reduce greenhouse gas emissions. In 2016, the Indonesian government ratified the Paris Agreement at the United Nation Framework Convention on Climate Change (UNFCCC) through Law Number 16 of 2016 (KLHK, 2018). The government targets that by 2030 GHG emissions will fall by 29 percent with its own efforts and reach 41 percent with international assistance. Previously, the government issued Presidential Regulation Number 61 of 2011 concerning the National Action Plan for Reducing Greenhouse Gas Emissions (RAN-GRK) which covers the fields of agriculture, forestry and peatlands, energy and transportation, industry, waste management, and other supporting activities.

Pollution due to carbon emissions motivates companies to disclose carbon emissions as a form of environmental responsibility. However, disclosure of carbon emissions for companies in Indonesia is still voluntary (Hardiyansah & Agustini, 2021). Disclosure of carbon emissions is a form of accountability for company activities towards climate change. This research focuses on financial development as one of the factors that is thought to influence the amount of CO2 emissions in a country. The urgency of conducting this research is because there are not many studies that analyze the influence of financial development on environmental damage in Indonesia. Therefore, the research intends to test the influence of financial development on emissions which is moderated by economic growth.

2. LITERATURE REVIEW

Financial Development

Increasing a country's financial development can be a starting point for a country to pay more attention to its environmental conditions. (Zaidi et al., 2019); (Shahbaz et al., 2013)shows that financial development and trade openness can reduce CO2 emissions. The existence of financial developments will encourage companies to increase their knowledge of companies that are more environmentally friendly so that the production process does not damage the environment (A. Q. Khan et al., 2018).

More specifically, (Bui, 2020)it explains two pathways of financial development in exacerbating environmental degradation. The first is through income inequality. Every country hopes that the inequality figure will have a low value so that in the producing environment, both large and small companies can access financial resources easily. When companies can access sources of funds easily, it will return to the initial argument, namely that the greater the production, the greater the possibility of environmental damage.

Second, through increasing demand for energy consumption. When financial development in a country increases, it will influence consumers to buy goods such as cars, houses and other household equipment that require more energy. This will increase energy consumption and worsen environmental conditions,

Lastly is the economic growth path, this path is the most common because it is stated in the EKC (Environmental Kuznet Curve) where economic growth causes environmental damage in the initial phase and then the second phase enters the industrial economic stage. In the final stage or third phase is the post-industrial economic phase which pays more attention to environmental damage so that the curve decreases and environmental degradation can be reduced as economic capacity increases (Vo et al., 2021).

Some research (Zaidi et al., 2019); (Shahbaz et al., 2013); (Bui, 2020)shows that financial development and trade openness can reduce CO2 emissions.

H1: Suspected financial development positive and significant effect on emissions

Economic Growth

Economic government is an indicator in the development process of a country or to see how successful a country is in the economic sector. Economic growth looks at how economic activity influences the increase in income of people in a country in a certain period. In addition, economic growth also illustrates how an economy with large amounts of goods and services can better meet the demands of households, companies and governments (Indraswari, 2016).

Indonesia's economic growth is determined by a long-term increase in energy consumption which has implications for the need to use energy efficiently. High energy use by economic actors in developed and developing countries has a positive effect on economic growth and CO2 emissions (Muhammad, 2019). Economic growth is closely related to the exploitation of natural resources and the environment. The economy will also have an impact on the production of waste on the environment. Until now, the driving component of Indonesia's economic growth has been supported by the use of energy that is not yet environmentally friendly.

Several studies (Tong et al., 2020)have found that the cause of high CO2 emissions per capita is energy consumption per capita which continues to increase, which also has an impact on the problem of global warming in the E7 countries (China, India, Indonesia, Brazil, Russia, Mexico and Turkey). Recent research also explains that there is a relationship between air pollution as measured using carbon emission indicators and per capita income (Awan & Azam 2022).

H2: It is suspected that economic growth can moderate financial developments on emissions.

