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EFFECTS OF MOTORCYCLE AND TRICYCLE TRANSPORTATION ON THE ECONOMY AND SECURITY OF KADUNA STATE, NIGERIA

Oludare, Wuraola Anna Department of Economics, Nigerian Defence Academy, Kaduna, Nigeria

Shuaibu, Adamu Mohammed Department of Economics, Nigerian Defence Academy, Kaduna, Nigeria

Saheed, Zakaree S., PhD Department of Economics, Nigerian Defence Academy, Kaduna, Nigeria

Abstract

Motorcycle and tricycle transportation is crucial in urban and peri-urban transport, employment, and economic involvement in Kaduna State, Nigeria. But it has benefits to the economy, as well as security challenge, road safety and conflict regulation. In this study, an attempt is made to scrutinize the economic and security impacts of motorcycle and tricycle transportation in Kaduna metropolis of Kaduna State. It uses a quantitative cross sectional survey methodology with some selected views of stakeholders and reviews of transport accessibility, livelihood opportunities, business activities, security exposure, road safety and regulatory conditions. The results suggest that 97% of respondents agreed that the motorcycle and tricycle services enhance access to the workplace, markets and customers, and 100% believed that the services create jobs and promote the small businesses. In addition, 95% confirmed that these services decrease the travelling time and promote economic activities. However, there were significant security and safety issues reported: 79% said they had experienced or witnessed a security incident in the past 12 months and 95% said they experienced or witnessed a road crash in the past 12 months. Furthermore, 95% disagreed that operator registration and identification was sufficient. These results provide a picture of economically significant but perceived security and road-safety concerns of motorcycle and tricycle transportation. The study calls for a balanced regulatory framework that enhances operator identification and registration, traffic-law enforcement, operator safety training and reporting of incidents, and for the transport regulators, security agencies and operators' associations to cooperate to ensure better livelihoods and affordable mobility. The results should be interpreted with caution, however, as they are based on respondents' experience or observation rather than being population prevalence data or relating to cause and effect.

Keywords: Motorcycle Transportation, Tricycle Transportation, Economic Impact, Transport Security, Road Safety, Regulation

1. Introduction

Transportation is vital to linking people, businesses and economic opportunities together. In developing countries, informal and paratransit services may complement poor formal transport systems to offer accessible mobility for developing countries. In addition to transport of people and items, these services are crucial to support livelihoods and provide opportunities for employment, markets, education, and healthcare (Bueno Rezende de Castro et al., 2022; Vecchio & Martens, 2021; Lenshie et al., 2022; Owino et al., 2024).

Amongst this transport system motorcycles, motorised tricycles are of particular significance, given their flexibility, manoeuvrability, and their ability to reach unserved areas with poor road infrastructure, and limited conventional transport services. For smallholder farmers in Akwa Ibom State, the preferred mode of transportation was motorcycles followed by tricycles (Akpan and Morimoto 2022). Likewise, Lenshie et al., (2022) correlated the rising use of these modes of transport in Nigerian's town with unemployment, transport needs, and alternative livelihoods.

Motorcycles and tricycles are not only a source of revenue for their operators, they also bring economic value. They link households and businesses to markets, workplaces and services to sustain economic participation and generate jobs (Collins et al., 2025; Owino et al., 2024). But these perks come with drawbacks, such as fluctuations in the economy, inconsistencies in pay, etc. In studies conducted by Obakemi (2021) and Mallett et al. (2023), the profit and welfare of operators was shown to be related to aspects of ownership, demand for passengers, operating costs, working conditions etc. These vulnerabilities must be assessed along with the economic importance of these transport modes.

In addition to the economic importance, motorcycles and tricycles also pose significant security and road-safety issues. They are flexible and accessible, which may pose monitoring and enforcement difficulties, especially in the context of weak regulatory institutions. For instance, in Akure, Adeniran et al. (2024) identified robbery and kidnapping and assault as forms of victimisation that were correlated to paratransit environments in Akure. However, it is crucial to differentiate between deliberate criminal acts and incidents of road safety in which vehicles are involved due to crashes, injuries and deaths. Dada et al. (2023) found that there are risky behaviours linked to the activities of commercial motorcycles such as speeding, traffic violations, and substance use in Nigeria, while Ntramah et al. (2023) and Nambiza et al. (2026) noted common road-safety problems that motorcycle taxi operators face. These results indicate that there is need for effective regulation, monitoring and institutional intervention in the risks of these transport modes.

