# “The impact of vertical fiscal imbalance and green fiscal spending on green economic growth in Indonesia”


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# THE IMPACT OF VERTICAL FISCAL IMBALANCE AND GREEN FISCAL SPENDING ON GREEN ECONOMIC GROWTH IN INDONESIA

## Abstract

Vertical fiscal imbalance within fiscal decentralization systems and the growing scale of green fiscal spending raise crucial questions about how fiscal structure and environmentally oriented government spending shape green economic growth. This study aims to investigate the impact of vertical fiscal imbalance and green fiscal spending on green economic growth in Indonesia from 2010 to 2022. A descriptive-quantitative approach and econometric methods, including Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS), were applied to panel data from 33 provinces in Indonesia, 2010 to 2022. The descriptive-quantitative results show that regions with high levels of industrialization tend to produce high carbon emissions, and regions receiving special autonomy funds tend to have high vertical fiscal imbalance. The results of the FMOLS and DOLS estimates confirm that vertical fiscal imbalance has a significant negative impact on green economic growth, thereby weakening the effect of green capital on green economic growth, with coefficients of –0.0731 (FMOLS) and –0.0115 (DOLS). Conversely, based on the FMOLS results, green fiscal spending has a positive impact on green economic growth, strengthening the effect of green capital on green economic growth with a coefficient of 0.0331. Strengthening the fiscal capacity of local governments through increased own-source revenues and better collaboration between central and local governments to support sustainable green economic growth is needed.

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## INTRODUCTION

Vertical fiscal imbalance is a critical issue in countries implementing a fiscal decentralization system (Bellofatto & Besfamille, 2018). Green fiscal spending is touted as a strategic policy aimed at maximizing green economic growth. Endogenous economic growth is associated with capital accumulation and human capital (Mankiw et al., 1992; Romer, 1986). Based on endogenous economic growth theory, the green economic growth concept of this study is driven by green capital and green human capital (Mensah et al., 2019; Yusliza et al., 2020). It provides a comparable view of the economy within the framework of endogenous growth and green economic growth models.

Studies on fiscal policy, economic growth, and environmental issues are highly relevant to research in Indonesia, a developing country that has adopted fiscal decentralization. Fiscal decentralization provides local governments with the opportunity to manage their regions, particularly in public expenditure management, although the majority of expenditures still rely heavily on fund transfers from the central government (X. Tan & Y. Tan, 2024). This system creates the potential for increased dependence of local governments on central transfers, raising concerns



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about the emergence of vertical fiscal imbalance in Indonesia, particularly in regions with special autonomy (Akadun, 2024; Lewis, 2023). Nevertheless, through fiscal decentralization, local governments gain financial resources to allocate toward various development programs, including those in the environmental sector or green fiscal spending (Chen et al., 2022; Liu et al., 2022b). The role of green fiscal spending is crucial in Indonesia, a country still facing challenges in environmental management, particularly in addressing carbon emissions from economic activities. According to a publication by the Indonesian Ministry of Forestry and Environment (2025), most provinces in Indonesia generate carbon emissions, while only a few produce carbon offsets. Therefore, achieving sustainable economic growth poses a significant challenge and requires effective fiscal policies (Feng & Ge, 2024).

First, the study focuses on fiscal policy management, specifically the vertical fiscal imbalance, which is believed to play a significant role in determining green economic growth. Vertical fiscal imbalance will make the government's fiscal policy unsustainable due to local governments' growing dependence on central government funding transfers (Li & Du, 2021). Government attention to environmental issues is limited due to vertical fiscal imbalance-related issues, increasing the risk of environmental degradation (Li et al., 2021). This statement underlines the importance of vertical fiscal imbalance analysis in addressing environmental issues. Moreover, high levels of vertical fiscal imbalance hinder investment (Lin & Zhou, 2021b). It is expected to weaken the effectiveness of green capital in promoting green economic growth; therefore, it is important to provide empirical evidence regarding this relationship. No studies have yet been found that explain how the interaction between vertical fiscal imbalance and green capital impacts green economic growth.

Second, this study investigates how green fiscal spending impacts green economic growth. The green fiscal spending allocation is specifically designed to directly improve environmental quality. However, no study has yet demonstrated whether green fiscal spending strengthens or weakens the impact of green capital on green economic growth. On the one hand, green fiscal spending can help ensure that green capital operates at its full potential and encourages private green investment (crowding-in) (Afolabi & Islam, 2025; He et al., 2023). On the other hand, there is a potential for "free riding" by the private sector, leading to a reduction in private green investment (crowding out) (Hong et al., 2022). The impact of the interaction between green fiscal spending and green capital on green economic growth has not yet been empirically proven.

## 1. LITERATURE REVIEW AND HYPOTHESES

Indonesia's economic expansion has been accompanied by rising carbon emissions, detrimental to the environment. Economic growth that disregards environmental quality will threaten our survival if it continues in the long term, making it difficult to achieve environmentally friendly economic activities. A more comprehensive perspective is needed that integrates environmental and economic sustainability, namely green economic growth (D'Amato & Korhonen, 2021; Raihan et al., 2022; Solarin et al., 2021; Tawiah et al., 2021). Rooted in endogenous growth theory, this study considers green capital and green human capital as the primary determinants of green economic growth. Most previous studies have demonstrated that an increase in green capital improves the quality of green economic growth, such as Gallo et al. (2025) across 18 OECD countries, Fu and Ullah (2023) in China, Sethi et al. (2024) in developing economies, and Wan and Sheng (2022) in China. Meanwhile, the impact of green human capital on green economic growth has yielded mixed findings: Liu et al. (2022a) found a long-term positive relationship, while Liu et al. (2022c) identified a U-shaped relationship in China. In the Indonesian context, research examining the impact of green capital and green human capital remains very limited.

Vertical fiscal imbalance can influence green economic growth through various mechanisms. The difference in fiscal capacity, as indicated by revenue and expenditure, between local governments and the central government is defined as vertical fiscal imbalance (Lin & Zhou, 2021a). Green economic growth will worsen if it is compounded by vertical fiscal imbalance (Bellofatto & Besfamille, 2018; Li & Du, 2021; Lin & Zhou, 2021a; Liu et al., 2024; Zhang & Hussain, 2021). Several studies have linked vertical fiscal imbalance issues to environmental concerns. Lin and Zhou (2021a), Guo et al. (2020), Wei et al. (2021), Feng et al. (2023), and Huang and Zhou (2020) found that vertical fiscal imbalance harms environmental quality. Government attention to and regulations on environmental issues are limited due to vertical fiscal imbalance issues, thereby increasing the risk of environmental degradation (Li et al., 2021). However, investigating the environmental impact of vertical fiscal imbalance alone is not enough. The reason is that environmental exploration often leads to efforts to prevent damage and fails to embody the concept of sustainability (Forsyth & Tepper, 2024). In the context of green economic growth, vertical fiscal imbalance leads to fiscal instability and fiscal unsustainability (Jia et al., 2021); for example, environmental spending has declined due to vertical fiscal imbalance, which, in turn, negatively affects green economic growth (Feng et al., 2023; Li & Du, 2021). When vertical fiscal imbalance occurs, governance is hindered (Chu & Fei, 2021). The government no longer prioritizes environmental protection due to reduced allocations for environmental spending, leading it to neglect green economic growth (You et al., 2019; Zhao et al., 2023). The vertical fiscal imbalance has undermined the government's efforts to promote green economic growth.

