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Analysis Best Practice Policy Road Pricing to Overcome Negative Externalities of Motorized Vehicles in West Java

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Abstract

This research analyzes best practice policy road pricing in overcoming the negative externalities caused by motorized vehicles in West Java. Negative externalities, such as traffic congestion and air pollution, are major challenges for urban areas in West Java. Through implementation policy studies on road pricing in Singapore and London, this research analyzes the effectiveness of these policies in reducing congestion and improving air quality. The research methods used include literature reviews, policy analysis, and in-depth interviews. The research results show that road pricing can be an effective tool in reducing congestion and air pollution, if there is collaboration with the transportation department, police, and raharja services, adequate technology, effective outreach, and integration with improved public transportation. This policy must be designed holistically by taking into account related opportunities and issues. The role of communication, transparency and an inclusive approach is very important in increasing public acceptance of this policy.

Introduction

West Java is the province with the largest human population in Indonesia, reaching 49 million people in 2022 (Central Statistics Agency 2023). This is in line with the large number of motorized vehicles in this province. Graph 1-1 shows that West Java province is the fourth province with the highest number of motorized vehicles in Indonesia in 2022.

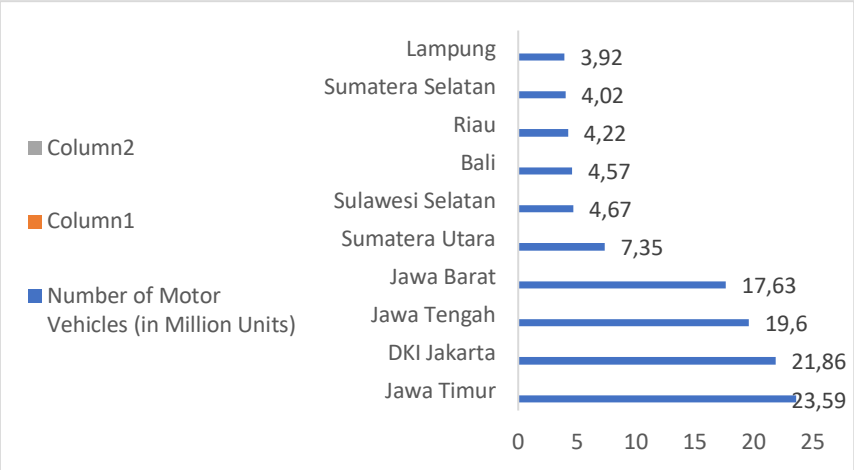

Figure 1. 10 Provinces with the Largest Number of Motorized Vehicles in Indonesia in 2022 (in Million Units)

Source: Central Statistics Agency, has been repossessed (2023)

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The number of motorized vehicles in West Java has continued to increase over the last five years which can be seen in Graph 1-2.

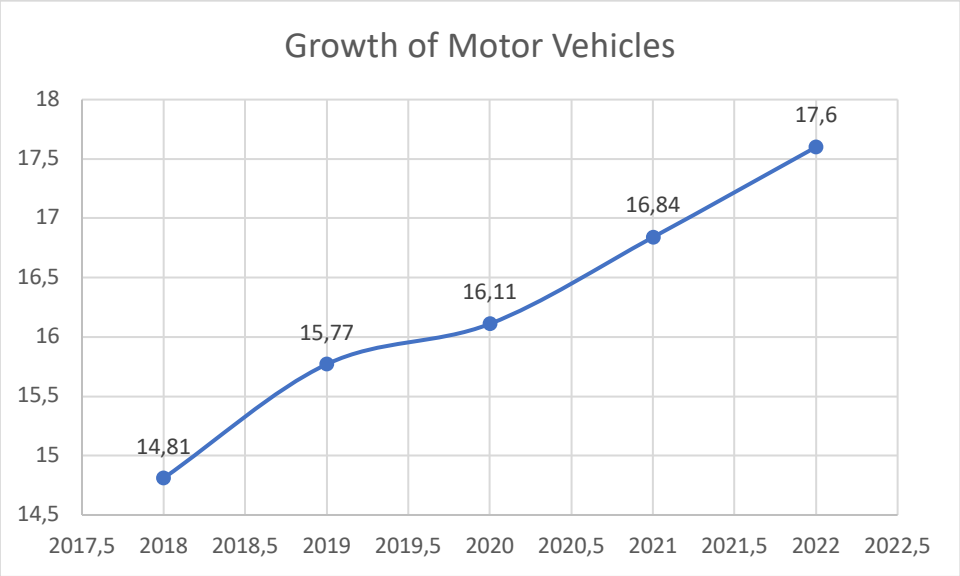

Figure 2. Growth of Motor Vehicles in West Java (in Million Units)

Source: West Java Province Central Statistics Agency, reprocessed by researchers (2019-2023)

In Figure above, it can be seen that over the 5 years the number of motorized vehicles has grown until in 2022 it will reach 17.6 million units. The high number of vehicles in West Java causes serious congestion problems. For example, Bogor as one of the cities in this province is included in the five cities with the highest levels of congestion in Indonesia (Global Traffic Scorecard, 2022). Congestion in West Java has resulted in a decline in the condition of existing roads. Table 1 shows the number of roads in West Java and their conditions from 2018 to 2022.

