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**Article**

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# FDI, Income, and Environmental Pollution in Indonesia

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**ABSTRACT**

The research aimed to evaluate the association of disposable income and environmental pollution on the investments measured using Foreign Direct Investment (FDI). The research was specific to the Indonesian economy. The research was secondary quantitative and the data was accumulated from World Bank. The time frame considered for this study ranged from 1960 to 2018. For statistical analysis, descriptive statistics, stationarity testing, ARDL assessment and Granger Causality have been used. The results unveiled that both disposable income and environmental pollution are found to have significant effect on the FDI of Indonesia. Therefore, both the proposed hypotheses have been accepted. The research is limited to Indonesia and no other country has been evaluated. Therefore, in future more countries can be considered for comparative analysis. In furtherance, more factors can be considered in future that affect Indonesian FDI.

**Keywords:** Disposable Income, Environmental Pollution, FDI, Indonesia
**JEL Classifications:** D00, Q50, E221

## 1. INTRODUCTION

Amongst countries in the developing world, Indonesia is one of the countries in ASEAN-5 nations having a significant share of FDI inflows over the past few years. According to the study conducted by Sapkota and Bastola (2017) the increasing development within these countries specifically in Indonesia, there has been a drastic impact of Foreign Direct Investment (FDI) inflows on the physical environment of the countries. FDI inflows have been observed to be highly essential and influential for the development of a nation specifically of those countries having lack of advancement within their local technologies and effectiveness in the regulatory capabilities. However, at the same time, it has been postulated by the FDI critics that the neo-liberal FDI have difference within the environmental regulations in terms of its influence through industry level location decisions increasing pollution within the environment (Baek, 2016). It has been found in the study conducted by Doytch and Uctum (2016) that FDI could lead towards various issues with respect to the environment and also with respect to the income level of people living in that region.

This issue has been paid more attention at both micro and macro levels. From the macro perspective, there have been some concerns with regards to the governmental policies and the international community (Gultom et al., 2020). However, from the micro level perspective, the tactics of organisations towards attracting FDIs regardless of the environmental costs in terms of its damage has been taken into consideration (Moosa and Moosa, 2019). Based on the study conducted by Abdouli and Hammami (2017) increase in FDI inflows leads towards the environmental degradation in terms of increasing pollution through these business operations. Moreover, it has also been observed that the degradation of the physical environment rises through the increase in per capita income level and decreases when the per capita income is relatively higher. It shows a significant relationship between the rise in income level and the degradation of the environment. However, the role of FDI within the development of a country is evident in terms of its economic growth but simultaneously it creates a negative impact on the safety concerns of the environment (Shahbaz et al., 2018).

Indonesia has experienced various development opportunities through the rise and development of its industrial sector based on FDI through various international organisations expanding to the country (Irma et al., 2018). This may include various organisations belonging to different sectors that started their operations in Indonesia that, as a result, impacted and facilitated the economic growth of the country in a positive manner. In most of the developing countries where there are highly polluting industries, more tax regulations related to the environmental concerns encourage the inflow of FDI within those countries. Most of the environmental issues in Indonesia include deforestation, water pollution from industrial waste and air pollution in most of its urban cities. These all sorts of pollution caused by the industrial sector accounts for more than 80% of the carbon dioxide $(CO_2)$ emissions making the country the third largest greenhouse gas emitter in the world (Udemba et al., 2019). The economic development of a country based on the industrial growth has a significant impact on the rise of the environmental problems and risks that are highly needed to be considered. Moreover, the outcome of increasing FDI inflows in the country is based on the negative impacts on the environment in accordance to various studies (Hadi et al., 2018). However, some studies also state the positive impact of FDI inflows on the environment in terms of being good and effective for it.