Integrating environmental and economic sustainability must be supported by the government, specifically through green fiscal spending. The relationship between green fiscal spending and green economic growth has been examined in several studies, yielding mixed results. By promoting green infrastructure, fiscal spending positively affects green productivity (Deng et al., 2023). The positive effect of fiscal spending on green economic growth indicators, such as green technology, may be weakened by fiscal constraints (Wei et al., 2023). Government investment in environmental protection programs positively affects green economic growth (Chen & Li, 2023; Fang & Chang, 2022; Hossain, 2024; Liu et al., 2023; Miao et al., 2023; Mohsin et al., 2022; Wang et al., 2023; Zhang et al., 2021). Zhao and Xu (2022) demonstrate an inverse relationship: beyond a certain threshold, additional green fiscal spending reduces green performance. Meanwhile, Arjomandi et al. (2023) assert that green fiscal spending can only boost green economic growth in the short term and may reduce it if sustained over the long term.

Approaches examining green economic growth offer significant advantages, as they not only mitigate adverse environmental impacts but also create sustainable economic development models. This approach focuses attention on economic activities that are not only efficient but also environmentally friendly. Based on a review of the literature on the relationship between vertical fiscal imbalance and green fiscal spending in green economic growth, this study aims to address identified research gaps. Most studies on vertical fiscal imbalance focus on its environmental impact. Meanwhile, previous studies on green fiscal spending have generally used public expenditure in the form of R&D expenditure as a proxy for green fiscal spending. The use of R&D expenditure as a proxy for green fiscal spending does not fully represent green fiscal spending. This study refines it by allocating central government expenditure specifically to the environmental sector and directly to all local governments.

This study is similar to that by Fang and Chang (2022), but Fang and Chang (2022) only estimated the effect of vertical fiscal imbalance on green economic growth without elaborating on the theoretical background or justification for their in-depth analysis of this relationship. Therefore, Fang and Chang's (2022) research is considered less robust and still limited in its discussion of the role of vertical fiscal imbalance in green economic growth dynamics. In addition, previous studies only estimated the direct effect of green fiscal spending on green economic growth. This limitation creates a gap that warrants further exploration.

Therefore, this study aims to investigate the impact of vertical fiscal imbalance and green fiscal spending on green economic growth in Indonesia from 2010 to 2022. The hypotheses are as follows:

*H1: Green capital positively affects green economic growth.*

*H2: Green human capital positively affects green economic growth.*

*H3: Vertical fiscal imbalance negatively affects green economic growth.*


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H4: *Vertical fiscal imbalance weakens the positive effect of green capital on green economic growth.*

H5: *Green fiscal spending positively affects green economic growth.*

H6: *Green fiscal spending strengthens the positive effect of green capital on green economic growth.*

## 2. METHOD

This study uses panel data from 33 provinces in Indonesia for the years 2010 to 2022. This study does not include five provinces such as North Kalimantan, Southwest Papua, Central Papua, Highland Papua, and South Papua, as they are Indonesia's most newly formed provinces. North Kalimantan was established in 2012, while the other four provinces were only legalized in 2022. Due to the limited time series data available for these five provinces, only 33 provinces are analyzed. The secondary data were sourced from the Directorate General of Fiscal Balance, the Ministry of Forestry and Environment, the Central Bank of Indonesia, and the annual Indonesian Central Bureau of Statistics for each province in Indonesia. The data collected consist of gross regional domestic product (in IDR), labor (in people), capital (in IDR), human capital (in Index), local and central government revenue and expenditure (in IDR), green fiscal expenditure (in IDR), and carbon emissions (thousands of tons of $CO_2$).

As a first step, this study conducted a preliminary data analysis to provide an overview of the data using descriptive statistics. Next, using a descriptive-quantitative approach, provinces were categorized by carbon emissions and vertical fiscal imbalance levels. This approach helps identify priority regions that require more in-depth policy interventions and provides strategic guidance to policymakers at the national and subnational levels.

Through economic modeling, this study employs the endogenous growth model to investigate the impact of vertical fiscal imbalance and green fiscal spending on green economic growth. The Cobb–Douglas function is used to explain the functional relationship of output ($Y_{it}$) produced with the inputs used, such as capital ($K_{it}$), labor ($L_{it}$), and human capital ($H_{it}$). According to endogenous growth theory (Arjun et al., 2020; Ghosh & Parab, 2021; Mankiw et al., 1992; Rebelo, 2009; Romer, 1986; Roufagalas & Orlov, 2020), the amount of labor available will be more beneficial to the economy if it is supported by human capital quality. The Cobb–Douglas function that explains the functional relationship of the main variables observed can be formulated mathematically as follows:

$$Y_{it} = K_{it}^{\alpha} L_{it}^{\beta} H_{it}^{\Upsilon}, \text{ or } yl_{it} = kl_{it} + hl_{it}, \tag{1}$$

where

$$\begin{aligned} yl_{it} &= \frac{output_{it}}{labor_{it}} = \frac{Y_{it}}{L_{it}}, \\ kl_{it} &= \frac{capital_{it}}{labor_{it}} = \frac{K_{it}}{L_{it}}, \\ hl_{it} &= \frac{human\,capital_{it}}{labor_{it}} = \frac{H_{it}}{L_{it}}, \end{aligned} \tag{2}$$

for all $i = 1, \ldots, N$; where $yl_{it}$ refers to output per labor, $kl_{it}$ denotes capital per labor, $hl_{it}$ is human capital per labor, and α, β, and γ are the parameters whose values are estimated. To calculate economic growth, capital, and human capital that considers environmental elements in producing output, the carbon emissions ($CO_2$) per labor are used to indicate green economic growth, which has previously been done by Mensah et al. (2019) and Citil (2024). In measuring the "green" components of economic growth, capital, and human capital, this study applies a carbon adjustment approach based on the results of panel regression estimates. This approach, often called a residual-based adjustment, has been used by several studies to measure the concept of a "green economy." It is based on the logic that environmentally harmful activities are separated from the observed variables, yielding a "cleaner" measure of the variables – a concept typically referred to in the literature as environmentally adjusted economic performance.

Tzouvelekas et al. (2006) used carbon emissions to measure Green Total Factor Productivity (Green TFP) by treating it as a residual after adjusting for environmental pressures. Xiang and Fan (2024) used the Solow Residual Method to test Green TFP. Residual-based adjustments are also used by Cárdenas Rodríguez et al. (2018) to measure Environmentally Adjusted Multifactor Productivity (EAMFP). The Solow method defines the residual as unexplained technology, whereas this study defines it as economic growth not explained by the pollutant factor ($CO_2$). Therefore, the difference between the initial $y_{it}$ and the carbon-emission-adjusted $y_{it}$ is interpreted as the portion of economic output that is relatively cleaner. This approach is robust enough to serve as a basis for measurement because it produces more stable indicators and unbiased estimates.