An important aspect of the link between transportation and economic welfare and security is far from obvious in Kaduna State. Ebe Collins et al. (2025) identified flexibility, speed and accessibility as key factors that determine patronage of the tricycles in Kaduna metropolis and livelihood opportunities as key factor which encouraged many of the tricycle operators to become tricycle operators. In the same vein, Umar, et al., (2025) brought to the fore security related issues in the working environment of commercial motorcycle riders in Samaru. While these studies highlight the relevance of motorcycles and tricycles in Kaduna's mobility and livelihood, they fail to fully address the economic and security impact of both types of vehicles.

This connection is made more complicated by transport regulations. Restrictions could be implemented to counter crime, traffic or road-safety issues, but they could also impact employment and household livelihoods. According to Ibrahim et al. (2025), commercial motorcycle regulations in Minna resulted in income loss and the worsening of economic conditions for impacted motorcycle operators. The same has been shown by Ackrill et al. (2023), who found that the enforcement behaviour of street-level officers is a determinant of the effects of motorcycle taxi restrictions in Lagos. The results highlight the importance of the proposed regulatory measures, considering security goals, economic factors and mobility related aspects.

With this background, this study focuses on the impact of motorcycle/tricycle transportation on the economy and security of Kaduna State of Nigeria. Specifically, it explores their role in employment, livelihoods, accessibility and economic opportunities, as well as related security and road-safety issues (criminal victimisation, monitoring and regulatory enforcement). The study aims to give a holistic information on the economic advantages and safety issues of motorcycle and tricycle transportation in Kaduna State by analysing the two dimensions in tandem.

2.1 Literature Review

Motorcycle and Tricycle Transportation

Motorcycle and tricycle transportation is a type of paratransit that has flexible routes, variable stops, and responds to passenger demand. Its rise can be traced back to a lack of ability of traditional transport systems to meet transport needs, especially in the poor and remote communities. Owino et al. (2024) demonstrate that motorcycle taxis and tricycles are now a fact of urban transport life in sub-Saharan African cities, as they offer services that are not always available from conventional transport modes. In the same vein, Lenshie et al. (2022) situate the proliferation of these modes in Nigeria's political economy of unemployment, informal workforce and transport

demand and regulation. They are not just informal transport, but mobility arrangements that are part of the local economy and institutions.

Motorcycles and tricycles still have other operating characteristics. Motorcycles are generally more manoeuvrable and offer highly flexible point-to-point travel, while tricycles have more passenger space, and offer some protection from weather and road conditions. Both go up in importance if road infrastructure is a constraint for larger vehicles (Akpan and Morimoto 2022). Lenshie et al. (2022) also illustrate that even if motorcycle demand is reduced by policy, the reduction is not necessarily complete, but is an incentive for a substitution to tricycles. The separation of the two modes is important for the current research, as they may hide meaningful differences in economic and security outcomes when they are combined.

Transportation and Economic Impact

Movement of vehicles is not the best indicator of the economic importance of transportation; it's accessibility. Accessibility is about opportunities which individuals can reach while mobility is about movement itself. The case of transport accessibility is discussed by Vecchio and Martens (2021), who view accessibility as a question of people's practical opportunities to engage in economic and social life; and conclude that such a view can be understood from the lens of the capabilities approach. Van Wee (2022) also defines accessibility as being multi-dimensional, based on the type of transport system, land-use structure, individual characteristics and time.

When looked at from an economic point of view, the contribution of motorcycle and tricycle is achieved when they provide access to work places, markets, customers, schools or other productive opportunities in Kaduna State. The importance of poor accessibility for the economy of Lagos is illustrated by the work of Collins et al. (2025) that highlights how poor accessibility and associated transport constraints can limit social and economic participation. Owino et al. (2024) also demonstrate that motorcycle and tricycle taxis can serve as a means for accessing markets and other key services as well as generate livelihoods. This is therefore an economic impact that can be considered as a sum of direct livelihood impacts and indirect accessibility impacts.