## 2. LITERATURE REVIEW

There has been a huge debate on the impact of FDI inflows with the development and growth of a country and also its negative impacts on the environment. Previous studies stated that the increasing industrial development within a country through the international influence has not always been better for the environment. According to the study conducted by Rafindadi et al. (2018) there is a systematic relationship between the environmental pollution and FDIs based on various institutional dimensions such as the scope of the financial market and composition of the industrial sector. It has been observed that the effective functioning of the domestic capital market and the increased participation of developing economies within the development of its private sector reduces the risks of the environmental damage within the country (Brucal et al., 2017). Some studies conducted in this study area have identified the positive impact of FDI on the productivity of the environment that is also called as green total factor productivity. Based on the study conducted by Hadi et al. (2018) there is a significant impact of FDI inflow on GTDP through the use of green technology within the contemporary business setting. Furthermore, the study conducted by Karimi et al. (2019) states that there is an inhibitory impact of FDIs on the environmental productivity.

With respect to the impact of FDIs on the environmental productivity at a micro level, few studies indicate that the increasing inflow of FDI increases the efficiency of firms that benefits the economy of the country and also gives a positive impact to the environment. According to the study conducted by Zhu et al. (2016) these impacts are based on the increasing effectiveness of these firms in terms of adopting sustainability within their operations that lead towards the minimization of the environmental risks. It has been found that the negative value

of FDI suggests that in an economy that is directing towards the growth, FDI have a positive impact on the environment (Apresian, 2016) Hence, it shows that FDI in developing countries act as conduits for the advanced and cleaner environmental technologies. There are various studies that find no relationship between the development of a country and the environmental regulation. According to the study conducted by Balsalobre-Lorente et al. (2019) there is no significant correlation between environmental regulations within the countries having developed industrial sectors and developing countries having higher FDI. This study states that foreign investors are not concerned over the environmental impacts through their businesses as they are highly concentrated within dirty industries.

Based on the study conducted by Widiatedja (2019) in both industrialized and developing countries, it is the primary responsibility of the policy makers in terms of controlling on the pollution rather than depending on the foreign investors or the foreign investments coming in a country. It is evident that increasing number of international businesses boosts the economic growth of a country in terms of providing employment that rise the income level of people (Thanh et al., 2019). But at the same time, it also provides a severe damage to the physical environment through business activities primarily within the supply chain functions and production of goods. In the light of the study conducted by Tasri and Karimi (2019) FDI has an indirect impact on the environmental pollution where this impact might be heterogeneous. The rationale behind this impact of FDI on the environmental pollution is based on the aim these FDIs have is to maximize profitability that do increases the productivity but bring serious issues within the environment (Widiatedja, 2019). FDI impacts the environment in two distinct ways that include through increasing pollution that is one of the negative impacts and the second way is based on the positive impact on the environment through using efficient technologies and management practices in order to improve the environmental quality (Prasetyawati, 2020).

Different studies highlight that the significant role of FDIs in stimulating productivity as it is considered to be one of the essential sources of raising capital that leads towards the technological advancement within these host countries that are used for prevention of the environment from hazardous consequences of pollution. However, the argument still remains within the previous studies in terms of the positive and negative impacts of FDI on the environmental pollution (Agustina and Flath, 2020). According to the study conducted by Gök (2019) there are some factors that describe the impact of FDIs on the environmental pollution that include scale of the economy, structural change, capital and governmental regulations and policies. Scale of the economy has been postulated to be highly positive within the developing countries based on the increasing FDI that also bring positive impacts on the income level of people (Sarkodie and Strezov, 2019). Moreover, this increases the environmental pollution as a result of increase in spending of people due to rise in income. The study conducted by Destek and Okumus (2019) states that pollution receives high attention when a nation attains basic levels in health and education (Gultom et al., 2020) through investments in terms of making strategies in order to get a control

over environment pollution. The environment pollution is indeed not only the responsibility of local government but also of the community, in addition to be supported by government policy, sustainable depelovment also needs support and participation of community (Normelani, 2017). FDI also lead towards the structural change through the industrial development within developing countries.

Based on the study conducted by Ridzuan et al. (2016) higher structural change within a developing country leads towards an increase in the environmental pollution that could be considered to be the outcome of FDIs within that region. When it comes to capital, FDIs play a vital role within raising capital in order to attain economic growth and development. According to the study conducted by Khan and Ozturk (2020) there is a higher requirement of raising capital for developing countries in which FDIs have a significant impact. Thus, it leads towards increasing environment pollution when more industries are setup within a region that raise capital leading towards the economic growth but also increases environmental risks with respect to increasing pollution. Therefore, it can be considered through the previous studies conducted that there are both direct and indirect impacts of FDIs on the physical environment and the income level of people living in that environment.