Using a residual-based approach, adjusted carbon is estimated via panel regression, incorporating model specification tests such as the LM, Chow, and Hausman tests, with all variables transformed to logarithms. Green economic growth, green capital, and green human capital can be interpreted as economic output, capital, and human capital adjusted for environmental pressures, as described in:

$$lyl_{it} = \alpha + \beta IHS\left(CO2_{it}\right) + \varepsilon_{it}, \tag{3}$$

where $lyl_{it} - \widehat{lyl}_{it}$ is $gy_{it}$;

$$lkl_{it} = \alpha + \beta IHS\left(CO2_{it}\right) + \varepsilon_{it}, \tag{4}$$

where $lkl_{it} - \widehat{lkl}_{it}$ is $gk_{it}$; and

$$lhl_{it} = \alpha + \beta IHS\left(CO2_{it}\right) + \varepsilon_{it}, \tag{5}$$

where $lhl_{it} - \widehat{lhl}_{it}$ is $gh_{it}$.

It should be noted that there are both positive carbon emissions and negative carbon offsets. Negative values cannot be transformed using the natural logarithm. Therefore, to accommodate negative carbon emission values in some provinces and time periods, the carbon emission data are transformed using the Inverse Hyperbolic Sine (IHS) function, with:

$$IHS\left(CO2_{it}\right) = \ln(CO2_{it} + \sqrt{CO2_{it}^{\ 2} + 1}). \tag{6}$$

Thus, the green growth equation based on endogenous economic growth, constructed in this study, is as follows:

$$gy_{it} = gk_{it} + gh_{it}, \tag{7}$$

where $gy_{it}$ shows green economic growth per labor, $gk_{it}$ shows green capital per labor, and $gh_{it}$ shows green human capital per labor. Modeling with fiscal policy is derived through capital input ($k_{it}$). The size of vertical fiscal imbalance largely determines local government investment. A high vertical fiscal imbalance will disrupt the region's capital flow. Thus, the green economic growth model influenced by fiscal imbalance can be formulated as:

$$gy_{it} = f\left(gk_{it}, gh_{it}, VFI_{it}, gk_{it} \cdot VFI_{it}\right), \tag{8}$$

where $VFI_{it}$ describes vertical fiscal imbalance and $gk_{it} \times VFI_{it}$ describes the interaction between green capital per labor and green human capital per labor with vertical fiscal imbalance. VFI can be calculated using the formula developed by Eyraud and Lusinyan (2013), namely:

$$VFI_{it} = \left(1 - \frac{\left(\dfrac{\frac{PFR_{it}}{Pop_{it}}}{\frac{PFR_{it}}{Pop_{it}} + \frac{CFR_t}{Pop_t}}\right)}{\left(\dfrac{\frac{PFE_{it}}{Pop_{it}}}{\frac{PFE_{it}}{Pop_{it}} + \frac{CFE_t}{Pop_t}}\right)}\right) \cdot \left(1 - \frac{\left(LE_{it} - LR_{it}\right)}{LE_{it}}\right), \tag{9}$$

or $$VFI_{it} = 1 - \frac{FR_{it}}{FS_{it}} \cdot \left(1 - LGF_{it}\right), \tag{10}$$

where

$$FR_{it} = \frac{\frac{PFR_{it}}{Pop_{it}}}{\frac{PFR_{it}}{Pop_{it}} + \frac{CFR_t}{Pop_t}}, \quad FS_{it} = \frac{\frac{PFE_{it}}{Pop_{it}}}{\frac{PFE_{it}}{Pop_{it}} + \frac{CFE_t}{Pop_t}}, \quad LGF_{it} = \frac{\left(LE_{it} - LR_{it}\right)}{LE_{it}}, \tag{11}$$


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where FR is fiscal revenue decentralization; FS is fiscal expenditure decentralization; LFG is local government fiscal deficit; PFR is local fiscal revenue per capita; CFR is central fiscal revenue per capita; PFE is local fiscal expenditure per capita; CFR is central expenditure per capita; LE is local fiscal expenditure; and LR is local fiscal revenue. Government assistance in the form of green fiscal spending affects green investment decisions in the economy, so green capital per labor can change. Therefore, the final model of this study is shown as:

$$gy_{it} = f\begin{pmatrix} gk_{it}, gh_{it}, VFI_{it}, \\ GFS_{it}\; gk \cdot VFI_{it}, gk \cdot GFS_{it} \end{pmatrix}. \tag{12}$$

Functions in equations (1), (7), (8), and (12) that have been determined will be estimated using the FMOLS panel and DOLS panel econometric methods. However, several stages of data analysis must be passed so that these two methods can be applied. First, a test of data stationarity using the unit root test with the Augmented Dickey Fuller method (Dickey & Fuller, 1979). Second, a cointegration test using the method developed by Kao et al. (1999). If the model is cointegrated, the FMOLS panel method and DOLS can be used (Mark & Sul, 2003; Pedroni, 2000). The FMOLS and DOLS methods provide several advantages in econometric analysis, namely:

1) FMOLS and DOLS can be used to obtain long-run relationship results in a cointegrated model (Yahyaoui & Bouchoucha, 2021);

2) FMOLS and DOLS provide robust estimation results by modifying Ordinary Least Square (OLS);

3) Modifications made to FMOLS are in the form of fixing endogeneity problems so that estimation results are unbiased and consistent;

4) Modifications to DOLS are done by adding lags and leads so that independent variables can be separated from short-term influences.

Thus, long-term relationships can be captured more accurately (Pedroni, 2000).

Functions in equations (1), (7), (8), and (12) are estimated using the FMOLS and DOLS methods. Those equations are adjusted to the FMOLS and DOLS modeling and transformed into logarithmic form.

$$Lyl_{it} = \alpha_0 + \alpha_1 Lkl_{it} + \alpha_2 Lhl_{it} + \varepsilon_{it}, \tag{13}$$

$$Lgy_{it} = \beta_0 + \beta_1 Lgk_{it} + \beta_2 Lgh_{it} + \varepsilon_{it}, \tag{14}$$

$$\begin{aligned} Lgy_{it} &= \varphi_0 + \varphi_1 Lgk_{it} + \varphi_2 Lgh_{it} \\ &+ \varphi_3 VFI_{it} + \varphi_4 L\left(gk \cdot VFI\right)_{it} + \varepsilon_{it}, \end{aligned} \tag{15}$$

$$\begin{aligned} Lgy_{it} &= \lambda_0 + \lambda_1 Lgk_{it} + \lambda_2 Lgh_{it} + \lambda_3 VFI_{it} \\ &+ \lambda_4 LGFS_{it} + \lambda_5 L\left(gk \cdot VFI\right)_{it} \\ &+ \lambda_6 L\left(gk \cdot GFS\right)_{it} + \varepsilon_{it}, \end{aligned} \tag{16}$$

where $L$ represents the logarithm, while $\alpha$, $\beta$, $\phi$, and λ denote the regression coefficients for each variable, $i$ is a cross-section, and $t$ is a time series. $\varepsilon$ denotes the error term.

