

The Effect of Environmental Tax-Spending Mix on Province Air Quality Index

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Abstract

The provincial government in Indonesia has been mandated to collect environmental-related taxes in recurrent vehicle taxes, vehicle transfer taxes, and gasoline taxes. These vehicle-related taxes have been the dominant type for the provincial government. Yet, the environment-related spending has been relatively low, within 1-3% of total expenditures. This study examines to what extent such environmental tax-spending mix affects the environmental outcomes measured by the air quality index. The novelty of this study comes in using detailed environmental-related tax revenues at the sub-national level and providing a context of the large developing country in a decentralized economy – Indonesia – as a case study. Our study finds the link between environmental tax in the case of the vehicle recurrent tax and gasoline tax in improving air quality and environmental quality index, respectively. But on the spending side, there is no evidence that provincial environmental spending may improve the air or environmental quality index. Nonetheless, we found a correlation between the vehicle transfer tax revenues and the share of province environmental spending, implying that environmental tax revenues, to some extent, correspond to the related provincial expenditures on environmental protection. This study signals the need also to expand environmental spending to complement existing environmental tax policy at the provincial level.

Keywords:

environmental taxes; vehicle-related taxes; sub-national level; air quality; environmental spending

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INTRODUCTION

Environmental-related taxes can be loosely defined as taxes levied on goods and or services related to environmental depletion, such as pollution, resource exploitation, and waste, and or direct taxes on those environmental "bads" (Bosquet, 2020). For example, carbon-related and or emission taxes can be viewed as an environmental type of tax as the objective is to reduce emissions linked to pollution. The tax levied on goods and services perceived to emit high emissions is referred to as the output type of tax. In contrast, the taxes that are directly imposed on emissions perceived to be harmful to the environment are the scope of carbon emission type of tax. Taxing this so-called negative externality has been long adopted in Indonesia, though the channel is through output taxes.

The recent initiative to adopt carbon tax at the central level, as stipulated in Law 7 2021, complemented an already existing type of tax that can also link to mitigating emissions at the lower government level. For example, some of the taxes levied at the provincial level may indirectly mitigate carbon emissions. At the provincial level, there are taxes on recurrent annual vehicles tax. The vehicle registration tax refers to the tax levied when there is a change in vehicle ownership and, to some extent, gasoline taxes. Although there is a subsidy at the national level for gasoline consumption, the provinces still receive tax revenues that are based on gasoline consumption at the gas (pump) station in the respective province. In addition to tax instruments, the government also implemented programs related to environmental protection. By the function of spending, spending is allocated for environmental protection at the central and lower-level governments.

This study aims to investigate the relationship between the presence of environmental tax and spending on air quality at the subnational level. We use Indonesia, a developing country that has introduced environmental tax and spending at the provincial level since the introduction of the decentralization era. Environmental protection in Indonesia is conducted not only by the national or central government but also by the lower-level governments. As a country with three tiers of government, the central – provincial – and local governments (municipalities or cities level of government), the policies on environmental protection naturally translated in the form of taxes and expenditure policies at central and lower-level governments. However, the discussion in the existing literature, for the case of Indonesia, referring to the context of its multi-level government, rarely discusses tax policies and their link to government spending despite the nature and type of taxes and functional spending assigned to lower-level government.

Vehicle-related provincial taxes are a significant type of tax for most provinces in the context of provincial tax revenue composition. The aggregate share of these vehicle-related taxes is 70-80% of provincial government tax revenues. However, for the spending side, referring to environmental spending, the provinces' average share of environmental spending is just less than 1% of the total budget. This relatively small spending share limits the coverage and program of environmental protection by the lower-level government, the provincial, and or local governments.

In terms of environmental outcomes, the government has regularly issued provincial-level environmental quality indexes since 2009. This environmental quality index consists of a water quality index, an air quality index, and a land quality index. The environmental spending at both provincial and local governments is mainly in the form of spending on waste and sanitation. Thus, its linkages with water and land quality could be more apparent. Meanwhile, the air-quality index can be attributed to the vehicle-related taxes' main objective.