Transportation and Security

Transport security is the security of passengers, operators, vehicles and transport environments against intentional threats like robbery, assault, kidnapping and harassment. This is different to road safety, which relates to unintentional damage caused by road accidents and unsafe road use. In an examination of the international literature on crime and safety in transit settings, Ceccato et al. (2022) find that the physical environment, movement patterns, social factors, temporal factors and guardianship interact to influence transport-related crime.

This conceptualisation is relevant to motorcycles and tricycles in particular as the flexibility of the motorbike/tricycle can also serve as a benefit to their accessibility and a challenge in monitoring. Adeniran et al. (2024) demonstrate that paratransit environments can provide opportunities for robbery, kidnapping and other criminal victimisation. However, this does not mean that the transport modes are necessarily criminogenic. Instead, it implies that the expected security results depend on the registration of their vehicles, operator identification, monitoring, operational management, law enforcement, and on the social context.

Informality, Regulation and the Economic–Security Nexus

The link between economic opportunity and security risk is made through informality. Institutions often give rise to a number of services like motorcycles or tricycles, especially in situations where formal public transport is not available for some reason. Regulation can thus have both security and economic impacts. Owino et al. (2024) challenge the exclusion of the operators of motorcycles and tricycles from transport planning, because they have their own socioeconomic role, and they propose better cooperation among operators, unions, regulators, police and users.

The question is not whether there is regulation, but how effective and how implemented. Ackrill et al. (2023) demonstrate that the effects of motorcycle-taxi restrictions in Lagos were mediated by a discretion at

the street level, creating both under- and over-enforcement scenarios. Additionally, motorcycle restrictions also have substantial socioeconomic costs for operators as shown by Ibrahim et al. (2025). These findings contradict the notion that policy can be restrictive without the resulting security issues. Lack of regulation, on the other hand, can maintain access to the program but can fail to solve issues of identification, risky behavior, and responsibility for the program. In this study, therefore, regulation is regarded as an institutional conditioning factor that can affect both the economic and the security outcomes.

2.2 Theoretical Review

Transport Accessibility and the Capabilities Approach

Sen (1999) has offered the main theoretical foundation for this study of the economic dimension, the capabilities approach. Sen centres his understanding of development on substantive freedom – the opportunities available to people to live in ways that are valuable. In the field of transport research, Vecchio and Martens (2021) are directly linking this perspective to accessibility, stating that transport should be assessed based on the opportunities it provides for access to and use of.

The motorcycle and tricycle transportation connection is obvious. Transportation has increased the person's practical ability where these modes are used to access jobs, markets, schools, health facilities or customers that the person otherwise could not reach. This framework thus offers a theoretical foundation for the study of aspects of economic impact, namely access to employment, market participation, travel time savings, and opportunities for livelihoods. The downside is that the more it is available, the more that doesn't mean it is safe or that it will prevent being victimised. That restriction requires a complementing security theory.

Routine Activity Theory

The Routine Activity Theory (Cohen & Felson, 1979) describes crime as the result of a motivated offender coming together with a suitable victim and a lack of capable guardianship. Its relevance to transportation is especially high because the transportation system brings people, goods and vehicles together in specific places and times repeatedly. Olaniyan et al. (2023) find that the theory can be applied in Nigeria's transit system, particularly in Ibadan, which is the focus of their study.

The theory implies that the security impacts of the operation of motorcycles and tricycles might be felt as a result of the alteration of movement patterns, availability of targets and guardianship in Kaduna. Weak registration and identification systems may reduce capable guardianship and create opportunities for criminal activities. Conversely, visible operator identification, effective surveillance and proactive policing may strengthen capable guardianship and reduce opportunities for crime.

One of the weaknesses of Routine Activity Theory is that it does not take account of features of the structure, such as unemployment, poverty, and the lack of institutional capacity. In this study it is thus complemented by the accessibility/capabilities lens, which provides the socio-economic motivation and benefits of informal transport.

Theoretical Framework

The two theoretical perspectives provide complementary explanations of the central research problem. The Capabilities Approach explains the economic pathway through which motorcycles and tricycles can increase access to employment, markets and services. Routine Activity Theory explains the security pathway through which transport patterns can influence exposure to criminal opportunities and the effectiveness of guardianship. The institutional dimension is captured through regulation, enforcement, infrastructure and operator identification.