Table 1. Number of Roads in West Java with Various Road Conditions during 2018-2022 (Units)

Year	Road Conditions					Percentage Road condition is moderate, damaged and damaged Heavy Compared to Total Roads
	Good	Currently	Damaged	Damaged Heavy	Amount	
2018	14,682	6,974	3,387	2,634	27,677	46.95%
2019	15,425	6,844	2,901	2,375	27,545	44.00%
2020	15,744	7,478	2,828	2,168	28,218	44.21%
2021	15,744	7,478	2,828	2,168	28,218	44.21%
2022	16,544	7,193	2,067	2,373	28,177	41.29%
Average Growth (Decline) Path						

Source: West Java Province Central Statistics Agency, reprocessed by researchers (2019-2023)

Table 1 provides an overview of how congestion and excessive road use can affect the condition of road infrastructure in West Java. It can be seen that although the percentage of roads in moderate, damaged and heavily damaged conditions compared to total roads decreased from 46.95% in 2018 to 41.29% in 2022. However, if you look at it this also means that there are still more than 40% of roads that are in good condition. moderate, damaged, or seriously

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damaged in 2022. This indicates that the majority of roads in West Java still require ongoing attention and maintenance.

Congestion is also one of the causes of air pollution in West Java. According to IQAir (2024), air pollution in West Java comes from several sources, including vehicle emissions, construction activities, factories, burning of fossil fuels and straw, and forest fires. Data from IQAir on May 7 2024 (2024) shows that several areas in West Java have different levels of air pollution. Cikarang, Purwakarta and Depok are reported to have unhealthy air quality levels. Meanwhile, Bandung and Bogor are classified as unhealthy for groups sensitive to air pollution.

Therefore, the number of motorized vehicles in West Java does cause negative externalities. Mankiw explains that negative externalities refer to the detrimental consequences of a person's or entity's actions on the welfare or condition of another person or entity, without any payment or receipt of compensation for the impact of those actions (Mankiw, 2013; Bohnenberger, 2020; Hayes et al., 2022).

Public transportation options can be a solution to control the number of vehicles on the road (Owczarzak & Żak, 2015). However, Dewi & Krisdiyanto (2023) highlight the main challenge in developing a future transportation system in West Java: sustainable and autonomous mobility. One of the challenges faced is the limited use of public transportation which is triggered by concerns about the reliability and comfort of this transportation. This phenomenon is also reflected in Figure 3, where the majority of commuter workers in West Java prefer to use private vehicles rather than public transportation when going to or returning from work.

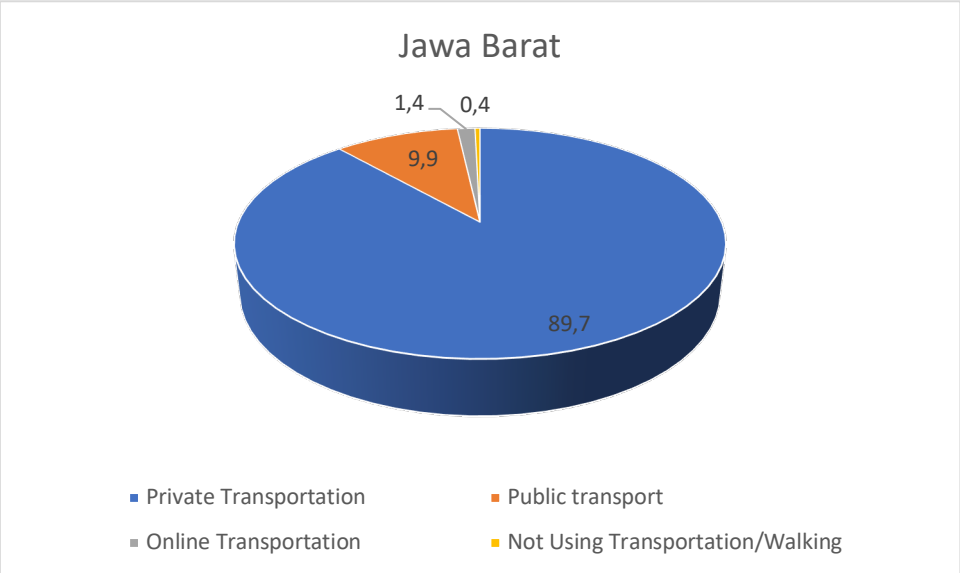

Figure 3. Percentage of Use of Transportation Modes for Commuter Workers to and from Workplaces in West Java in 2022

Source: Central Statistics Agency, reprocessed by researchers (2023)

From Figure 3 above, it can be seen that the majority of commuter workers still prefer to use private vehicles with a percentage reaching 89.7%. Meanwhile, the percentages of using public transportation, online transportation and not using any mode of transportation were 9.9%, 1.4% and 0.4% respectively. This shows that there are gaps that need to be addressed in efforts to increase the accessibility and attractiveness of public transportation for the community.

From the Regional Government side, the policy taken is to implement the Motor Vehicle Tax (PKB) policy to reduce the number of motorized vehicles. This policy is stipulated through

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West Java Provincial Regulation No.9 of 2023 concerning Regional Taxes and Regional Retributions (West Java Regional Regulation No.9/2023). This Regional Regulation is the legal basis for the West Java regional government to impose PKB on vehicle owners whose addresses are in the West Java administrative area. The basis for the imposition of PKB is the product of 2 (two) main elements, namely: a) Motor Vehicle Sales Value (NJKB); And 2) The weight reflects the relative level of road damage and/or environmental pollution due to the use of motorized vehicles.