## 2.1. Theoretical Framework
There are some theories that describe the impact of FDIs on the environmental pollution and income in terms of their relationship with each other. One of those theories include Green Economics Theory that talks about the sustainable development of a country without impacting the environment negatively and also utilizing green practices within the industrial sector for the betterment of the physical environment.

### 2.1.1. Green economics theory
Green economics theory is related to the development of a country based on sustainability ensuring the implementation of green practices within the business sectors of the country in order to prevent the environment from hazardous consequences. According to the study conducted by Law et al. (2016) green economics theory is based on the methodology of economics that is highly focused on the harmonious interaction between human activities and its impact on the nature in terms of meeting the needs of both of these aspects. In the context of this theory, growth and development of an economy are driven by public and private sectors and also the foreign investments that contribute towards the growth of an economy.

Based on the study topic, this theory has a vast implementation within the business sector specifically businesses coming from foreign investors in terms of making them realize the significance of the natural environment and the harm it is getting through these business activities. According to the study conducted by Falatehan and Bahtiar (2019) adoption of green initiatives by the use of advanced and clean technology, productivity can be increased within these businesses and its processes brought through FDIs for raising capital and income level and also it can impact the environment in a positive manner. The concern for environmental

safety has increased within the contemporary business settings that make it essential for the industrial sector towards reducing environmental pollution and to make the economy progress through sustainable practices (Swainson and Mahanty, 2018). Therefore, it can be considered that this theory is highly significant in terms of making a country go towards sustainable development through FDIs.

## 2.2. Hypotheses
According to the discussion on the studies conducted before this research, the following propositions have been made to test in the later sections.

$H_1$: The impact of disposable income on FDI is significant in the case of Indonesia.

$H_2$: The impact of physical environment on FDI is significant in the case of Indonesia.

## 3. RESEARCH METHOD

The current study has aimed towards determining the influence of income and environmental pollution on FDI in Indonesia. With this regard to this, the time series of disposable income, CO emission and FDI have been gathered. The time series from 1960 to 2018 has been collected in the current study.

## 3.1. Augmented Dickey-Fuller (ADF)
With reference to the findings of Mukoka (2018) in the econometric assessment that is the involvement of time series data, there is a need to consider certain assumptions. Among different assumptions, the use of stationarity is also essential to determine. Furthermore, the findings of Paparoditis and Politis (2018) suggested that Augmented Dickey-Fuller is considered as one of the essential statistical technique which helps in distinguishing whether the time series is stationary or non-stationary. Further, it has also been stated that ADF supposes through the null hypothesis that a time series entails unit-roots. With the absence and presence of the null hypothesis, it can be determined that a time series is stationary or not. The mathematical model highlighting the functionality of the ADF technique is also mentioned as followed:

The mathematical model on which the ADF techniques relies is presented as followed:

$$\Delta q_t = \lambda_0 + \lambda_1 t + \lambda_2 q_{t-1} + \sum_{i=1}^{n} ni1\, \Delta f_{t-1} + \pounds_t$$

In the equation above, $\Delta$ is defined as the difference operator. Meanwhile, $\pounds_t$ can be defined as the random error of stationary. In addition, $q_t$ reflects the non-stationary series.

## 3.2. Autoregressive Distributed Lag (ARDL)
The study is devoted to determining the influence of environmental pollution and income on FDI of Indonesia. In this regard, there was a need to determine the association among the variables. In statistics, different analysis techniques are being used for the purpose of determining the short term and long term association

between the variables. One of the essential statistical analysis technique which is preferably used for determining the long term association between the variables is concerned with autoregressive distributed lag technique. With reference to the findings of Nkoro and Uko (2016) it has been described that the ARDL approach is considered as one of the preferable techniques for determining the long term association during the econometric assessment. Further, it is also being discussed that the ARDL approach forms the basis with the iterative maximising of marginal log in order to predict 1 time series from the other. In realisation of this, the standard log function has also been presented as followed:

$$G_t = \beta + \alpha DI_t + \alpha CO_t + £_t$$

In the expression above, $G_t$ can be described as the log for FDI while $£_t$ is assumed as error terms. Further, $\alpha$ is considered to be as parameter estimate.