## 3. RESULTS

Descriptive statistics of all data variables used in this study from 2010 to 2022 from 33 provinces in Indonesia are presented in Table 1. The average value of green GRDP per labor is much smaller than the value of endogenous growth per labor. The average value of green GRDP per labor is 53.4 thousand Rupiahs. The higher the value of green GRDP, the greater the output generated from 1 teragram of $CO_2$. The lowest carbon emissions were recorded at minus 127.2 teragrams in West Papua Province in 2013, indicating that more carbon dioxide was absorbed than was released (carbon offset). The highest carbon emissions were 18,367.61 teragrams from Central Kalimantan Province in 2019, caused by deforestation to clear land for oil palm plantations and coal mining activities. Indonesia's average carbon emissions are 194.66 teragrams, indicating environmental degradation. The Indonesian government allocates an annual budget for the environment, although the amount is not very large, averaging only 233.69 billion rupiah. This is one of the efforts to maintain environmental sustainability.

Carbon emissions in this study are an important component in measuring green economic growth. Therefore, it is crucial to analyze a descriptive

**Table 1.** Descriptive statistics

| Description | Abbr. | Formula | Unit | Mean | Med | Max | Min | Std. Dev | Covar | Skew. | Kurtosis |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Gross Regional Domestic Product (GRDP) | Y | – | Trillion IDR | 284.48 | 118.72 | 1953.49 | 14.98 | 401.58 | 0.7 | 2.29 | 7.56 |
| Capital | K | – | Trillion IDR | 89.27 | 34.94 | 750.57 | 3.43 | 135.02 | 0.66 | 2.87 | 11.8 |
| Human Capital | H | – | Points | 69.02 | 69.05 | 81.65 | 54.45 | 4.58 | 15.06 | –0.03 | 3.65 |
| Labor | L | – | Million people | 3.94 | 2.13 | 24.82 | 0.37 | 5.53 | 0.71 | 2.53 | 8.26 |
| Carbon Emission | C | – | $CO_2$ Teragram | 194.66 | 10.82 | 18367.61 | -127.2 | 1435.26 | 0.13 | 10.07 | 109.13 |
| GRDP per labor | EGL | (EGRDP/L) | Million IDR | 75.68 | 57.46 | 380.49 | 18.36 | 58.95 | 1.28 | 2.57 | 9.72 |
| Endogenous growth per labor | lyl | Log (EGL) | Percent | 17.99 | 17.88 | 19.75 | 16.72 | 0.56 | 32.12 | 1.1 | 4.19 |
| Capital per labor | kl | (K/L) | Million IDR | 41.36 | 17.71 | 338.57 | 1.5 | 57.77 | 0.71 | 2.86 | 12.41 |
| Human capital per labor | hl | (H/L) | Points | 4.65E-05 | 3.31E-05 | 0.0001 | 2.93E-06 | 3.81E-05 | 1.22 | 1.1 | 3.33 |
| Vertical Fiscal Imbalance | VFI | See Eq. (2) | Points | –0.07 | –0.06 | 0.42 | –0.68 | 0.16 | 0.43 | –0.67 | 4.41 |
| Green Fiscal Spending | GFS | – | Billion IDR | 233.69 | 26.04 | 7,464.89 | 0.5 | 691.01 | 0.33 | 5.94 | 47.8 |

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overview of carbon dynamics in Indonesia. Table A1, Appendix A, shows that Indonesia generates carbon offsets ($CO_2 < 0$) and carbon emissions ($CO_2 > 0$) at the provincial level. Carbon offsets indicate that carbon emissions have been reduced to zero and that more carbon is absorbed from the atmosphere than is produced.

The results of the descriptive-quantitative data analysis in Table A1 show that only a few provinces in Indonesia are capable of generating carbon offsets. Over time, the number of provinces generating carbon offsets has tended to decline. Maluku is the only province in Indonesia that has consistently generated carbon offsets. Southeast Sulawesi, Jambi, North Sulawesi, Maluku, East Nusa Tenggara, Gorontalo, Bengkulu, North Maluku, West Sulawesi, Papua, and West Papua also frequently generate carbon offsets. According to CBS Indonesia (2022), these provinces are classified as having a low economic status, leading to the conclusion that provinces with low economic development and industrialization have significant potential for generating carbon offsets. Low industrialization indicates low dependence on fossil fuels, resulting in far lower carbon emissions (Anam et al., 2025). The COVID-19 pandemic caused a significant decline in the economy and tourism in Bali, resulting in Bali generating carbon offsets in 2020 and 2021. Reduced tourism activity has been shown to reduce carbon emissions by Raihan et al. (2025b) and Waaje et al. (2025).

High-income provinces tend to generate carbon emissions. Some of the high-income provinces in Indonesia include DKI Jakarta, West Java, East Java, Central Java, East Kalimantan, Riau, Banten, North Sumatra, and South Sulawesi. Prosperous regions are hubs of heavy industrial activity and major contributors to carbon emissions, where the consumption of fossil fuels typically generates carbon emissions. This statement is supported by Miah et al. (2025) and Raihan et al. (2025a), who found that economic growth and intensive energy use increase emissions. As presented in Table A1, nearly 80.42% of Indonesian provinces are carbon emitters. In 2015, there was a significant increase in carbon emissions, reaching 653.3% compared to the previous year due to severe peatland fires in Central Kalimantan that same year.

A high vertical fiscal imbalance (positive or negative) indicates an imbalance between the fiscal capacity of the central government and that of local governments. A positive vertical fiscal imbalance indicates that the central government has greater fiscal capacity than local governments, and vice versa. As shown in Table A2, the average percentage of provinces with a positive vertical fiscal imbalance is 28.90 percent. Regions receiving special autonomy funds tend to have a higher vertical fiscal imbalance relative to the central government, such as Papua, West Papua, Aceh, Yogyakarta Special Region, and Jakarta Special Capital Region. Fiscal imbalance will be high if they fail to balance expenditures and revenues, thereby becoming dependent on central government transfers. 71.1 percent of other provinces in Indonesia have a negative vertical fiscal imbalance. This indicates that the central government has lower fiscal capacity than local governments. Greater fiscal capacity reflects a region's ability to generate revenue and manage expenditures efficiently.

The green economic growth, green capital, and green human capital data were measured using residuals from the panel regression. The results of the LM, Chow, and Hausman tests confirm that the random effects model is the best among those tested for the effects of CO2 on economic growth, capital, and human capital. Details of the random effects model test results are presented in Table 2.