The West Java government has also implemented progressive tariffs for PKB, especially for vehicles with the same ownership since 2011. The aim of this progressive tariff system is to encourage deeper consideration by the public regarding motor vehicle ownership in the hope of reducing the number of vehicles. The basis for the imposition of PKB in West Java is based on the wealth *base*. However, this does not have a big influence because the growth in the number of motorized vehicles in West Java is still increasing every year. Thus, a tax calculation formula is needed to overcome this. Examples from Singapore and London show that tariffs based on motor vehicle intensity (*consumption base*) can be the best alternative. Singapore has succeeded in tackling traffic congestion in the city center, even with the continued growth in the number of motorized vehicles. Traffic volume remains below 1975 levels, and average speeds during peak hours remain optimal, namely 64.1 km/h for expressways and 28.9 km/h for arterial roads based on 2014 data. Surveys show an increased percentage of travelers using public transportation during peak hours increased from 59% in 2008 to 63% in 2012. Implementation of Electronic *Road Pricing* from 1998 to 2008 it is also estimated to have reduced carbon dioxide emissions by 103 kilotons (Asia Development Bank, 2023; Adu-Ababio, 2015).

Congestion *Charge* also had a significant positive impact including limiting traffic entering the zone by 18% during weekday charging hours, reducing congestion by 30%, increasing bus journeys in central London by 33%, allowing 10% of journeys to switch to walking, cycling, and public transportation (Santos et al., 2008; Lah, 2019). Apart from these direct benefits, *Congestion Charge* also helps reduce the trend of increasing congestion that can be seen in other cities. Then, this policy succeeded in reducing dangerous nitrogen dioxide (NO2) levels by 46% and 21% lower respectively in central and inner London when compared to conditions without the scheme (Transport for London, 2024).

Based on the background of the problem above, the problem can be formulated as follows, namely analysis *best practice* policy *road pricing* to overcome the negative externalities of motorized vehicles in West Java.

Literature review

Local tax

Aji et al. (2022) stated that regional taxes are taxes collected and determined by regions based on tax regulations for the purposes of financing their households as public legal entities. The benchmark criteria for regional taxes are as follows (Devas, 1989):

Adequacy: The tax imposed must be able to meet regional financial needs to provide services to the community with three aspects of adequacy: (a) Revenue (*yield*) must be significant, stable, and predictable; (b) Elastic, capable of following developments and elastic to inflation and population growth); (c) Tax collection costs (*Cost of collection* low), seen from the small collection costs and the comparison between tax results and collection costs.

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Justice: three forms of justice according to Davey as quoted by Darwin (2010), including (a) *Vertical equity* (people with greater economic resources are taxed at higher, progressive rates); (b) *Horizontal equity* (relating to the relationship in tax charges that vary depending on income levels. If taxes are imposed at progressive rates, this is considered a form of fairness because the percentage of income paid for taxes increases along with income levels.); (c) *Geographical equity* (ensuring that taxation is evenly distributed across regions to avoid unfair disparities)

Economic Utility: Encouraging the efficient use of economic resources without hampering economic growth.

Implementation capacity: Includes administrative aspects related to the ability of officials to carry out tax administration tasks as well as political aspects that consider public acceptance and approval without causing excessive protests. Furthermore, Mansury (1994) emphasized that effective tax administration must fulfill the following principles (Ogbonna & Appah, 2016): (i) The provisions of the tax law must be clear and easy to understand, so as to provide ease of tax administration for taxpayers. (ii) Simplicity will help reduce tax violations. Simplicity in this case includes simplicity in the preparation of tax law so that it is easy to understand and apply by tax authorities and taxpayers in fulfilling their tax obligations. (iii) When carrying out reforms in the tax sector, it is important to consider convenience factors in order to achieve efficiency and effectiveness in tax administration.

Suitability as a source of regional tax revenue: taxes must be clear in which region they must be paid so that taxpayers are not easily avoided and do not impose a heavy burden on administrative arrangements. Apart from that, it does not deepen disparities between regions.

Tax on Motorized Vehicles

According to Samudra (1995), the reason for implementing Motor Vehicle Tax is because the use of roads, which are public goods, provides benefits to the general public. The use of these highways carries a number of costs, both direct and indirect. Direct costs include damage to roads which results in a financial burden for the government (Hayat & Amaratunga, 2014). Meanwhile, indirect costs or externality costs (*spillover cost*) includes air pollution, noise pollution, and congestion (Zefreh & Torok, 2021). External costs are additional costs incurred by the vehicle and can be detrimental to society and the government, such as air pollution, congestion, noise and damage to the view. Viikari (2008) suggests that the costs of preventing and controlling pollution must be borne by the party responsible for the pollution. *polluter-pays principle*.

According to Siregar (1990), there are two approaches in determining the amount of costs that must be borne by road users:

Cost of service approach (*the cost of service*): Taxes imposed on road users should be proportional to the external costs incurred by those road users. In this context, motorized vehicles with a larger weight such as trucks and buses will be subject to higher taxes than vehicles such as sedans (Burnham et al., 2021). This is because trucks and buses tend to cause greater externalities, such as damage to roads and air pollution, compared to sedans.

Benefits received approach (*benefits received*): Taxes imposed on road users should be proportional to the benefits received by those users. The amount of tax paid should include maintenance costs per kilometer of highway plus traffic congestion costs (Hau, 2005). This received benefits approach aims to encourage economic growth, in particular by providing tax incentives to commercial vehicles which have an important role in moving the flow of goods and/or passengers, while private vehicles will be subject to higher taxes.

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Tax base

According to Hancock (2018), there are three basic tax impositions that can be used:

Riches (*wealth base*): Taxes on wealth were the first to be imposed because they were easier to implement than taxes on income. This tax base is able to replace passive and effective income tax *prinsip ability to pay*. However, taxes on wealth experience problems in collection and are difficult to implement in industrial settings.

Income (*income base*): Income is often used as a basis for taxation in various countries. However, the definition of income is often complex, and an effective tax on income must take into account the erosion of capital due to inflation and must be consistent with individual well-being.