Emission

Carbon dioxide (CO2) emissions are a type of greenhouse gas emission which is the main factor in the emergence of the global warming phenomenon. The production of carbon dioxide (CO2) gas emissions is closely related to human activities (anthropogenic activities). Carbon dioxide emissions resulting from energy use are caused by the world's dependence on fossil energy sources, which is around two-thirds of total energy use (Luukkanen & Kaivo-oja, 2002). High energy consumption in Indonesia can cause negative impacts on the environment. Shifts in economic structure affect pollution intensity. When consuming, people use a lot of natural resources and dirty technology, causing environmental damage without any countermeasures. The Kuznets curve also shows that when people's income begins to rise, environmental quality will become better and the marginal utility of consumption will decrease.

This suggests that society is starting to appreciate greater environmental quality. From the Kuznets curve it can be seen that as people's income increases, which means economic growth, it will initially cause pollution. However, in the end it will improve the quality of the environment again because over time people tend to reduce economic activities that cause externalities, and with increasing income people will tend to increase their concern for the environment through the use of environmentally friendly technology. According to Mark (2006) in Umniati (2015) CO2 emissions have an economic impact, namely CO2 emissions change income and reduce the price value of production results due to climate change, and CO2 emissions result in additional costs for reducing emissions.

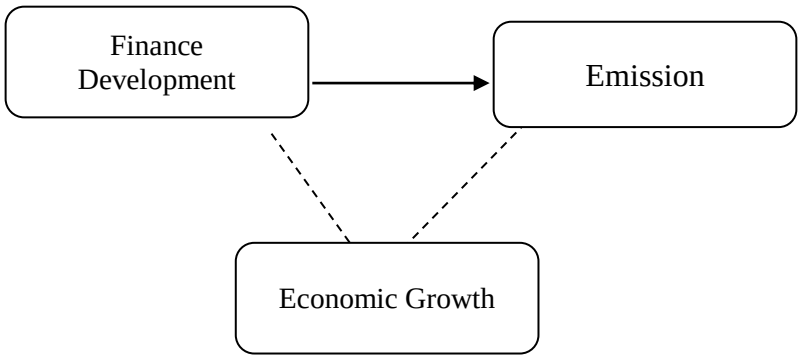

Figure 1 Conceptual Framework

3. RESEARCH METHODS

This research will analyze the causal relationship between financial development, economic growth and carbon dioxide emissions. The data used as variables in this research are primary energy consumption data, gross domestic product (GDP) data at constant prices, and carbon dioxide emissions data. The data used is time series data from 2015 to 2023, case studies in Indonesia. The collected data was analyzed using Structural Equational Modeling (SEM) with the help of SmartPLS software.

4. RESULTS

Model measurement (Outer Model)

a. *Convergent Validity* Test

This test aims to provide an explanation of the extent to which measurement indicators are positively correlated with alternative construct measurements. An indicator is said to have a good valid value if the factor loading value is > 0.70 and the average factor inflation variance (AVE) value must be greater than 0.5 (Ghozali, 2021). Test results:

Table 1. Validity convergent

Variable	Loading Factor
Financial Development	0.890
Emissions	0.729
Economic Growth	0.780

Based on table 1 above, it can be seen that all Questionnaire items in this study had a *loading factor value* > 0.70. So it can be concluded that the questionnaire items in this study have met the requirements of the *convergent validity test* .

b. Validity Discriminant

Test This evaluate is indicators something variable valid or No. Assumption Which underlying discriminant validity Which Good is square mark root AVE variable more big compared to correlation between other constructs. By Because That, variable the considered fulfil criteria the. According to Ghozali & Latan in (Rahmad Solling, 2019) testing Discriminant Validity by looking at the cross loading value must be more than 0.7.

Table 2 . Validity discriminant

Variable	**GHC (X1)**	**EP (Y)**	**GS (Z)**
Financial Development	**0.9 75**		
Emissions	0.721	**1,000**	
Economic Growth	0.734	0.28 7	**1,000**

Based on Table 2 . It is known that the cross loading value of items from each indicator on the measured variable because it is concerned is greater than measuring other variables. All values are > 0.5, so it can be concluded that the results of this research instrument meet discriminant validity.

c. **Average Variance Extracted (AVE)**

Objective from testing This is For evaluate is variables Which there is in modeling have consistency in measure What Which want to be measured or have reliability Which can accepted. Results the explained in the table following.