**Table 2.** Measurement of green economic growth, green capital, and green human capital indicators using residuals from panel regression models

| Dependent variable | Variable | Coefficient | Std. error | t-Statistic | Prob. |
|---|---|---|---|---|---|
| Lyl (Economic growth per labor) | C | 0.027511 | 0.007466 | 3.684976 | 0.0003 |
| | IHS_CO2l | 17.96230 | 0.192103 | 93.50374 | 0.0000 |
| Lkl (Capital per labor) | C | 0.023549 | 0.008194 | 2.873883 | 0.0043 |
| | IHS_CO2l | 16.77551 | 0.248843 | 67.41406 | 0.0000 |
| Lhl (Human capital per labor) | C | 0.009330 | 0.006829 | 1.366109 | 0.1726 |
| | IHS_CO2l | –10.33618 | 0.164042 | –63.00948 | 0.0000 |

**Table 3.** Panel unit root test (ADF method)

| Variables | Level | | First Difference | |
|---|---|---|---|---|
| | t-Statistic | Probability | t-Statistic | Probability |
| Lyl | 70.855 | 0.3190 | 154.866 | 0.0000*** |
| Lkl | 72.520 | 0.2718 | 160.882 | 0.0000*** |
| Lhl | 44.384 | 0.9711 | 148.350 | 0.0000*** |
| Gy | 45.163 | 0.9767 | 205.874 | 0.0000*** |
| Gk | 56.348 | 0.7956 | 178.017 | 0.0000*** |
| Gh | 53.040 | 0.8755 | 157.959 | 0.0000*** |
| VFI | 120.523 | 0.0000*** | 213.506 | 0.0000*** |
| gk × VFI | 116.426 | 0.0001*** | 224.660 | 0.0000*** |
| LGFS | 114.692 | 0.0002*** | 194.643 | 0.0000*** |
| gk × LGFS | 60.035 | 0.6834 | 218.868 | 0.0000*** |

*Note:* * and *** denote statistical significance at 10% and 1%. Lyl: logarithm of output per labor; Lkl: logarithm of capital per labor; Lhl: logarithm of human capital; Gy: green economic growth per labor; Gk: green capital per labor; Gh: green human capital per labor; VFI: vertical fiscal imbalance; Gk × VFI: interaction between green capital per labor and vertical fiscal imbalance; LGFS: logarithm of green fiscal spending; and Gk × LGFS: interaction between green capital per labor and green fiscal spending.

The results show that the calculated residuals provide information on the variables adjusted for carbon emissions.

The unit root stationarity test results are clearly shown in Table 3. At the level, not all variables are significant at the 5% level. Therefore, transformation into the first difference form is required. The overall unit root test results show that all variables in this study have been stationary at the same level, namely, the first difference level.

Table 4 shows the cointegration test using Kao's method. Kao's cointegration test results show a long-run relationship for all four models. This is indicated by the cointegration test results that reject the null hypothesis, so the variables in the model are cointegrated.

**Table 4.** Kao cointegration test results

| Models | t-Statistic | p–value |
|---|---|---|
| Model I | 1.7795 | 0.0376** |
| Model II | –1.9881 | 0.0234** |
| Model III | –1.9805 | 0.0238** |
| Model IV | –1.6725 | 0.0472** |

*Note:* ** denotes statistical significance at 5%.

Based on Table 5, using both FMOLS and DOLS methods, Model I shows that capital per labor has a positive and significant effect on economic growth. Human capital per worker has a negative and significant effect on economic growth. These results indicate that an increase in physical capital is a major driver of economic growth. An increase in human capital cannot boost economic growth. These findings confirm that an increase in physical capital directly increases output productivity, whereas the effect of human capital on output productivity depends heavily on its quality.

Model II shows that green capital per labor and green human capital per labor both have positive, significant effects on green economic growth per labor. These findings support *H1* and *H2*, indicating that to promote green economic growth, increased investment in green capital and green human capital is needed. Model III shows that the direct effect of vertical fiscal imbalance on green economic growth per labor is not significant. Therefore, $H_3$ is rejected. The interaction between vertical fiscal imbalance and green capital per labor significantly negatively affects green economic growth per labor, supporting *H4*. This indicates that an increase in vertical fiscal imbalance weakens the positive effect of green capital per labor on green economic growth per labor. The results of Model IV provide broader evidence. However, the FMOLS and DOLS results differ slightly regarding the effects of green fiscal spending and green capital per labor which are multiplied by green fiscal spending on green economic growth. The FMOLS results indicate that green fiscal spending is not significant for green economic growth, whereas the DOLS results show that green fiscal spending has a significant positive effect on green economic growth. Therefore, FMOLS rejects *H5*, whereas


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**Table 5.** Estimation results with FMOLS and DOLS panels

| Variables | Model I (lyl) | Model II (lgy) | Model III (lgy) | Model IV (lgy) |
|---|---|---|---|---|
| **The Coefficients and Statistical Significance Level of the FMOLS panel** | | | | |
| Lkl | 0.4378 | | | |
| | (8.5897)*** | | | |
| Lhl | −0.2439 | | | |
| | (−1.7752)* | | | |
| Gk | | 0.5353 | 0.5117 | 0.3828 |
| | | (13.0843)*** | (12.4640)*** | (9.2838)*** |
| Gh | | 0.3144 | 0.3216 | 0.2063 |
| | | (17.7397)*** | (17.8882)*** | (012.478)*** |
| VFI | | | 0.0260 | 0.0415 |
| | | | (0.6483) | (1.2524) |
| gk × VFI | | | −0.0731 | −0.0820 |
| | | | (−2.3605)** | (−3.2504)*** |
| LGFS | | | | 0.0332 |
| | | | | (1.4477) |
| gk × GFS | | | | 0.0331 |
| | | | | (2.2484)** |
| R-Squared | 0.9939 | 0.9938 | 0.9937 | 0.9822 |
| Adj. R-Squared | 0.9933 | 0.9932 | 0.9931 | 0.9803 |
| **The Coefficients and Statistical Significance Level of the DOLS panel** | | | | |
| Lkl | 0.5721 | | | |
| | (27.1884)*** | | | |
| Lhl | −0.1033 | | | |
| | (−2.9597)*** | | | |
| Lgk | | 0.0575 | 0.3503 | 0.3420 |
| | | (2.3752)** | (14.7272)*** | (13.0465)*** |
| Lgh | | 0.4041 | 0.6559 | 0.6579 |
| | | (14.0991)*** | (26.7708)*** | (26.7995)*** |
| VFI | | | 0.0091 | 0.0109 |
| | | | (1.1131) | (1.3244) |
| gk × VFI | | | −0.0115 | −0.0121 |
| | | | (−1.8125)* | (−1.8812)* |
| LGFS | | | | 0.0018 |
| | | | | (2.7036)*** |
| gk × GFS | | | | 0.0002 |
| | | | | (0.4598) |
| R-Squared | 0.9995 | 0.9312 | 0.9994 | 0.9994 |
| Adj. R-Squared | 0.9984 | 0.8258 | 0.9992 | 0.9992 |

*Note:* *, **, and *** denote statistical significance at 10%, 5%, and 1%. Lyl: logarithm of output per labor; Lkl: logarithm of capital per labor; Lhl: logarithm of human capital; Gy: green economic growth per labor; Gk: green capital per labor; Gh: green human capital per labor; VFI: vertical fiscal imbalance; Gk × VFI: interaction between green capital per labor and vertical fiscal imbalance; LGFS: logarithm of green fiscal spending; and Gk × LGFS: interaction between green capital per labor and green fiscal spending.