The resulting theoretical relationship can be represented as:

Motorcycle/Tricycle Transportation → Accessibility and Mobility → Economic Opportunities → Economic Outcomes

and

Motorcycle/Tricycle Transportation → Exposure and Guardianship Conditions → Security Risks/Protection → Security Outcomes

with regulation, infrastructure, enforcement and socioeconomic characteristics conditioning both pathways.

This synthesis provides the theoretical foundation for examining economic and security outcomes as related but distinguishable dimensions of motorcycle and tricycle transportation. It also supports an empirical strategy in which the two outcomes can be modelled jointly without assuming that transportation produces either uniformly beneficial or uniformly adverse consequences.

2.3 Empirical Review

The literature suggests a conditional picture of the effects of motorcycle and tricycle transportation, while the empirical evidence generally confirms that it has a certain socioeconomic relevance. There are a number of differences between studies in terms of geographical context, population, method of transportation, and measured outcome which limit the ability to generalize findings across studies. Three general observations, however, can be drawn: Motorcycle and tricycle transportation may increase economic opportunities, but the same time, it can create safety and security hazards for both users and operators; and regulation can impact that balance.

Akpan and Morimoto (2022) examined travel-mode choices among smallholder farmers in Akwa Ibom State, Nigeria, with particular attention to the factors influencing the selection of different transportation modes in an environment characterised by poor road infrastructure. Methodologically, the study employed a quantitative approach and multinomial logit analysis to examine the determinants of transport-mode choice. The findings indicated that motorcycles were the most frequently used transport mode, followed by tricycles, reflecting the importance of these modes where conventional transportation options were constrained by road conditions. The study demonstrated that transport characteristics significantly influenced individuals' choices, suggesting that motorcycles and tricycles provide practical responses to mobility and accessibility challenges. Although the study focused primarily on transport-mode choice rather than direct economic welfare, its findings highlight an important mechanism through which transportation may influence economic participation: the ability to access workplaces, markets and other productive destinations. However, the study did not directly establish the effects of these transport modes on household income or business productivity.

Obakemi (2021) investigated the determinants of earnings among commercial tricycle operators in Ilorin metropolis, Nigeria. The study adopted a quantitative survey approach, administering questionnaires to 335 commercial tricycle operators and obtaining 321 valid responses for analysis. The study examined the relationship between operators' earnings and factors such as vehicle ownership, passenger volumes and union membership. The findings established that these factors were important determinants of income among commercial tricycle operators. This suggests that tricycle transportation constitutes a significant income-generating activity, with operators' earnings influenced by both operational and institutional conditions. Nevertheless, the findings also indicate that participation in the sector does not necessarily guarantee economic security, as operating expenses, ownership arrangements and institutional charges may reduce net earnings. The study provides useful evidence on the income-generating potential of tricycle transportation, although its focus on operator earnings leaves the wider economic implications for passengers, traders and small businesses insufficiently explored.

Owino et al. (2024) examined the motorcycle taxi sector in sub-Saharan Africa, focusing on its operational needs, practices and equity implications. The study adopted a multi-country research approach involving motorcycle taxi operators and relevant stakeholders across the region. Its investigation considered the role of motorcycle and tricycle transportation in mobility, employment, access to essential services and the broader socioeconomic environment. The findings indicated that these transport services facilitate access to markets, educational institutions and healthcare facilities while providing employment and livelihood opportunities. The authors argued that excluding the sector from formal transport planning could undermine recognition of its existing contribution to socioeconomic development. However, the study also drew attention to concerns relating to affordability,

equity and the need to incorporate the perspectives of operators, passengers and regulators into transport planning. Although the multi-country approach provides a broader understanding of the sector, differences in institutional arrangements, infrastructure and socioeconomic conditions across countries may limit the direct application of its findings to Kaduna State. This creates a need for context-specific empirical evidence on the economic and security implications of these transport modes in the study area.