Table 3. Average Variance Extracted (AVE)

Variable	***Average Variance Extracted* (AVE)**
Financial Development	0.767
Emissions	0.758
Economic Growth	0.891

Based on Table 3 , the results show that the validity test of the AVE value of all variables, namely consisting of 3 variables, shows an AVE value > 0.50. This meets the minimum AVE value determined, namely 0.50, and the root value for each construct is greater than the correlation value so that the constructs in this research model can still be said to have good discriminant validity values.

d. Reliability Test (***Composite Reliability)***

Table 4
Composite Reliability* and *Cronbach Alpha

Variable	***Cronbach's Alpha* value**	**Mark *Composite Reliability***
Financial Development	0.867	0.980
Emissions	1,000	1,000
Economic Growth	0.842	0.878

Based on Table 4, it shows that the results of the output composite reliability and Cronbach's alpha for all constructs are > 0.7. which shows that each construct or variable has good reliability. So it can be concluded that the construct values in the research are reliable.

Structural Model Analysis (Inner Model)

R-Square

The R-Square value is used to explain how much endogenous variable data can be explained by exogenous variable data. R-Square is a number that ranges from 0 to 1, with the condition that the closer it is to one, the better. Ghozali's (2021) view explains that the r-square value is 0.75 (strong), 0.50 (medium), and 0.25 (weak).

Table 5. R- Square

Variable	*R-Square Value*
Financial Development	**0.532**
Emissions	**0.624**

Table 5, the R-square value for Financial Development is 0.532. This value indicates that the model in this research is in the medium category . Meanwhile, Emissions shows an r-square value of 0.624 , this value shows that the resulting influence is in the medium category.

Testing Hypothesis

Path Analysis

According to Ghozali & Latan in (Rahmad Solling, 2019) the significance value can be used (two-tiled) t-statistic (>1.96), path coefficient results (>0.1) and p-value (0.05).

Table 6.
Path Coefficient Results

	Variable	Path coefficient	**Q Statistics (O/STDEV)**	**P value**
Influence	Financial Development →Emissions	0.157	3,450	**0,000**
	Financial Development →Emissions →Economic Growth	0.199	2,795	**0.003**

Based on table 6 above, it can be concluded as follows:

Financial development on emissions has a p-value ≤ 0.05 and the result is 0.000 ≤ 0.05. Based on this explanation, it can be concluded that Hypothesis 1 is Green Human Capital has a positive and significant effect on Employee Performance and is **accepted .**

Financial Development on Emissions is moderated by economic growth having a p-value ≤ 0.05 and the result is 0.003 > 0.05. Based on this explanation, it can be concluded that Hypothesis 2 is Financial Development The effect on emissions is moderated by economic growth and **is accepted .**

5. DISCUSSION

Influence of Financial Development Against Emissions

As the level of environmental emissions increases, a country's economic growth will also increase. This indicates that environmental emissions have a positive relationship with economic growth (Boopen, S, and Vinesg, s. 2011). This shows that increased financial development has strengthened the positive impact of energy consumption on high emissions.

According to (Bui, 2020)financial development, one way of worsening environmental degradation is through income inequality. Every country hopes that the inequality figure will have a low value so that in the producing environment, both large and small companies can access financial resources easily. When companies can access funding sources easily, production will be greater and the possibility of environmental damage will be greater.

Good financial development can encourage companies to increase their knowledge about environmentally friendly companies so as to make production processes more environmentally friendly. Through the implementation of good and organized financial policies, the government can provide encouragement to companies to help improve environmental quality and control emissions. The financial sector plays a role in environmental performance as well as validating the financial sector's contribution to increasing carbon dioxide emissions. Thus, financial sector integration can be a direction in encouraging low-carbon development.Some research (Lu, 2018);(Zhang & Zhou, 2016) shows positive results.

The Influence of Financial Development on Emissions is Moderated by Economic Growth

Financial development has a negative moderating effect on the effect of economic growth on emissions. This indicates that an increase in financial development weakens the positive impact of economic growth on emissions production so that it becomes more environmentally friendly. The positive relationship between economic growth and CO2 emissions only occurs in developing countries due to less efficient energy use (Chen et al., 2016); (Wang et al., 2016). The relationship between economic growth and CO2 emissions can be resolved by implementing renewable energy resources and ensuring adequate energy supply in the economy gradually (Mirza & Kanwal, 2017); (M. K. Khan et al., 2020); (Radmehr et al., 2021).