DOLS accepts it. Based on the DOLS results, an increase in green fiscal spending is associated with an increase in green economic growth. Conversely, the interaction between green capital per labor and green fiscal spending is not significant in the DOLS model for green economic growth, whereas in the FMOLS model, it has a positive, significant effect on green economic growth. Thus, *H6* is accepted by FMOLS and rejected by DOLS. As green fiscal spending increases, the positive effect of green capital per labor on green economic growth per labor will strengthen.

# 4. DISCUSSION

This study shows that capital and human capital exert opposite influences on economic growth. Capital per labor has a positive effect on growth per labor. In addition, this study shows that the effect of capital per labor on economic growth is initially small. When the physical capital base is high, it results in a smaller increase in output or diminishing marginal returns of capital. These finding showing the significance of capital in explaining economic growth are highly correlated to the research findings by Roufagalas and Orlov (2020) in developing countries; Ngepah et al. (2021) in South Africa; Ghosh and Parab (2021) in India; Zhang and Wang (2021) in China; Matousek and Tzeremes (2021) in 100 world countries; and Duan et al. (2022) in BRICS countries.

Human capital per labor has a negative impact on growth per labor. According to United Nations Development Programme (UNDP, 2025), Indonesia ranks 113th globally in human capital, leading to low productivity. The impact of efforts to improve the quality of education and health on human capital cannot be realized immediately in terms of output growth, but these improvements require a longer process. These research findings are supported by the findings of Vijaya Kumar and Balu (2024) and Zhang and Wang (2021). Vijaya Kumar and Balu (2024) in India emphasized that human capital is underutilized, and Zhang and Wang (2021) confirmed that low human capital hinders economic convergence.

Following the extension of the research model to the green economic growth model of this study, green capital per labor and green human capital per labor are used as predictor variables in Model II. The estimation results show that green capital per labor and green human capital per labor drive green economic growth. The use of green capital indicates a more environmentally friendly investment, as its output has a minimal ecological impact. Green human capital refers to the quality of labor with environmental awareness, enabling production activities to be carried out in line with environmental sustainability. Therefore, investment in human capital is highly relevant to important environmental issues in green economic growth. These results are similar to those of Pal et al. (2024), Hussain et al. (2022), Yusliza et al. (2020), and Capasso et al. (2019), which show that green capital and green human capital are integral parts of green economic growth.

According to Model III (FMOLS and DOLS methods), vertical fiscal imbalance is not significant for green economic growth. In addition, Model III shows that vertical fiscal imbalance is a pure moderator variable: it has no direct effect on green economic growth ($p$-value > 0.1), but its interaction with green capital per labor does (FMOLS $p$-value: < 0.05 and DOLS $p$-value: < 0.1). The interaction between green capital per labor and vertical fiscal imbalance negatively affects green economic growth because vertical fiscal imbalance creates barriers to the effective allocation and use of green capital. High vertical fiscal imbalance must be reduced by strengthening local governments' financial capacity and encouraging collaboration between central and local governments to support green economic growth. This finding is supported by Tawiah et al. (2021), who show that the quality of government institutions – in this context, vertical fiscal imbalance – does not affect green economic growth. In contrast, Lin and Zhou (2021a) highlighted that vertical fiscal imbalance hinders economic development (industrial structure and technological innovation), thereby harming environmental efficiency. Next, Lin and Zhou (2021a) and Wei et al. (2021) show that vertical fiscal imbalance contributes to increased environmental degradation in developing countries.

Based on DOLS estimation, the results of Model IV show that green fiscal spending positively affects green economic growth. The governments can invest to ensure environmental sustainability. Based on FMOLS estimation, Model IV shows that green fiscal spending acts as a pure-moderator variable: green fiscal spending has no direct effect on green economic growth ($p$-value: > 0.1), and its interaction with capital per labor is significant on green economic growth ($p$-value: < 0.01). It is evident that green fiscal spending internalizes vertical fiscal imbalance by mitigating its negative impact on green economic growth. This is illustrated when the magnitude of green capital per labor which is multiplied by vertical fiscal imbalance in Model III is smaller than the magnitude of green capital per labor which is multiplied by vertical fiscal imbalance in Model IV. Green fiscal spending can help overcome market failures by incentivizing private-sector investment in green technology. As green fiscal spending is inte-


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grated into the model (i.e., Model IV), the impact of green capital per labor decreases substantially. This result suggests that green fiscal spending may reduce the efficiency of the green capital impact in promoting green economic growth. High green fiscal spending can cause "crowding out" of a country's economy. This stifles innovation and reduces the private sector's initiative to promote green economic growth. Therefore, it is essential to balance government support and incentives to sustainably grow private-sector investment in green capital. Similar findings were confirmed by Mensah et al. (2019) and Lin and Zhu (2019), who found that environmental budgets were beneficial for achieving green economic growth.

## CONCLUSION

The objective of this study is to investigate the impact of vertical fiscal imbalance and green fiscal spending on green economic growth in Indonesia during the period 2010 to 2022. FMOLS and DOLS results show that green capital and green human capital have a significant positive effect on green economic growth. Vertical fiscal imbalance negatively impacts green economic growth. Vertical fiscal imbalance reduces the efficiency of green capital per labor, thus impeding green economic growth. Green fiscal spending is found to have a positive impact on green economic growth in the presence of supporting government investment in green technology and infrastructure. The significant contribution of green capital to green economic growth is reduced in the presence of green fiscal spending due to crowding out the private sector and creating greater dependence on the government.

This paper explicitly highlights the crucial role of balanced fiscal capacity at various levels of government to support green economic growth by emphasizing the importance of a pro-environment fiscal policy. Policy recommendations that can be proposed are as follows. First, strengthening the government's fiscal capacity by exploring economic potential can increase local revenue, as well as a more equitable fiscal distribution is needed, so that local governments do not lose focus on green economic growth. Second, avoiding crowding-out with local and central government strategies must be able to balance green fiscal spending with private contributions in green investment, for example by providing incentives for the private sector to develop green projects. Finally, human resource development in the environmental dimension will increase the concern for sustainable environmental sustainability.

Future research may investigate the role of institutional quality in developing economies to provide broader evidence on the determinants of green economic growth.