This study extends the ongoing literature in several areas. First, existing literature on the impact of environmental taxes and or environmental spending is primarily discussed in terms of type or specific program assessment referring to taxes or expenditure-related policies (Fullerton & Muelegger, 2019; Kaufmann, 2019; Kulin & Seva, 2019; Fairbrother, 2017). Regarding the tax-spending mix, only a few studies conducted taxes and spending as part of policy option assessment (Sommer et al., 2022). This paper uses Indonesia as a case study to bring a significant developing country context in a decentralized economy.

The working of policies may be inter-related, as policies on taxation may also function as a disincentive to emit emissions and or reduction in the consumption and or ownership of the respective goods and services perceived to contribute to carbon emission affecting as well not only private but also government response in terms of its public spending (Aydin & Esen, 2018; Safi et al., 2021). Given this context, the second research gap of this study is to understand which instruments, environmental-related taxes, and or the spending program on the environment may contribute to improving environmental protection indicators.

Prior studies in Indonesia, most of them separately, address the impact of sub-national level environmental spending or particular sub-national government revenues on the outcome of environmental protection (Mutiarra et al., 2021; Cadman et al., 2019). The environmental protection outcome that is used in those studies is mainly on the forestry-related outcome, which is generally only applied to some regions, especially provinces with large urban areas. The novelty of our study is examining a more general context of the sub-national government's intervention by linking the use of environmental-related taxes/revenues with the spending allocation in the respective sector.

This study is limited to the provincial level given the environmental type of taxes are relatively dominant taxes for the provinces rather than local governments. As we do not include the environmental taxes of the municipalities, the spending correspondence in this study is only assessed at the level of the provincial government as well. This study is structured as follows. Section 2 explains the data and method. Section 3 discusses and analyzes the empirical result. The last section concludes the paper.

METHODS

The estimation model uses the panel fixed effect model with provincial environmental quality index and provincial air quality index as the dependent variables. The following is the estimation model:

$$Y_{it} = \alpha_i + \theta S_{it} + \sum \beta_j T_{it}^j + \sum \gamma_k X_{it}^k + e_{it} \quad (1)$$

Our Y_{it} represents environmental outcome, i.e environmental quality index or air quality index in the province i at year t , S_{it} is the environmental protection spending size of the province i at year t (% to total spending, current year or one-year lag). T_{it}^j is per capita environmental taxes of type j referring to either vehicle recurrent tax, vehicle transfer tax, or gasoline tax of province i at year t . X_{it} represents other explanatory variables. e_{it} is the error term.

As shown in the estimation model, in addition to the variable of interest from the type of environmental taxes, another variable of interest is the related provincial spending variable. Therefore, the variable of interest is the share of environmental spending from the total provincial spending and per capita vehicle-related taxes. The share of environmental spending is assumed to have a positive relationship with environmental outcome indicators. Previous studies show that it is the share of the spending and not per se the level of spending that affected improved environmental outcomes (Lopez et al., 2011). Meanwhile, per capita type of taxes is frequently used in analyzing lower-level government type of taxes, generally based on consumption and or considered as community type of taxes. For these vehicle-related tax variables, we used per capita type of taxes in the estimation models as explanatory variable(s). The impact of the sub-national vehicle-related taxes may reduce emissions through lower utilization and or ownership of vehicles. As in the case of provincial environmental spending, the spending program may also target reducing pollution or, in general, improving the environmental quality.

As the type of province taxes are not earmarked directly to the spending related to provinces' spending on environmental protection, we may assume that the spending on environmental protection is independent of the province tax revenues, especially on vehicle-related taxes. However, there is also plausibility that the related province tax revenues may also influence the size of the environmental protection spending of the respective government. To incorporate a plausible link between the tax and spending policy on environmental protection, we also use a panel tobit estimation on identifying which factors affect the share of environmental spending as the sub-national level of government applies a balanced budget approach. An increase in tax revenues referring to vehicle-related tax revenues may drive spending, including a share of provincial spending on the environment. Below is the estimation model for environmental protection spending:

$$S_{it} = \delta + \sum \gamma_j T_{it}^j + \sum \beta_l Z_{it}^l + u_{it} \quad (2)$$

where Z_{it} is other explanatory variables and u_{it} is the error term.