The findings in the research conducted are also in line with (Chen et al., 2016); (Wang et al., 2016) who explain that the positive relationship between per capita economic growth and CO2 emissions only occurs in developing countries. Until now, Indonesia is still classified as a developing country due to its low mastery of technology, especially environmentally friendly technology. It is necessary to understand and master environmentally friendly technology to reduce the rate of increase in CO2 emissions per capita without having to reduce the rate of economic growth per capita. This opinion is also supported by (Muhammad, 2019); (Tong et al., 2020) who suggest that countries in the world adopt environmentally friendly technology through appropriate environmental economic policies.

6. CONCLUSION

This study develops financial development by including monetary policy in influencing carbon dioxide emissions in Indonesia. Based on the results of data analysis, it can be concluded that financial development has a positive effect on carbon dioxide emissions in Indonesia. However, economic growth is unable to moderate the influence of financial developments on carbon dioxide emissions. The results of this research reveal that financial development has an important role in controlling environmental damage. Good financial

development can encourage companies to increase their knowledge about environmentally friendly companies so as to make production processes more environmentally friendly.

REFERENCE

Andrian, T., & Kevin. (2021). Determinant Factors of Carbon Emission Disclosure in Indonesia. *Journal of Southwest Jiaotong University*, *56*(1). https://doi.org/10.35741/issn.0258-2724.56.1.32

Awan, A. M., & Azam, M. (2022). Evaluating the impact of GDP per capita on environmental degradation for G-20 economies: Does N-shaped environmental Kuznets curve exist? *Environment, Development and Sustainability*, *24*(9), 11103–11126. https://doi.org/10.1007/s10668-021-01899-8

Bui. (2020). Transmission Channels Between Financial Development and CO2 Emissions: A Global Perspective. *Heliyon* , *6*(11).

Chen, P. Y., Chen, S. T., Hsu, C. S., & Chen, C. C. (2016). Modeling the global relationships among economic growth, energy consumption and CO2 emissions. In *Renewable and Sustainable Energy Reviews* (Vol. 65). https://doi.org/10.1016/j.rser.2016.06.074

Indraswari, D. M. (2016). Analisis Hubungan Kausalitas Pertumbuhan Ekonomi, Konsumsi Energi dan Emisi CO2 serta Peramalan Permintaan Energi di Indonesia. *Skripsi, Universitas Diponegoro*.

Jahangir Alam, M., Ara Begum, I., Buysse, J., & Van Huylenbroeck, G. (2012). Energy consumption, carbon emissions and economic growth nexus in Bangladesh: Cointegration and dynamic causality analysis. *Energy Policy*, *45*, 217–225. https://doi.org/10.1016/j.enpol.2012.02.022

Khan, A. Q., Saleem, N., & Fatima, S. T. (2018). Financial development, income inequality, and CO2 emissions in Asian countries using STIRPAT model. *Environmental Science and Pollution Research*, *25*(7), 6308–6319. https://doi.org/10.1007/s11356-017-0719-2

Khan, M. K., Khan, M. I., & Rehan, M. (2020). The relationship between energy consumption, economic growth and carbon dioxide emissions in Pakistan. *Financial Innovation*, *6*(1). https://doi.org/10.1186/s40854-019-0162-0

Larasati, R., Cores Seralurin, Y., Van, P., & Sesa, S. (2020). The International Journal of Social Sciences World Effect of Profitability on Carbon Emission Disclosure. *The International Journal of Social Sciences World (TIJOSSW)*, *2*(2). https://doi.org/10.5281/zenodo.4248320

Lu, W. C. (2018). The impacts of information and communication technology, energy consumption, financial development, and economic growth on carbon dioxide emissions

in 12 Asian countries. *Mitigation and Adaptation Strategies for Global Change*, *23*(8), 1351–1365. https://doi.org/10.1007/s11027-018-9787-y

Luo, le, Tang, Q., & Lan, Y. C. (2013). Comparison of propensity for carbon disclosure between developing and developed countries: A resource constraint perspective. *Accounting Research Journal*, *26*(1), 6–34. https://doi.org/10.1108/ARJ-04-2012-0024