Expenditure or consumption (*expenditure for consumption base*): An expenditure tax taxes what is taken out of the economy in a specific period or is different from an income tax that contributes over time. Expenditure taxes have the ability to combine personal allowances and a wide variety of tax rates or are similar to the approach used in income taxes. As a result, it is possible for the expenditure tax to apply progressive rates and take into account the situation of the taxpayer if necessary.

Congestion Charge

Urban road traffic congestion rates refer to motorized vehicles that enter a certain area or section of road within a certain time interval and will be charged a special rate (González-Aliste et al., 2023; Shafiei et al., 2023). Ye (2012) added that when setting congestion pricing, it is important to consider the following factors:

Vehicle Type: Tariffs must prioritize passenger transportation with high capacity. Thus, public transportation with high capacity should not be subject to tariffs or be subject to lower rates, while vehicles with low capacity should be subject to higher rates.

Congestion Level: Tariffs should be higher on road sections with high levels of congestion and long duration of traffic jams. This is intended to encourage travelers to change their routes and travel times. Road sections with low levels of congestion should not be charged or charged at low rates.

Road Network Situation: The fare must be higher than the non-tariff route chosen by *travelers* on the road network, in order to reduce traffic flow.

Travelers bearing ability: Rates should take into consideration how much the rate can be paid or desired by *travelers* for their journey. Thus, the traffic congestion charging rate policy can be implemented without resistance from the public.

Santos & Fraser (2006) suggests that the tariff system for *road pricing* has different impacts. *Cordon-based charging* impose high tariffs at certain road points or when they occur, delay sufficient. *Delay-based charging* tariffs are imposed when there is a sufficient delay to trigger the tariff. *Delay-based charging* tends to require higher fares to reduce trips because drivers can easily reroute them. This is because fares are variable and uncertain which influences drivers' willingness to change routes or reduce their trips (Alemi et al., 2018).

On the other hand, *cordon-based charging* and *distance-based charging* encourage greater rerouting. At the tested standard rate level, *time-based charging* is the most effective in reducing travel distances within the fare area, temporarily *delay-based charging* is the least effective (Kreindler, 2024; Lindner et al., 2024). However, the increase in trips outside the fare area overall offsets the reduction in trip distances within it, so that the net effect on average trip

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distances is nearly the same for all systems. *Time-based charging* and *distance-based charging* have similar performance, while *delay-based charging is less* effective. *Cordon-based charging is* also less effective and does not produce higher benefits with increasing rates. Therefore, *distance-based charging is seen* as the most effective system in reducing travel time and general costs. *Time-based charging* can also be a better alternative than *delay-based charging*, although both are risky in encouraging risky behavior in drivers (Santos & Fraser, 2006).

Selmoune et al. (2020) four main factors that influence the acceptability of congestion pricing are as follows:

Fairness factors: Fairness issues arise when there is distribution *pricing* that affect different socio-demographic groups. Often, mobility-impaired individuals and low-income drivers are most impacted by heavy travel burdens when congestion pricing is implemented, because they have more limited travel options. This occurs because the "poor" is burdened with additional expenses, limiting their use of road infrastructure compared to their wealthier counterparts. Additionally, when a pricing scheme is implemented, many concerns about its fairness arise from citizens living inside and outside the charging zone. This suggests that the public should be aware that the introduction of congestion pricing schemes is a step forward in creating fairer use of the transport system (Krabbenborg et al., 2020).

Personal privacy: Personal privacy concerns are one of the main factors influencing the acceptability of congestion pricing. Transportation stakeholders are required to maintain the privacy of drivers and vehicles.

Increased risk: Ingberman in Selmoune et al. (2020) states that the main reason uncertainty causes a lack of support when introducing congestion pricing schemes is because many voters tend to maintain their status quo when new schemes are introduced without proper trials. De Borger and Dumbass also identified two types of uncertainty: uncertainty due to revenue allocation and uncertainty due to the efficiency of the proposed scheme.

Implementation difficulties: A simpler scheme will be more widely accepted by the public. Thus, it is important to start with a simple and well-understood proposal to ensure that residents and the public understand it.

Negative Externalities

The linkage between one activity and other activities that does not involve market mechanisms is called externality (Castle, 1965). In general, externalities are side effects of certain actions that affect other parties, either positively or negatively. According to Pindyck & Rubinfeld (2005), externalities are activities by producers or consumers that have an impact on other producers and consumers, but are not counted in market costs.

Mundt & Houston (2010) define externalities as costs and benefits that are not taken into account in the equation of an exchange, which can have an impact on exchange participants or other people. Externalities can be positive or negative. Positive externalities occur when an activity produces benefits for other parties who are not directly involved in the activity. On the other hand, negative externalities occur when an activity causes losses or bad impacts for other parties. Environmental externalities are benefits and costs that arise from physical or biotic changes in the environment (Owen, 2004; Bikomeye et al., 2021).

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Methods

This research uses a qualitative approach because it aims to provide a more in-depth explanation of a process that occurs. The qualitative research approach is more concerned with the process than with the results. This is because the relationship between the parts being studied will be much clearer if observed in the process. In this study, researchers provide an overview of alternative bases for taxation of motorized vehicles in West Java. In terms of research benefits, this research is a type of pure research, because this research is carried out to meet the researchers' own needs and is carried out in order to develop knowledge. Pure research also includes research conducted within an academic framework. Regarding data collection techniques, this research uses a literature study with the data obtained, namely secondary data. Secondary data is data sourced from literature studies related to the problems observed. This data was obtained from books, journals, articles and other literature that discuss the topic of this research. Therefore, the literature study in this research was used to obtain data related to regional tax policies in West Java as well as relevant agencies and the validity of the data can be trusted.