For the above estimation model (1) and (2), the data started from 2015 as before that year there is the issue of a new province – referring to the establishment of the province of North Kalimantan. For the estimation model (1), the dependent variables are the environmental-related outcome data which consist of the environmental quality index and air quality index issued by the Central Bureau of Statistics. To note, the use

of the general index of environmental quality and a specific index of air quality, as discussed, is due to the characteristic of the provincial taxes which are dominated by the vehicle-related taxes, and in the context of environmental spending – at the provincial level, may also be used for other than programs intended directly to improve air quality. Examples of sectors that are also managed at the provincial level related to environmental protection programs are water basin management and CO₂ emission planning (ADB, 2016; Qibthiyyah, 2019). In the case of subnational level tax revenues data by type of taxes, relatively complete data is only available for the last ten years.

RESULT AND DISCUSSION

For the three types of vehicle taxes, adopting vehicle recurrent tax and vehicle transfer tax may affect environmental and air quality, possibly due to changes in the number of registered vehicles irrespective of usage. In the case of the gasoline tax, as gasoline is subsidized, it generally links to vehicle usage, and gasoline, to some extent, reflects vehicle usage. The estimation results in Table 1 show a correlation between higher per capita recurrent vehicle taxes and improvement in the province's environmental quality index, specifically in the provincial air quality index. The recurrent vehicle tax is the most dominant type of tax for the provinces and is a relatively stable type of revenue. From the air quality index estimation, an increase of 100 thousand IDR per capita of vehicle recurrent tax may improve the air quality index by 5.2 points of the index.

Given that the average of per capita recurrent vehicle taxes is 131.74 thousand IDR (see Annex), there is a need for a significant increase in vehicle tax revenues to increase the province's air quality index significantly. A positive correlation between per capita vehicle recurrent tax revenues and air quality index indicates that a higher number of registered vehicles may not deteriorate air quality if it is dominated by relatively low-emission vehicles. For example, in the case of European countries, the number of vehicles on gasoline consumption has a negative effect, implying there may be a more efficient gasoline consumption from existing registered vehicles (Zimmer & Koch, 2017).

However, from the estimation of a broader outcome, the province environmental quality index, the result in Table 1 shows no effect of per capita vehicle recurrent tax. The per capita gasoline tax tends to link with the province's environmental quality index, although the effect is still relatively small. An increase of 100 thousand IDR per capita in gasoline tax only increases around 2.3 points of the province's environmental quality index. The positive correlation of per capita gasoline tax to both outcome, air quality index, and environmental quality index, as shown in Table 1 estimation results of model 1a and 1b respectively, implies that provinces with higher per capita gasoline revenues may also have higher environmental and air quality index. The results are as expected if the gasoline tax revenue increase comes from a type of gasoline that may be relatively cleaner or the type the central government does not subsidize. As a note, the gasoline taxes received by the provinces are based on retail (pump station) sales, consisting of subsidized and non-subsidized gasoline. Thus, increasing per capita gasoline taxes may indicate lower

consumption, assuming higher prices, possibly from non-subsidized gasoline, or an increase in cleaner gasoline consumption, emitting lower carbon emissions.

From the estimation results in Table 1, the vehicle transfer taxes show contradictory implications, as the higher per capita vehicle transfer tax would instead be associated with lower environmental performance for the respective provinces. The negative coefficient of vehicle transfer taxes, as shown in the estimation results of the province environmental quality index and the province air quality index, is puzzling. The vehicle transfer tax rates are progressive, and there could be a condition in which secondary vehicle ownership then shifted to a lower price of vehicles that may instead have higher emissions, or there could also be the ineffectiveness of demand management policies in the transportation sector affecting instead an increase in vehicle ownerships, such as on the policy of odd-even to mitigate road congestion (Yudhistira et al., 2019).

Table 1. The Effect of Environmental Tax on Environmental Quality

	Air Quality Index (1a)	Environmental Quality (1b)	Share of Environmental Spending (2)
Per Capita Vehicle Recurrent Tax	0.053* (0.016)	0.012 (0.021)	
Per Capita Vehicle Transfer Tax	-0.0067*** (0.012)	-0.076*** (0.017)	
Per Capita Gasoline Tax	0.007*** (0.006)	0.023*** (0.008)	
Lag of Share Environmental Spending	0.006 (0.452)	-0.070 (0.599)	
Population	6.602** (1.996)	-4.35* (2.644)	-0.0001 (0.0001)
Population Square	-0.089 (0.029)	0.089** (0.039)	
Per Capita GRDP	0.081 (0.093)	0.087 (0.122)	0.0424 (0.037)
Per Capita GRDP Square	-0.00004 (0.0002)	0.00002 (0.0003)	
Vehicle Recurrent Tax			0.00027** (0.0001)
Vehicle Transfer Tax			0.00045*** (0.0001)
Gasoline Tax			-0.0005*** (0.00017)
Observations	164	164	193
R-squared	0.55	0.33	
Log Likelihood			-282.744