## AUTHOR CONTRIBUTIONS

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# APPENDIX A

**Table A1.** Carbon offsets and carbon emissions in Indonesia

| Year | Carbon Offsets | | | Carbon Emissions | | |
|---|---|---|---|---|---|---|
| | Carbon Offsets (Gg CO2) | Number of Prov. | Province. | Carbon Emissions (Gg CO2) | Number of Prov. | Provinces. |
| 2010 | (287,915.25) | 9 (27.27%) | PPB; PPA; MLK; MLU; SLG; SLB; GRT; SLB; GRT; SLT; SLU | 1,137,784.10 | 24 (72.73%) | KPR; BKL; NTT; BBL; SMB; KLR; DIY; SLS; NTB; BTN; ACH; JKT; LMP; KLS; SMU; JTG; JBR; SMS; KLT; BLI; JTM; RIA; KLB; JMB |
| 2011 | (280,146.19) | 10 (30.30%) | PPB; PPA; MLK; MLU; SLG; SLB; NTT; GRT; SLT; SLU | 1,304,481.98 | 23 (69.70%) | BKL; BBL; SLS; SMB; NTB; KLR; DIY; ACH; KPR; BTN; JKT; LMP; SMU; KLS; JBR; SMS; JTG; KLB; KLT; BLI; JTM; RIA; JMB |
| 2012 | (281,729.94) | 9 (27.27%) | PPB; PPA; MLK; MLU; SLG; SLB; GRT; SLT; SLU | 1,209,171.99 | 24 (72.73%) | KPR; NTB; DIY; ACH; BKL; NTT; BBL; BTN; SLS; SMB; LMP; SMU; JKT; KLS; KLR; JMB; KLB; SMS; JTG; KLT; KLT; JBR; BLI; JTM; RIA |
| 2013 | (277,320.50) | 6 (18.18%) | PPB; PPA; MLK; MLU; SLB; SLU | 1,461,811.03 | 27 (81.82%) | GRT; SLT; KPR; BKL; NTB; BBL; DIY; ACH; NTT; SMB; BTN; SLS; LMP; SLG; SMU; KLS; JKT; KLR; JMB; JBR; JTG; SMS; KLT; BLI; JTM; KLB; RIA |
| 2014 | (163,852) | 7 (21.21%) | PPA; PPB; MLK; MLU; SLB; GRT; SLT | 1,387,077.03 | 26 (78.79%) | SLU; ACH; NTB; SMB; BKL; KPR; DIY; BBL; BTN; SLS; SLG; NTT; SMU; JKT; KLS; JMB; KLR; LMP; KLB; SMS; JTG; JBR; BLI; JTM; KLT; RIA |
| 2015 | (122,466.72) | 5 (15.15%) | PPA; PPB; MLK; SLU; MLU | 10,448,867.68 | 28 (84.85%) | SLB; KPR; GRT; SLT; SLG; BTN; BKL; SMB; DIY; SLS; NTT; LMP; BBL; JKT; JMB; ACH; SMU; NTB; KLR; KLS; KLB; JBR; JTG; BLI; JTM; SMS; RIA; KLT |
| 2016 | (239,947.40) | 6 (18.18%) | PPA; JMB; PPB; MLU; MLK; SLU | 9,822,534.37 | 27 (81.82%) | GRT; SLT; BTN; BBL; BKL; KPR; SMB; DIY; SLB; SLG; LMP; NTT; NTB; SLS; JKT; ACH; KLS; SMU; JBR; KLR; JTG; KLB; BLI; JTM; SMS; RIA; KLT. |
| 2017 | (119,097.61) | 4 (12.12%) | PPA; MLU; MLK; SLU | 16,255,320.32 | 29 (87.88%) | GRT; SLT; BKL; SLB; BTN; ACH; SLG; KPR; NTT; BBL; SMB; DIY; LMP; NTB; JKT; SLS; KLS; JBR; KLR; SMU; JTG; SMS; BLI; JTM; JMB; RIA; KLB; PPB; KLT. |
| 2018 | (39,568.40) | 5 (15.15%) | KPR; MLK; MLU; SMB; SLB | 16,737,734.87 | 28 (84.85%) | PPB; GRT; SLT; SLG; BKL; NTT; SLU; DIY; ACH; PPA; NTB; BBL; BTN; SMS; JMB; SLS; JKT; KLS; LMP; JBR; JTG; KLR; SMU; KLB; BLI; JTM; RIA; KLT |
| 2019 | (60,210.33) | 6 (18.18%) | PPB; MLK; MLU; SLU; KPR; SLB | 19,950,559.62 | 27 (81.82%) | SLG; BBL; GRT; SLT; BKL; PPA; SMB; DIY; NTT; ACH; NTB; LMP; JKT; SLS; KLS; JMB; KLR; SMU; BTN; JBR; JTG; KLB; BLI; JTM; SMS; RIA; KLT. |
| 2020 | (111,583.37) | 6 (18.18%) | BLI; JTM; MLU; MLK; SLU; BKL | 3,619,426.37 | 27 (81.82%) | SLB; KPR; SLG; ACH; BTN; BBL; PPA; SMB; NTT; DIY; GRT; SLT; NTB; JMB; SLS; LMP; KLB; KLS; KLR; JKT; SMU; JTG; SMS; JBR; RIA; PPB; KLT. |
| 2021 | (96,953.49) | 5 (15.15%) | BLI; JTM; MLK; KPR; SLB | 1,290,468.24 | 28 (84.85%) | NTB; SLU; BKL; SLG; NTT; GRT; SLT; BTN; DIY; PPA; BBL; SMB; ACH; KLR; JMB; SLS; LMP; KLS; KLB; SMU; JBR; JKT; JTG; SMS; MLU; KLT; PPB; RIA |
| 2022 | (21,653.43) | 6 (18.18%) | MLK; SLU; GRT; SLT; SLB; BKL | 986,613.47 | 27 (81.82%) | SMB; KPR; PPB; JKT; NTB; BTN; DIY; SLG; PPA; NTT; BBL; ACH; KLB; JMB; LMP; KLS; SLS; KLR; MLU; SMU; BLI; JTM; JBR; KLT; JTG; SMS; RIA |

*Note:* ACH: Aceh; BLI: Bali; BBL: Bangka Belitung; BTN: Banten; BKL: Bengkulu; DIY: DI Yogyakarta; JKT: DKI Jakarta; GRT: Gorontalo; JMB: Jambi; JBR: Jawa Barat (West Java); JTG: Jawa Tengah (Central Java); JTM: Jawa Timur (North Java); KLB: Kalimantan Barat (West Kalimantan): KLS: Kalimantan Selatan (South Kalimantan): KLT: Kalimantan Tengah (Central Kalimantan); KLR: Kalimantan Timur (North Kalimantan); KPR: Kepulauan Riau (Riau Islands); LMP: Lampung; MLK: Maluku; MLU: Maluku Utara (North Maluku); NTB: Nusa Tenggara Barat (West Nusa Tenggara); NTT: Nusa Tenggara Timur (West Nusa Tenggara); PPA: Papua; PPB: Papua Barat (West Papua); RIA: Riau; SLB: Sulawesi Barat (West Sulawesi); SLS: Sulawesi Selatan (South Sulawesi); SLT: Sulawesi Tengah (Central Sulawesi); SLG: Sulawesi Tenggara (Southeast Sulawesi); SLU: Sulawesi Utara (North Sulawesi); SMB: Sumatera Barat (West Sumatera); SMS: Sumatera Selatan (South Sumatera); SMU: Sumatera Utara (North Sumatera).