The usefulness of an ARDL approach can be described from a different perspective. One of the fundamental reason for developing an ARDL method is its robustness. And, it significance in determining the long term association among the variables. The mathematical model highlighting the basis of the developed ARDL model is as followed:

$$\Delta G_t = \beta 1 + \sum_{i=1}^{m1} \theta_{1i} \Delta G_{t-i} + \sum_{j=0}^{n2} \alpha_{2j} \Delta DI_{t-j} +$$

$$\sum_{j=0}^{n2} \alpha_{2j} \Delta CO2_{t-j} + \gamma_1 G_{t-1} + \gamma_2 DI_{t-1} + \gamma_2 CO2_{t-1} + \mu_t$$

In the above equation, the cointegration association between $G_t$ and disposable income and environmental pollution has also been highlighted. In addition to this, the long and short term association has also been highlighted through the following developed model.

$$\Delta G_t = \beta 2 + \sum_{i=1}^{m2} \alpha_{2i} \Delta G_{t-i} + \sum_{j=0}^{n2} \alpha_{2j} \Delta DI_{t-j} + \sum_{j=0}^{n2} \alpha_{2j} \Delta CO2_{t-j} + \mu_{2t}$$

$$\Delta G_t = \beta 3 + \sum_{i=1}^{m3} Q_{3i} \Delta G_{t-i} + \sum_{j=0}^{n3} \alpha_{3j} \Delta DI_{t-j} +$$

$$\sum_{j=0}^{n3} \alpha_{3j} \Delta CO2_{t-j} \phi \varepsilon_{t-1} + \mu_{3t}$$

Here $\phi$ denotes error correction term.

### 3.3. Granger Causality
It is evident that long term and short term association both are required to determine while comprehending whether the time series predict the other time series. However, it has also been discussed that long term association is mainly determined through models like VAR and VECM. In terms of determining the short term association, the most appropriate and widely used statistical model is concerned as Granger Causality. With reference to the findings of Barnett (2014), Granger Causality is a preferably applied analysis technique that is distinct because of determining the short term association. Further, the long term association between the time series can also be determined by utilising Granger

Causality. The models that are developed for the short and long term association are as followed:

Short-run:

$$H_0 : \theta_{nth} = 0 \ and \ H_0 : \Gamma_{ith} = 0$$

Long-run causality:

$$H_0 : \psi_{nth} = 0$$

Further, it becomes important to mention that tests are mainly applied through statistical packages like EVIEWS.

## 4. RESULTS AND ANALYSIS

For the attainment of the research objective, this section summarises the results which is based on the descriptive analysis, stationarity testing, ARDL model and Granger Causality.

### 4.1. Descriptive Statistics
The time-frame for this study ranged from 1960 to 2018 which entails to the inference that the 59 years have been considered in this research. The results presented in Table 1 implies that on average, the FDI's flow in Indonesia was approximately USD 4 billion, $CO_2$'s emission was 186,472 kt and the average disposable income was USD 7,279. However, the FDI is seemingly fluctuating because the standard deviation is higher than the mean value (SD= USD 6 billion). Comparatively, the deviation in $CO_2$ emission (SD = 155,712 kt) and disposable income (SD = 3,540) is less. Overall, the descriptive analysis infers that the investments in Indonesia are inconsistent specifically if last 59 years are considered.