Result and Discussion

Overview of Motor Vehicle Tax Regulations in Regional Laws and Regulations in West Java

In its development, the latest regulations regarding regional taxes and regional levies are regulated in Law No.1/202. Through these regulations, a system is established for regional taxes, which means that regional governments are prohibited from collecting taxes other than the types of taxes mentioned and determined in Law No.1/2022. The following is Table 4-1 for a comparison between the policies in Law No.28/2009 and Law No.1/2022.

Table 2. Comparison PKB regulations in Law no. 28 of 2009 and Law no. 1 of 2022

Description	USA No.28/2009	UU No.1/2022
CLA rates	Private motor vehicle tax rates are stated as follows: (1) For first Motor Vehicle ownership, the tariff rate ranges from 1% to a maximum of 2%; (2) For second and subsequent Motor Vehicle ownership, rates can vary progressively, with a minimum rate of 2% and a maximum rate of up to 10%.	Motor Vehicle Tax Rates (PKB) are determined as follows: (1) For ownership and/or control of the first Motorized Vehicle, the maximum is set at 1.2%; And (2) For the second and subsequent ownership and/or control of Motorized Vehicles, it can be determined progressively with a maximum limit of 60%. Specifically for regions at the same level as provincial regions which are not divided into autonomous regencies/cities, the PKB rates are set as follows: (1) For ownership and/or control of the first Motorized Vehicle, with a maximum limit of 2%; And (2) For the second and subsequent ownership and/or control of Motorized Vehicles, it can be determined progressively with a maximum limit of 10%.

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	PKB tariffs for public transportation, ambulances, fire engines, social services, social and religious institutions, government/TNI/POLRI, regional governments, and other vehicles regulated by regional regulations, have a minimum tariff rate of 0.5% and a maximum tariff rate of 1%. The motor vehicle tax rate for heavy equipment and large equipment is set at a minimum rate of 0.1% and a maximum rate of 0.2%.	The PKB tariff for ownership and/or control of Motorized Vehicles used for public transportation, employee transportation, school transportation, ambulances, firefighting, social religious, social and religious institutions, Government and Regional Government, is set at a maximum of 0.5%.
Basis for imposition of PKB	The basis for imposing PKB involves two main elements, namely the selling value of motor vehicles and the weight of the vehicle. Determination of the selling value of motor vehicles is based on general market prices, while weights are calculated based on certain factors.	
Motor Vehicle Selling Value:	The sales value of a motor vehicle is a key factor in calculating the PKB. This value is determined based on the general market price in the first week of December of the previous tax year.	
General Market Price	The general market price is the average price obtained from various data sources that are considered accurate. If the general market price of a vehicle is unknown, the resale value can be determined by considering several alternative factors such as: Cylinder content and/or power unit: Valuation can be done based on the price of a motor vehicle with the same cylinder content and/or power unit. Vehicle Use: Whether the vehicle is used for public or private purposes. Vehicle Brand: The price of a motor vehicle of the same brand can be used as a reference. Year of Manufacture: Resale value can be considered based on the Year of manufacture of the vehicle. Vehicle Manufacturer: This factor refers to the price of vehicles from the same manufacturer. Similar motor vehicles: This factor refers to the price of similar motor vehicles. Import Notification Document: If the vehicle is imported, the value can be calculated based on the goods import notification document.	
Motor Vehicle Weight:	Motor vehicle weight is calculated based on several factors, including: (1) Axle Pressure: Weight is measured based on the number of axles, wheels, and vehicle weight. Axle pressure is the main determinant in this calculation; (2) Fuel Type: This factor is differentiated based on the type of vehicle fuel, whether gasoline, diesel, or other fuel other than renewable energy. Type, Use, Year of Engine Manufacture, and Engine Characteristics: Based on vehicle engine characteristics such as type, use, year of manufacture, and cylinder contents.	

Source: Processed Writer (2024)

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In Table 2 above, it can be seen that there are differences only in the tariff provisions regulated between Law No.28/2009 and Law No.1/2022. In Law No.1/2022, it does not explicitly state that PKB rates must be progressive.

The subject of the PKB is imposed on individuals and legal entities who own motorized vehicles. This is in line with environmental tax theory, namely the polluter pays principle put forward by (Viikari, 2008). This principle emphasizes that the party that causes pollution has the responsibility to cover the costs of pollution prevention and control measures implemented by the authorities. The application of the polluter pays principle contains two important aspects (Larina et al., 2021). First, parties who pollute the environment, in this context motor vehicle owners, are expected to be responsible for the environmental impacts produced by their vehicles. Second, the costs of overcoming and reducing the impact of pollution should not be borne by the general public, but should be borne by the party causing the pollution (Čižiūnienė et al., 2021).

In Law No.28/2009 and Law No.1/2022, there is a PKB which is one of the concept taxes *earmarking tax* or tax revenues whose expenditure is specifically determined to control negative externalities resulting from motorized vehicles. Based on Article 25 of Government Regulation No. 35 of 2023 concerning General Provisions for Regional Taxes and Regional Levies, income from PKB and Opsen PKB must be allocated at least 10% for construction, road maintenance and improving public transportation. This concept is based on the principle of benefit (*benefit principle*) which states that motor vehicle owners who pay taxes should receive direct benefits, such as better roads and more comfortable driving (in-depth interview, 2024).