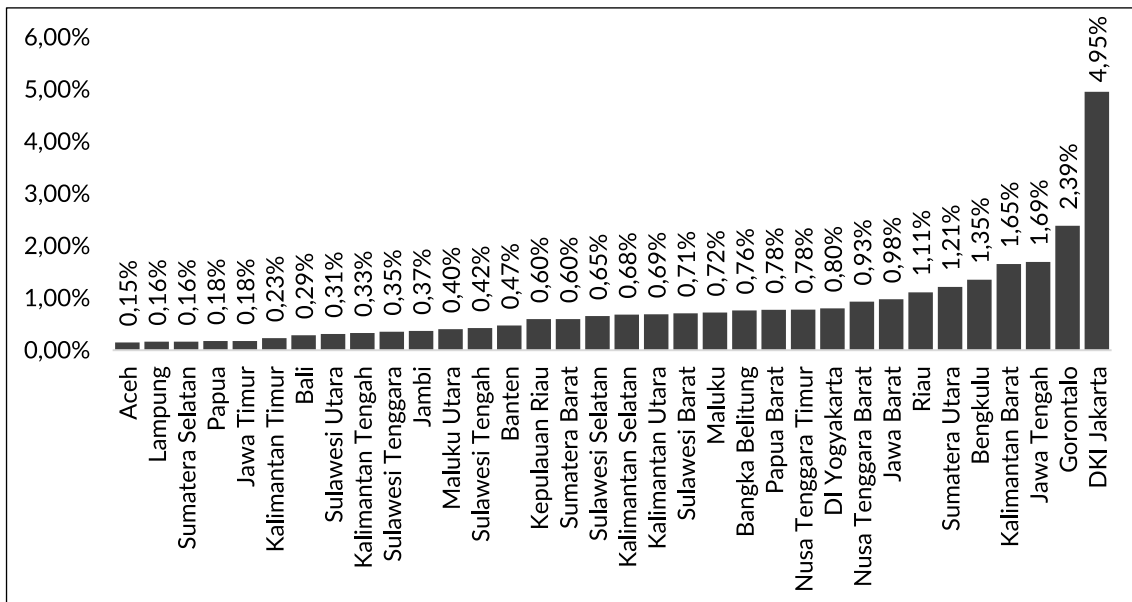
The figures in parentheses indicate the standard error. *, **, *** represent significance at the level of 10%, 5% and 1%, respectively.

Source: Author's Calculation Results (2023).

Overall, our results on the effectiveness of the three vehicle-related taxes complemented existing studies from other countries that investigate the link of vehicle-related taxes to environmental outcomes such as air quality or carbon emission (Lo et al., 2022; Moz-Christofoletti & Pareda, 2021; Streinsland et al., 2018). Our study, in terms of the effectiveness of vehicle recurrent tax and gasoline tax, is in contrast with the study by Lo et al. (2022) that shows no effect of vehicle recurrent tax and gasoline tax in reducing air pollution in the case of China. Meanwhile, Moz-Christofoletti and Pereda (2021), based on a case study of Brazil, and Steinsland et al. (2018), based on a case study of Norway, shows the effectiveness of fuel tax in reducing carbon emission and that the taxes tend to welfare improving for the case of Norway. However, it is a regressive tax in the case of Brazil.

In the context of provincial environmental spending, the coefficient of provincial environmental spending is insignificant from the estimation model of the province air quality index and the province environmental quality index. A low share of environmental spending at the provincial level, which is on average 0.8% for 2015-2020, as shown in Figure 1, may contribute to its ineffectiveness for improving the environmental quality index and in the context of province air quality. Based on the estimation result in Table 1, an additional 1% of the previous year's environmental spending would not translate to an increase in the province air quality index or province environmental quality index, as in both estimation results, the coefficient of environmental spending share is not statistically significant. These results may reflect a condition in which fiscal instrument in terms of spending is not directly allocated for the impacted agents, resulting in unclear performance indicators of the respective spending function.