### 4.2. Stationarity Testing
One of the most significant aspects for the evaluation of time-series data is the evaluation of stationarity. In this concern, ADF has been adopted whilst the criterion for selection is taken to be SIC. The results presented in Table 2 asserts that the first variable under consideration is $CO_2$ emission whose t-statistics is computed to be −1.842 (P = 0.357 > 0.05). Therefore, it can be asserted that this variable possess unit root and is non-stationary in nature. The next variable is FDI which has been treated in the study as the independent variable. The t-statistics is computed to be −0.85 (P = 0.806 > 0.05) and this implies that this time-series variable

**Table 1: Evaluation of descriptive statistics**

|  | FDI (USD) | $CO_2$ emission (kt) | DI (USD) |
|---|---|---|---|
| Mean | 4,329,180,022 | 186,472.4838 | 7,279.609 |
| Standard deviation | 6,753,974,549 | 155,712.3402 | 3,540.456 |
| Minimum | −4,550,355,286 | 21,404.279 | 2,278 |
| Maximum | 2,512,073,2060 | 637,078.911 | 14,218.2 |

**Table 2: Evaluation of stationarity**

| ADF-Unit root testing | t-statistics | P-value |
|---|---|---|
| $CO_2$ emission | −1.842 | 0.357 |
| FDI | −0.815 | 0.806 |
| DI | −3.155** | 0.028 |

**Is indicating significance at 5%

is also non-stationary in nature. The last variable of the study is considered to be DI which is disposable income. The t-statistics of the said variable is computed to be −3.155 with P = 0.028 < 0.05, hence, it can be asserted that the variable is stationary. Comprehensively, the variables have mixed nature with respect to the stationary.

## 4.3. ARDL Model Assessment
In this following section, the effect of $CO_2$ emission as a proxy to physical environment and disposable income is tested using ARDL model. The results in Table 3 indicates that the optimal lag order chosen automatically by E-Views is (2,1,4). The results in the mentioned table further indicates that FDI's flow in the case of Indonesia is significantly dependent on its lagged values (B= 0.578; P = 0.000 < 0.01) and (B = 0.263; P = 0.008 < 0.01) respectively. The effect is further computed to be positive. In addition, the long-run effect of $CO_2$ emission captured using the variable at level is positive and significant (B = 1.243; P = 0.01 < 0.05). This implies that in the long-run, more pollution in Indonesia results in more FDI. However, if the short-run effect is computed, it is negative (B = −1.108; P = 0.01 < 0.05). Therefore, more pollution in the short run in terms of $CO_2$ emission would lead to decrement in the FDI's flow in Indonesia. Another variable which has been tested in this study is DI or disposable income and its long-run effect is calculated to be positive (B = 7.977; P = 0.048 < 0.05). Therefore, increment in the country's disposable income would lead to increment in the investment in the Indonesian region. On the contrary, in the short-run, the effect is computed to be negative, however, till the second lag, the effect is apparently insignificant. Hence, the short run effect and association is minimal. Moreover, the overall variance that DI, $CO_2$ emission and lagged values is explaining is computed to be 86.33% which following the adjustment is reduced to 83.01%. In furtherance, the overall model is also significant and this inference has been draw on the basis of f-statistics (P < 0.05). Given this, the model is controlled for the problems or serial correlation or heteroscedasticity with the use of White errors.

## 4.4. Granger Causality
For the purpose of evaluating the causality between the variables, Granger causality has been employed. The results presented in Table 4 depicts that $CO_2$ emission and DI possess bi-causality

because both the directions are computed to be statistically significant (P < 0.1). In addition, the effect of DI on FDI is computed to be statistically significant (F-statistics = 2.482 with P = 0.06 < 0.1). However, in the short run, it is found that $CO_2$ emission does not granger cause FDI. It has been asserted because the p-value is computed to be higher than 10%.

## 4.5. Assessment Summary of Hypothesis
The hypotheses have been summarised on the basis of statistical evidence. Therefore, both the proposed hypotheses have been accepted because the effect of both $CO_2$ emission and disposable income is found to be significant on FDI. Overall, a shift in the direction of effect is found specifically on the basis of short and long-run.

## 5. DISCUSSION

The association and effect of $CO_2$ emission as a metric of environmental pollution and disposable income have been evaluated on the FDI of Indonesia. It has been found from the assessment that both the variable have reasonable effect on the inflow of the investment in Indonesia. Concerning this, the findings are coherent with the research of Rafindadi et al. (2018) where it has been asserted that systematic relationship between the environmental pollution and FDIs exists on the basis of various institutional dimensions. Therefore, if the concerned authorities and the institutions actively contribute their parts in curbing the pollution in Indonesia, the investments can be increased leading the flourishing economy. Another significant findings is associated with the fact that improvement in the savings strategy, the environment of investments in Indonesia can be promoted. It has been inferred on the basis of significant results.