Lenshie et al. (2022) investigated the political economy of informal transportation and urban and peri-urban mobility in Nigerian cities, with particular attention to the transition from motorcycle to tricycle transportation. The study employed a qualitative, political-economy-oriented approach to examine the relationship between transport regulation, informal livelihoods and changing mobility patterns. Its analysis considered how government restrictions on commercial motorcycles influenced the expansion of tricycles as an alternative means of transportation. The findings demonstrated that restrictions on one transport mode could encourage the adoption of another rather than eliminate the underlying demand for informal mobility. This suggests that transportation policies may reshape the structure of informal transport activities without necessarily removing the economic needs that sustain them. The study is relevant to the present research because it illustrates the interconnectedness of transport regulation, employment and accessibility. Nevertheless, its emphasis on political economy and institutional change does not directly quantify the effects of motorcycle and tricycle transportation on economic outcomes or security conditions in Kaduna State. The present study therefore extends this line of inquiry by examining the economic and security dimensions jointly within a specific geographical context.

In Kaduna State, Ebe Collins et al. (2025) examined the use of tricycles as a commercial passenger transportation mode in Kaduna metropolis. The study employed a descriptive survey design, collecting data from 330 tricycle operators and 200 users. The investigation considered factors influencing tricycle patronage and the socioeconomic reasons for operators' participation in the business. The findings indicated that flexibility, speed and accessibility were important factors influencing patronage, while many operators reported entering the sector to obtain employment or earn a livelihood. These findings confirm the growing importance of tricycle transportation within Kaduna metropolis and its contribution to mobility and employment generation. However, the descriptive nature of the study limits its ability to establish whether dependence on tricycle transportation is associated with broader improvements in household income, business productivity or other economic outcomes after controlling for socioeconomic differences. Furthermore, its primary focus on tricycle patronage does not provide an integrated assessment of motorcycle and tricycle transportation in relation to crime exposure, road safety and regulatory effectiveness. The present study addresses these limitations by examining both transport modes and their economic and security implications in selected local government areas of Kaduna State.

Adeniran et al. (2024) investigated paratransit-related crime in Akure, Nigeria. The study adopted an empirical research approach to examine criminal victimisation within the paratransit environment. The findings identified robbery, kidnapping, assault and other forms of crime associated with paratransit settings. The study highlighted how criminal opportunities may arise when vulnerable passengers encounter potential offenders in environments characterised by inadequate guardianship. However, the findings do not establish that transport operators are inherently criminal; rather, they demonstrate that certain transport environments may expose passengers to victimisation under particular conditions. The principal contribution of the study lies in highlighting the relationship between transport environments and criminal opportunities. Nevertheless, its focus on paratransit crime does not fully explain how operator registration, identification, monitoring and enforcement influence security outcomes in Kaduna State.

Evidence concerning road safety is more extensive. Dada et al. (2023) examined risky riding behaviours among motorcycle taxi drivers in Nigeria. The study employed an empirical approach to investigate drivers' perceptions and practices relating to motorcycle road

safety. The findings identified speeding, traffic violations, riding without headlights and psychoactive-substance use as important risky behaviours. The study also reported an association between anticipated economic benefits and risky riding tendencies, suggesting that the pursuit of higher earnings may influence operators' safety-related decisions. This finding provides a potential link between the economic pressures experienced by commercial motorcycle operators and road-safety outcomes. However, the reported association should not automatically be interpreted as proof of causation. The study is relevant to the present research because it suggests that road-safety interventions should consider not only operator behaviour but also the economic conditions under which motorcycle transportation operates.

The empirical evidence thus provides strong counter evidence to an economic-only explanation of the transportation of motorcycles and tricycles. They can experience injuries and unsafe driving while gaining access and employment, and this can occur together. However, it is not clear from the literature whether there is a universal causal relationship between the presence of motorcycles or tricycles and insecurity. Instead, risk seems to be controlled by the actions of operators, road infrastructure, registration, monitoring, policing and enforcement. Thus, the question to be answered is whether these conditions have an appreciable effect on the perceived security situation in Kaduna State.