Furthermore, West Java issued West Java Governor Regulation Number 39 of 2022 concerning the Basis for Imposing Motor Vehicle Tax and Motor Vehicle Title Transfer Fee (West Java Gubernatorial Regulation No. 39/2022). This regulation stipulates, among other things: 1) The PKB for public transportation of people is set at 30% of the PKB tax base with a rate of 1% of the tax bas; 2)The PKB for public transportation of goods is set at 60% of the PKB tax base with a rate of 1% of the tax base; 3) The PKB for battery-based Electric Motorized Vehicles (KBL), both for transportation of private persons and personal goods, is set at 10% of the basic PKB imposition; 4) Battery-Based KBL PKB for public transportation of people and goods has a tariff of 10% of the basic tax imposition of the PKB with a tariff of 1% of the basic tax imposition; 5) Battery-Based KBL PKB for public goods transportation is subject to 10% of the basic PKB charge; 6) PKB for ambulances, fire extinguishers, and cleaning services owned by the Central Government, Indonesian National Army, National Police of the Republic of Indonesia, and Regional Governments are subject to 0% of the basic PKB charge; 7) The PKB for motorized vehicles used for social and religious activities is set at 12.5% of the basic value of the PKB; 8) The PKB imposition for ambulances, fire extinguishers and cleaning services owned by state-owned enterprises, regionally-owned enterprises and private parties is charged at 0.5% of the basic PKB imposition.

Then, PKB rates for individuals with multiple motor vehicle ownership are regulated in West Java Governor Regulation Number 02 of 2020 concerning the Third Amendment to West Java Governor Regulation Number 33 of 2013 concerning Guidelines for Implementing West Java Province Regional Regulation Number 13 of 2011 concerning Regional Taxes for Types of Motor Vehicle Tax and Motor Vehicle Title Transfer Fees (West Java Gubernatorial Regulation 02/2020) are as follows:

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Table 3. West Java PKB Progressive Rates for Individuals Who Own Ownership Vehicle Motorized

Ownership	PKB rates for 2,3,4, or wheeled vehicles More
First	1.75%
Second	2.25%
Third	2.75%
Fourth	3.25%
Fifth and so on	3.75%

Source: Gubernatorial Regulation West Java 02/2020

Table 3 above indicates that the progressive tariff functions to control the number of motorized vehicles (regular). Because the tax is supposed to be progressive, people will be more considerate in their decisions when buying a new vehicle. However, the main focus of progressive tariffs on this PKB is to increase state revenues, not overcome congestion (in-depth interview, 2024).

This is in line with data that even though progressive tariffs have been implemented, the number of motorized vehicles in West Java continues to increase every year as seen in Table 4 below.

Table 4. Amount Vehicle Motorized Per Type Vehicles in West Java along with Its growth during 2018-2022 (Units)

Year	Passenger car	Bus	Truck	Motorcycle	Amount	Annual Growth (%)
2018	3,534,784	19,443	360.243	10,899,031	14,813,501	
2019	3,628,502	20,712	384,828	11,737,547	15,771,589	6.5%
2020	3,652,233	20,839	391,265	12,043,160	16,107,497	2.1%
2021	3,698,521	21,529	414,995	12,708,100	16,843,145	4.6%
2022	3,803,808	21,997	433,001	13,341,328	17,600,134	4.5%
Amount					**81,135,866**	

Source: Central Statistics Agency Province West Java, reprocessed by researchers (2019-2023)

Table 4 shows that the average growth of motorized vehicles in West Java was 4.5% over the last 5 years. For example, the number of motorized vehicles in 2022 will reach 17.6 million units or an increase of 4.5% compared to the previous year which was only 16.8 million units. With the increase in the number of motorized vehicles in West Java every year, even though the PKB progressive tariff has been implemented, this can indicate several factors that influence this phenomenon: 1) Limitations on Policy Effectiveness: Progressive tariff policies have not reached the expected level of effectiveness in controlling the number of motorized vehicles; 2) Increased Purchasing Power and Mobility: Increasing the purchasing power of people in West Java could be the main factor driving an increase in the number of motorized vehicles. People who are more financially capable are more likely to buy private vehicles, regardless of the tariff applied; 3) Infrastructure Growth and Accessibility: Infrastructure development and ease of accessibility can also contribute to an increase in the number of motorized vehicles. It is proven that according to Dewi & Krisdiyanto (2023) alternative transportation infrastructure such as public transportation is inadequate or less efficient, so people tend to prefer using private vehicles.

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On the other hand, the basis for imposing PKB tax in Indonesia is: *wealth base* because progressive rates are applied according to how many motorized vehicles are owned by the same individual. The application of progressive tariffs in the PKB has taken into account the principles of justice, especially in matters of ability *to pay.* This is in accordance with what (Hancock, 2018) stated that the tax base based on wealth is able to replace passive and effective income tax *prinsip ability to pay*. Principal *ability to pay* focuses on the financial ability of each individual or vehicle owner to pay taxes. Progressive PKB tariffs should be able to provide economic justice by considering the number of motor vehicle owners (Enceng et al., 2024). Thus, the PKB paid by the PKB Mandatory Party will reflect the benefits received and their financial capabilities. However, this progressive tariff has more challenges in its implementation. One of them is the potential to avoid paying tax at progressive rates by registering a vehicle in someone else's name or at an incorrect address. This causes PKB's progressive tariff policy to be ineffective in achieving the goal of controlling the growth of motorized vehicles (Rohmah & Karsinah, 2024).

Analysis Alternative Policy Obtainable Road *Pricing* Made *Best Practices* for Overcome Externalities Negative on Vehicle Motorized

***Electronic Pricing Road* in Singapore**

In 1988, Singapore changed the direction of its motor vehicle tax policy from being based on vehicle ownership to focusing more on road use to overcome congestion. At the start of its implementation, the Singapore Government reduced vehicle registration fees, Additional Registration Fees, and *road taxes on vehicles*. The government also provides in-vehicle units for free. These steps were taken to reduce the cost burden for motorists and gain public support for ERP (Asia Development Bank, 2023).