Luukkanen, J., & Kaivo-oja, J. (2002). ASEAN tigers and sustainability of energy use - Decomposition analysis of energy and CO2 efficiency dynamics. *Energy Policy*, *30*(4). https://doi.org/10.1016/S0301-4215(01)00091-X

Mirza, F. M., & Kanwal, A. (2017). Energy consumption, carbon emissions and economic growth in Pakistan: Dynamic causality analysis. In *Renewable and Sustainable Energy Reviews* (Vol. 72). https://doi.org/10.1016/j.rser.2016.10.081

Muhammad, B. (2019). Energy consumption, CO2 emissions and economic growth in developed, emerging and Middle East and North Africa countries. In *Energy* (Vol. 179, pp. 232–245). Elsevier Ltd. https://doi.org/10.1016/j.energy.2019.03.126

Najah, M. M. S. (2012). Carbon Risk Management, Carbon Disclosure and Stock Market Effects: An International Perspective. *Thesis*.

Radmehr, R., Henneberry, S. R., & Shayanmehr, S. (2021). Renewable Energy Consumption, CO2 Emissions, and Economic Growth Nexus: A Simultaneity Spatial Modeling Analysis of EU Countries. *Structural Change and Economic Dynamics*, *57*. https://doi.org/10.1016/j.strueco.2021.01.006

Saud, S., Chen, S., Haseeb, A., & Sumayya. (2020). The role of financial development and globalization in the environment: Accounting ecological footprint indicators for selected one-belt-one-road initiative countries. *Journal of Cleaner Production*, *250*. https://doi.org/10.1016/j.jclepro.2019.119518

Saud, S., Danish, & Chen, S. (2018). An empirical analysis of financial development and energy demand: establishing the role of globalization. *Environmental Science and Pollution Research*, *25*(24), 24326–24337. https://doi.org/10.1007/s11356-018-2488-y

Shahbaz, M., Hye, Q. M. A., Tiwari, A. K., & Leitão, N. C. (2013). Economic growth, energy consumption, financial development, international trade and CO2 emissions in Indonesia. In *Renewable and Sustainable Energy Reviews* (Vol. 25, pp. 109–121). https://doi.org/10.1016/j.rser.2013.04.009

Tong, T., Ortiz, J., Xu, C., & Li, F. (2020). Economic growth, energy consumption, and carbon dioxide emissions in the E7 countries: A bootstrap ARDL bound test. *Energy, Sustainability and Society*, *10*(1). https://doi.org/10.1186/s13705-020-00253-6

Vo, D. H., Nguyen, N. T., Vo, A. T., Ho, C. M., & Nguyen, T. C. (2021). Does the Kuznets curve apply for financial development and environmental degradation in the Asia-Pacific region? *Heliyon*, *7*(4). https://doi.org/10.1016/j.heliyon.2021.e06708

Wang, S., Li, Q., Fang, C., & Zhou, C. (2016). The relationship between economic growth, energy consumption, and CO2 emissions: Empirical evidence from China. *Science of the Total Environment*, *542*. https://doi.org/10.1016/j.scitotenv.2015.10.027

Zafar, M. W., Zaidi, S. A. H., Sinha, A., Gedikli, A., & Hou, F. (2019). The role of stock market and banking sector development, and renewable energy consumption in carbon emissions: Insights from G-7 and N-11 countries. *Resources Policy*, *62*, 427–436. https://doi.org/10.1016/j.resourpol.2019.05.003

Zaidi, S. A. H., Zafar, M. W., Shahbaz, M., & Hou, F. (2019). Dynamic linkages between globalization, financial development and carbon emissions: Evidence from Asia Pacific Economic Cooperation countries. *Journal of Cleaner Production*, *228*, 533–543. https://doi.org/10.1016/j.jclepro.2019.04.210

Zhang, C., & Zhou, X. (2016). Does foreign direct investment lead to lower CO2 emissions? Evidence from a regional analysis in China. In *Renewable and Sustainable Energy Reviews* (Vol. 58). https://doi.org/10.1016/j.rser.2015.12.226