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**Table A2.** Fiscal imbalance in Indonesia

| Year | Vertical fiscal imbalance > 0 | | Vertical fiscal imbalance < 0 | |
|---|---|---|---|---|
| | Number of Provinces | Provinces | Number of Provinces | Provinces |
| 2010 | 7 (21.21%) | SLG; KLB; LMP; BLI; BTN; PPB; JMB | 26 (78.78%) | SLB; NTT; DIY; PPA; ACH; RIA; KLS; KLR; BKL; BBL; JKT; SMU; MLK; MLU; JTM; GRT; JBR; KLT; KPR; JTG; NTB; SLS; SLU; SLT; SMB; SMS |
| 2011 | 13 (39.39%) | LMP; ACH; BKL; SLU; JMB; SLB; BLI; DIY; PPA; KLS; SMB; BBL; MLK | 20 (60.60%) | KLB; BTN; SMS; JKT; SLG; JTG; KLT; GRT; PPB; NTT; JBR; RIA; KPR; JTM; SMU; NTB; MLU; SLS; KLR; SLT |
| 2012 | 14 (42.42%) | ACH; LMP; JTG; SLG; BBL; DIY; JTM; PPA; GRT; BTN; PPB; KLS; NTT; KLT | 19 (57.57%) | SLB; BLI; JBR; KLB; BKL; JMB; SMU; MLK; RIA KLR; JKT; KPR; MLU; SLT; SLU; SMS; SLS; SMB; NTB |
| 2013 | 7 (21.21%) | BLI; BTN; JKT; JTG; GRT; BKL; JMB | 26 (78.78%) | JTM; ACH; PPB; DIY; KLS; NTB; BBL; KPR; KLR; KLB; PPA; SMU; MLK; SLB; NTT; RIA; SLS; JBR; KLT; LMP; SMS; MLU; SLU; SMB; SLT; SLG |
| 2014 | 7 (21.21%) | BBL; BLI; JKT; JTG; JTM; PPB; KLS | 26 (78.78%) | KLB; GRT; DIY; KLR; SLU; JMB; BTN; ACH; NTB; NTT; JBR; SMS; PPA; LMP; SLB; MLU; KLT; RIA; KPR; BKL; MLK; SMB; SMU; SLS; SLG; SLT |
| 2015 | 11 (33.33%) | KLR; JKT; JTM; ACH; NTB; BLI; BTN; KPR; GRT; KLT; JTG | 22 (66.66%) | JMB; NTT; KLB; BKL; KLS; LMP; BBL; DIY; SLU; JBR; MLK; RIA; SMU; PPA; PPB; SLB; SMS; MLU; SLG; SLT; SLS; SMB |
| 2016 | 9 (27.27%) | NTB; KLT; SMB; BBL; ACH; DIY; KLR; PPB; BTN | 24 (72.72%) | MLU; JTG; NTT; BLI; KLB; BKL; MLK; RIA; JKT; KLS; JMB; LMP; KPR; JTM; PPA; JBR; SLS; GRT; SLT; SLB; SMU; SMS; SLU; SLG |
| 2017 | 9 (27.27%) | KLT; BLI; DIY; SMB; SLT; PPA; NTB; JTG; ACH | 24 (72.72%) | PPB; BTN; GRT; JBR; SLU; MLU; KLS; BKL; JTM; LMP; JMB; KLR; JKT; SMU; RIA; NTT; BBL; KPR; SLS; SMS; MLK; SLB; SLG; KLB |
| 2018 | 9 (27.27%) | MLU; BBL; GRT; ACH; SMU; NTB; JBR; NTT; BKL | 24 (72.72%) | KLR; KLT; RIA; JMB; JKT; BLI; PPB; JTG; DIY; KPR; SMS; PPA; BTN; KLS; KLB; SMB; MLK; JTM; SLU; SLT; SLG; SLB; SLS; LMP |
| 2019 | 11 (33.33%) | ACH; GRT; BLI; BKL; BTN; DIY; KLS; BBL; JTG; KLB; PPB | 22 (66.66%) | MLU; NTB; SLU; KPR; KLR; JBR; JMB; SMS; RIA; KLT; JKT; NTT; LMP; JTM; MLK; SMB; SLS; SLG; SLT; SLB; SMU; PPA |
| 2020 | 8 (24.24%) | GRT; BBL; JMB; JTG; KLB; NTB; DIY; JBR | 25 (75.75%) | KLS; PPA; BTN; BKL; KLT; ACH; PPB; LMP; SMS; KLR; JTM; MLU; SLG; BLI; JKT; KPR; RIA; MLK; SMU; NTT; SMB; SLT; SLB; SLU; SLS |
| 2021 | 9 (27.27%) | JMB; BTN; KLB; PPA; KLS; KLR; JTM; BKL; ACH | 24 (72.72%) | JTG; GRT; DIY; SLS; LMP; KLT; JBR; PPB; RIA; NTT; BBL; JKT; KPR; BLI; SMS; NTB; SMB; MLU; MLK; SMU; SLG; SLB; SLT; SLU |
| 2022 | 10 (30.30%) | KLB; KLS; BBL; JTM; LMP; PPA; PPB; ACH; JMB; DIY | 23 (69.69%) | NTB; KLR; JBR; GRT; BKL; KPR; KLT; SLT; RIA; BLI; JKT; BTN; JTG; NTT; SLU; MLU; MLK; SMS; SMU; SMB; SLG; SLS; SLB |

*Note:* ACH: ACH: Aceh; BLI: Bali; BBL: Bangka Belitung; BTN: Banten; BKL: Bengkulu; DIY: DI Yogyakarta; JKT: DKI Jakarta; GRT: Gorontalo; JMB: Jambi; JBR: Jawa Barat (West Java); JTG: Jawa Tengah (Central Java); JTM: Jawa Timur (North Java); KLB: Kalimantan Barat (West Kalimantan): KLS: Kalimantan Selatan (South Kalimantan): KLT: Kalimantan Tengah (Central Kalimantan); KLR: Kalimantan Timur (North Kalimantan); KPR: Kepulauan Riau (Riau Islands); LMP: Lampung; MLK: Maluku; MLU: Maluku Utara (North Maluku); NTB: Nusa Tenggara Barat (West Nusa Tenggara); NTT: Nusa Tenggara Timur (West Nusa Tenggara); PPA: Papua; PPB: Papua Barat (West Papua); RIA: Riau; SLB: Sulawesi Barat (West Sulawesi); SLS: Sulawesi Selatan (South Sulawesi); SLT: Sulawesi Tengah (Central Sulawesi); SLG: Sulawesi Tenggara (Southeast Sulawesi); SLU: Sulawesi Utara (North Sulawesi); SMB: Sumatera Barat (West Sumatera); SMS: Sumatera Selatan (South Sumatera); SMU: Sumatera Utara (North Sumatera).