ERP rates in Singapore are designed to maintain optimal traffic speeds and are adjusted periodically to reflect changing traffic conditions (Koh & Chin, 2022; Olszewski & Xie, 2005). On arterial roads, the target speed is between 20 and 30 km/h, and for toll roads between 45 and 65 km/h. Thus, the determination of congestion pricing in Singapore is based on *delay-based charging* where a congestion pricing system charges driver depending on the level of traffic density at that time. As a result, higher fees are charged during peak hours when traffic congestion is usually highest. The ERP costs are influenced by several factors (*Government of Singapore*, 2024): 1) Time of Day: Rates are higher during peak hours; 2) Vehicle Type and Size: Larger vehicles incur higher fees; 3) Operational Days: ERP operates from Monday to Saturday, except national holidays.

ERP uses two main approaches to determine the amount of costs that must be borne by road users, namely the service cost approach and the benefits received approach (Siregar, 1990). The cost-of-service approach focuses on tax charges that are proportional to the externality costs incurred by road users. Vehicles with greater externalities, such as trucks and buses, are subject to higher taxes than private vehicles such as sedans. This is because trucks and buses tend to cause greater road damage and higher air pollution compared to sedans. On the other hand, the benefits received approach considers the amount of tax based on the benefits obtained by road users. In this case, the ERP amount paid by road users should include maintenance costs per kilometer of highway plus traffic congestion costs (Perera et al., 2021).

One important innovation in Singapore ERP is the use of On-Board Unit (OBU) technology which is divided into two types: *Single Piece* OBU for motorbikes and *Three Piece* OBU for other vehicles. *Single Piece* OBU consists of a unit that functions as a link between the vehicle and the ERP system. *Three Piece* the OBU is divided into three components, namely the

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antenna, processing unit, and touch screen. All vehicles registered in Singapore must install *Unit In-Vehicle* (old technology) or BOTH to get through gantry ERP in operation. If you do not have an IU or OBU, the driver will be subject to a fine of $70.00 for each Gantry Skipped ERP.

London Congestion Charge in London

London Congestion Charge imposed on motorized vehicles operating in *Congestion Charge Zone* (CCZ) in central London between 07.00 to 18.00 Monday – Friday and 12.00 to 18.00 on Saturday and Sunday. *Charge* This is not worn during Christmas and New Year celebrations. *Standard charge* which is around £15 if paying in advance or on the same day. Meanwhile, £17.50 before midnight on the third day after the trip. As such, London charges a daily fee for each vehicle driving on public roads within a CCZ regardless of how many times the user crosses the area. In addition, the penalty is between £160 and £180 for non-payment *charges*. *Congestion charge* in London uses a cost-of-service approach and a received benefits approach to determine the amount of costs that must be borne by road users. Meanwhile, penalties provide strong sanctions for rule violators, which can encourage compliance with the established tariff system.

This fee charging system uses *automatic number plate recognition cameras* to record and identify vehicles entering the CCZ (Mirzahossein et al., 2021). These cameras are equipped with infrared technology that detects vehicle registration numbers, which are then automatically entered into the billing system. If a vehicle is not detected by the automated system, local authorities will carry out manual checks to ensure all vehicles entering the zone have been charged (Transport for London, 2024).

Opportunities for Implementation Road Pricing in West java

West Java faces complex traffic problems and high levels of air pollution. System implementation *road pricing* in West Java can provide opportunities significant in efforts to manage traffic and improve air quality. PKB and Road Pricing are two funding mechanisms that have fundamental differences in their implementation. CLA is an annual *charge*, whereas *road pricing* leading to retribution (in-depth interview, 2024). Here are some of the main characteristics of the differences between PKB and *road pricing*. PKB is an annual tax imposed on all motor vehicle owners. Some of the main characteristics of PKB are:

Stable Annual Income: PKB provides stable income for local governments because it must be paid annually by all vehicle owners, regardless of how often or where the vehicle is used.

Not Depending on Road Use: The PKB does not take into account the frequency of vehicle uses or the location of its use. All vehicle owners pay the same amount based on their vehicle category, whether they use their vehicle frequently or not.

Road pricing is a levy imposed on certain road users based on the frequency and time of use. Following are some of the main characteristics of *road pricing*:

Revenue Based on Usage: Income from *road pricing* depending on the number of vehicles using the road the levy is charged. This revenue may fluctuate based on traffic levels.

Traffic Management: *Road pricing* can be used as a tool to reduce congestion. By charging fees on certain routes, road users are encouraged to avoid those routes or choose alternative transportation such as public transport, thereby reducing traffic congestion.

There are opportunities for implementation *road pricing* in West Java include:

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Control of Motor Vehicle Use: *Road pricing* can act as an effective regulatory tool to reduce the level of congestion in the city. By using a consumption-based tax basis, road pricing provides incentives to motor vehicle users to consider more carefully the needs and frequency of use of their vehicles. One of the advantages of road *pricing* is its ability to regulate traffic flow based on set rates. By setting rates based on time and zones such as in Singapore and London, *road pricing is able* to optimize road use by directing vehicles to more efficient routes and reducing congestion at vulnerable points. For example, higher fares during peak hours or in areas with high levels of congestion will encourage vehicle users to choose more optimal times and routes. Apart from the direct benefits in reducing congestion, *road pricing* also has a positive impact in reducing air and noise pollution as well as road damage in the city.