Reflecting on the study of Thanh et al. (2019) the findings of this study are consistent because the former study stressed on the aspect of income and savings by asserting that the country is inclined towards investment which influences the foreign investors to contribute as well and this boosts the economic progress of the country as a whole. Another implication of the study is that improvement in the environmental aspects along with the income can lead to more employment opportunities. This aspect is crucial to be noticed because a country like Indonesia can grow further

**Table 3: ARDL model of the study**

| Selected model: ARDL (2,1,4) | | | | |
|---|---|---|---|---|
| Variable | Coefficient | SE | t-Statistic | Prob.* |
| FDI (−1) | 0.578*** | 0.107 | 5.403 | 0.000 |
| FDI (−2) | 0.263*** | 0.094 | 2.790 | 0.008 |
| $CO_2$ Emission | 1.243** | 0.461 | 2.694 | 0.011 |
| $CO_2$ Emission (−1) | −1.108** | 0.452 | −2.451 | 0.019 |
| DI | 7.977** | 3.894 | 2.048 | 0.048 |
| DI (−1) | −4.102 | 5.292 | −0.775 | 0.443 |
| DI (−2) | −5.873 | 4.723 | −1.243 | 0.222 |
| DI (−3) | 18.342*** | 5.746 | 3.192 | 0.003 |
| DI (−4) | −15.464*** | 4.839 | −3.196 | 0.003 |
| C | −2.885** | 1.336 | −2.160 | 0.037 |
| R-squared | 86.33% | | F-statistic | 25.973 |
| Adjusted R-squared | 83.01% | | Prob. (F-statistic) | 0.000 |

***Indicating significant at 1%; **indicating significance at 5%

**Table 4: Assessment of causality**

| Propositions | F-Statistic | Prob. |
|---|---|---|
| $CO_2$ Emission does not Granger Cause DI | 2.251* | 0.078 |
| DI does not Granger Cause $CO_2$ Emission | 4.704*** | 0.003 |
| FDI does not Granger Cause DI | 1.471 | 0.231 |
| DI does not Granger Cause FDI | 2.482* | 0.061 |
| FDI does not Granger Cause $CO_2$ Emission | 0.409 | 0.801 |
| $CO_2$ Emission does not Granger Cause FDI | 1.933 | 0.126 |

***Indicating significant at 1%; **indicating significance at 5%; *indicating significance at 10%

as developing state with more of its population contributing to the work force. Precisely, FDI, income and pollution are found to be interlinked aspects in the case of Indonesia and improvement in any would affect the other significantly, therefore, plausible policies are required by the government to curb the pollution and spread awareness regarding expenditure and income.

## 6. CONCLUSION

The study was concerned with determining the influence of income and environmental pollution on FDI in the context of Indonesia. The study has adopted a quantitative approach to comprehend the research phenomenon. For this purpose, the time series from 1960 to 2018 was gathered and was processed through the ARDL statistical model along with Granger Causality once the time series satisfied the necessary criteria. The findings of the current research suggest that both the regressors that were environmental pollution and income have a significant effect on the FDI for Indonesia. The findings of the current study are also well aligned with the prior findings where it has also been discussed that income and environmental pollution significantly affect FDI of a country.

The current study discusses in detail how the FDI of a country is predicted by measures like environmental pollution and income. In addition, the time series from 1960 to 2018 was also sufficient enough to comprehend the research phenomenon. However, the absence of qualitative evidence indicates one of the major weaknesses of the current research. In this aspect, there is an opportunity for the future researcher to execute this research with the inclusion of some qualitative evidence as it gives new dimensions to the research context. Further, the findings of the current research can only be applied with full confidence in the context of Indonesia. Therefore, future researchers can also study the current research phenomenon from the context of different geographical locations.

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