Figure 1. Share of Environmental Spending (Average 2015-2020)



Source: Authors' calculation from Provincial Finance Statement (Ministry of Finance)

The per capita GRDP does not significantly affect environmental quality outcomes on other explanatory variables. It is the province's population size that may have an impact

on the province's environmental quality index. Provinces with a relatively low population may experience an increase in population size correlated with higher environmental quality. However, the correlation is reversed for the provinces with a relatively high population. These estimation results signal the inverse Kuznet effect between population size and environmental protection. Urbanization for the provinces that have not reached a threshold level is somehow beneficial for environmental protection improvement, referring to the improvement in the environmental quality index.

Furthermore, the estimation results, shown in Model 2 in Table 1, found a significant correlation between vehicle-related tax revenues and provincial environmental spending. The provinces with high vehicle-related tax revenues referring to vehicle transfer tax and recurrent vehicle tax revenues will tend to have a higher share of environmental spending. However, a negative correlation exists between gasoline tax revenues and the share of environmental spending. As the magnitude of the coefficient is relatively small, only provinces with very high revenues from these taxes may also have a corresponding high share of environmental spending. The share of environmental spending is the percentage of environmental spending from total spending, showing the government's commitment to this area in terms of spending allocation.

Our estimated results show that tax revenues are still an important aspect that needs to be mobilized. In the case of vehicle-related taxes, the taxes revenue of vehicle recurrent tax is also an objective of the government. Thus, the relief of taxes for low-emission vehicles when it is levied through the scheme of vehicle recurrent taxes needs to be ensured that it will not have a long-term impact on the reduction in tax revenues. To a degree, this vehicle recurrent tax, from our study, also shows a positive correlation with provincial government spending for environmental protection. The spending on environmental protection has been relatively low at the provincial level, within 1-3% of total spending. In the case of Indonesia, there is no fiscal rule on environmental spending despite extensive environmental-related tax instruments assigned to lower-level governments. The environmental tax-spending mix has the potential to scale up environmental protection efforts.

Even though the role of provincial spending referred to the share of the environment has not significantly affected related environmental indicator outcomes, our study finds the link between province environmental spending and its environmental-related taxes. Based on 2015-2020 provincial-level data, the correlation between environmental taxes of vehicle recurrent taxes and vehicle transfers tax with the provincial environmental spending size is positive, netting out the negative correlation of the gasoline tax. Our studies show that these environmental taxes potentially promote a higher share of provincial expenditure on the environment. The results imply how vehicle transfer tax correlates to the size of province spending for environmental protection. Therefore, this study signals the need to expand environmental spending to complement existing environmental tax policy at the provincial level. In addition to an increase in tax revenues, the taxes may somehow still improve environmental outcome, as have been shown in studies on other countries: Denmark, Norway, and China (Yan & Eskeland, 2018; Ciccone, 2018; Mabit & Fosgerau, 2011; Liu, 2023).

CONCLUSION

Our study explores the effect of taxes and spending on environmental protection outcome indicator(s). The provincial government in Indonesia collected taxes that can be referred to as environmental-related taxes, such as vehicle, vehicle transfer, and gasoline taxes. These vehicle-related taxes have been the dominant type of taxes to the provincial government, amounting to, on average, 80% of provincial tax revenues. Among those three types of vehicle-related taxes, each may affect environmental protection directly or indirectly. In this case, a set of environmental taxes in the form of vehicle-related taxes, referring to vehicle recurrent tax and gasoline tax, have correlated with an improvement in the air quality index, a major indicator of the environmental quality index. Meanwhile, vehicle transfer tax revenues tend to negatively correlate with an improvement of the air quality index, indicating that among the three types of taxes, vehicle recurrent taxes and gasoline tax signal effectiveness for improving the air quality index. The vehicle recurrent tax also positively correlates with the share of provincial-level environmental spending.

The finding of our study indicates that going forward, in terms of policy formulation, the government needs to first assess the effectiveness of each scheme of taxes not only in terms of the tax structure but also in the likely response of each instrument as well as possible interconnected between taxes policies and government spending. For example, for the improvement of air quality, the instrument of the gasoline taxes and, to a degree, vehicle recurrent tax signal the existence of environmental dividend.

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