Additional Funding Sources for Regions: Funds collected from *road pricing* can be allocated for improving the bus network, improving road and bridge infrastructure. This will improve the quality of public transportation services and provide a more environmentally friendly alternative for the community. In other words, *road pricing* can be a source of additional funding for strategic issues in West Java and also the development and maintenance of better road and public transportation infrastructure. One of the regional government work plan programs in West Java is Regional Connectivity Infrastructure (in-depth interview, 2024). This program aims to better connect various regions in West Java through road construction and maintenance. *Road pricing* can be the right funding solution to support this program. With additional funds from road pricing, regional governments can focus more on improving and developing infrastructure which will facilitate community mobility and encourage regional economic growth. Determination *road pricing* can use the approach to the *cost of service* and/or approach *benefit services* as explained by Siregar (1990). Judging from the implementation of Singapore and London, they both pay attention to these two approaches. In the approach *cost of service*, then the tax rate will vary based on the weight of the vehicle and its type. Plus, approach *benefit received* where the tax that must be paid is equivalent to the maintenance costs per kilometer of highway plus traffic density costs.

Factors affecting Acceptance of Determination *Road Pricing* in West java

As explained by Selmoune et al. (2020), the main factors influence the acceptance of the determination of road *pricing* are fairness issues, privacy issues, increased risks, and implementation difficulties.

Justice Issues: *Road pricing* needs to pay attention to issues of social justice so as not to burden certain groups of society. The aspect of justice must be the main focus in determining tax rates (Devas, 1989). As for determination, road *pricing* should be allocated to improve and expand the public transportation system, thereby providing better and affordable alternatives for all levels of society.

Personal data issues: Personal privacy concerns are one of the main factors influencing the acceptability of congestion pricing. Personal data such as driver identity, vehicle details and transaction information must be guaranteed safe. Transportation stakeholders in West Java have a responsibility to ensure that this data is not misused or accessed by unauthorized parties.

Increased Risk: Uncertainty is one of the main reasons why people tend to refuse *road pricing*. Lack of support when introducing assignment schemes *road pricing* may be caused by uncertainties arising from the allocation of revenue and efficiency of the proposed scheme. Therefore, the public needs to be given space to provide input and ask questions, so that the resulting policies can be more in line with their needs and expectations. As for transparency in the use of funds obtained from *road pricing* it is very important to ensure that the public sees

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the real benefits of this policy. Information regarding how the funds is used to repair and upgrade infrastructure service public transportation must be communicated clearly and openly to the public.

Implementation Difficulty: Implementation difficulties are indeed a crucial factor in the acceptance of the designation scheme road pricing by society. In this context, it is important to propose a scheme that is simple and easy to understand so that it is accepted by the public at large. This ensures that residents and the public can understand the basic concepts of the scheme without excessive confusion. The Singapore case provides an interesting example of possible changes to the original congestion pricing scheme. Singapore started with a flat rate about $1.3 before modifying and expanding into a more complex ERP scheme. Although there is an increase in complexity in this scheme, this is not considered a major problem because drivers are familiar with the basics of pricing schemes and aspects of efficiency and fairness can be improved (Selmoune et al., 2020).

There are other factors that influence the acceptance of the determination road pricing are as follows:

Public Understanding: According to (Devas, 1989), public acceptance of local taxes must take into account the level of approval without causing excessive complaints. In the context of road pricing, public understanding of the benefits provided by this system is very important. The government needs to socialize and educate the public about the objectives of determining road pricing, such as reducing congestion, increasing mobility, and reducing air pollution. With good understanding, society will be more accepting and supportive of implementation road pricing.

Technical and Infrastructure Constraints: Implementing Road pricing requires reliable technological infrastructure, such as the use of OBU in Singapore. The government needs to ensure that the infrastructure and technology used can function well and be reliable over the long term. This requires large financing. Infrastructure such as number plate recognition cameras and intermediate systems BOTH with a central server also requires significant costs for installation and maintenance.

Administration *Road Pricing*: Aspects of technology and human resources can be closely linked to the theory of (Devas, 1989), that regional tax assessment benchmarks must pay attention to how local governments are able to carry out tax administration. The principles expressed by Mansury (1994) regarding the clarity of tax laws, simplicity in drafting laws, and the ease of tax reform are key in administration. *road pricing*. Clarity of tax laws is a vital guideline in managing administration *road pricing*. Clear guidelines as a basis for law enforcement can have an impact on administration *road pricing* effectively. Likewise, simplicity in drafting laws in context *road pricing* will ensure that the administration can run effectively. The convenience factor in paying road prices, both through electronic and manual methods, also makes an important contribution to increasing acceptance and support from the public. This convenience not only makes the payment process easier for road users, but also helps support the overall effectiveness of road pricing administration.

Conclusion

The CLA is imposed on individuals and legal entities who own motor vehicles, with an emphasis on the responsibility of polluters to bear the costs of the resulting environmental impact. However, challenges arise in law enforcement because there is a loophole to transfer vehicle ownership to another person so that it is not subject to progressive tax. Policy *road pricing* offers a potential solution to overcome the use of motorized vehicles on the highway,

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thereby reducing congestion, pollution and road damage. Meanwhile, the success of this system requires careful preparation, especially in detecting vehicles passing through the road and managing related data as well as related data privacy issues. Collaboration with the transportation department, police, and raharja services is also needed so that the data collected can be used as a basis for analysis by the West Java Bapenda regarding the potential of the object. *road pricing*. In this context, the development of information technology-based infrastructure technology on roads also plays a key role, so the government needs to provide adequate funds to develop this infrastructure. Then, the human resource aspect becomes an essential consideration in successful implementation of road *pricing*. By taking into account opportunities and issues related to implementation *road pricing*, this policy can be designed holistically to achieve the desired goals. In handling issues regarding policy acceptance *road pricing*, the role of communication, transparency and an inclusive approach is very important. Local governments and related stakeholders must be actively involved in providing clear information to communities affected by policies *road pricing* This.

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