The evidence suggests, then, that there is a more complex picture in the regulation. Unsafe practices and inadequate identification, criminal exploitation can continue, and over-restrictive regulation can have a negative impact on livelihoods and access to cheap mobility. Cooperation between transport operators and their users, transport unions, police and regulators is thus highlighted by Owino et al (2024). The empirical literature does not suggest that either "unrestricted" operation or a "total ban" are going to work; rather, it emphasizes the need for consideration of the institutional contexts in which regulation can ensure "legitimate mobility" while minimizing preventable risks.

2.4 Research Gap

The empirical literature identifies four important gaps: First, although there were some commonalities in transport and institutional outcomes, many studies examined these factors separately. First, the economic and security results are often analysed in isolation, despite being influenced by the same transport and institutional factors. Second, Nigerian research is focused in certain cities and tends to focus on specific aspects, like travel choice, revenue to operators, crime, road safety or effects of bans. Third, Kaduna-specific evidence is still sparse and is limited primarily to patronage outcomes in the tricycle sector or to the activities of the motorcycle riders and not to the integrated economic and security outcomes. Fourth, most of the evidence available for Kaduna is descriptive, and that makes it difficult to conclude whether outcomes observed are likely to continue after controlling for socioeconomic and regulatory factors.

The gaps are significant because sometimes simultaneous and even conflicting effects can be generated by motorcycle and tricycle transportation. What could be good for employment and markets can be bad for passengers or operators, in terms of road-safety or security risks. Likewise, regulation can have some effects in limiting certain risks, but also has some effects in terms of cost of livelihood and mobility. The current study, on the contrary, goes beyond the one-dimensional approach and investigates the motorcycle and tricycle transportation as interdependent but different influences on economic and security outcomes in Kaduna State.

This study's empirical value is that it tests these relationships with primary cross-sectional data, and separates motorcycle and tricycle transportation from a single homogeneous transportation mode. This allows analysis to test if the two modes are similarly or differently related to the economic and security outcomes and whether these relationships are still significant when controlling for relevant individual and institutional factors. Evidence generated from the activity can add to the understanding of the economic and security impacts of informal transportation in Kaduna State with consideration to context.

3. Methodology

3.1 Research Design and Sources of Data

The study is of quantitative cross sectional survey type with some key informant interviews. The study aims to explore the relationship between motorcycle and tricycle transport and economic and security outcomes for those who provide, use or rely on these transport options; the design is appropriate for this research question. The primary data will form the main source of evidence, and all relevant administrative evidence about transport regulation, road safety and security were used to provide contextual support.

Geographically, the study is limited to Kaduna metropolis. The locations chosen are suitable for studying the economic and security aspects of the motorcycle and tricycle transportation mode; they include dense urban, peri-urban and commercially active areas in which these modes are part of everyday transportation. The selected area also allow for a more detailed analysis of the variation between and within the metropolis to understand transport use, transport regulation and security conditions locally rather than assuming they would be uniform across the state.

3.2 Study Population and Respondent Categories

The quantitative population comprises four principal respondent categories whose experiences collectively capture both the supply and demand sides of motorcycle and tricycle transportation:

i. **Commercial motorcycle operators (Okada riders):** The 100 respondents provide information on employment, income, operating costs, working conditions, regulatory compliance, road safety and security experiences.
ii. **Commercial tricycle operators (Keke riders):** The 100 respondents provide information for comparing tricycle operations with motorcycle operations regarding livelihood opportunities, operating conditions, accessibility, regulation and security exposure.
iii. **Regular motorcycle and tricycle users/passengers:** The 100 respondents provide evidence on affordability, accessibility, travel-time benefits, convenience, personal security and exposure to transport-related risks.
iv. **Traders and small-business operators:** The 100 respondents capture the indirect economic effects of motorcycle and tricycle transportation through access to markets, customers and suppliers, movement of goods, employee mobility and continuity of business activities.

This is especially relevant with the inclusion of traders and small-business operators as the study looks at impacts to the economy rather than just transport operators. Their answers enable the analysis to differentiate direct effects on employment in the transport sector from the indirect economic effects created by the increased mobility and market connections.

3.3 Sample Size and Sampling Procedure

Given the absence of a sufficiently complete and unified sampling frame covering all four respondent categories, the minimum quantitative sample will be determined using Cochran's (1977) formula for large or indeterminate populations:

$$n = \frac{Z^2 pq}{e^2}$$

where $n$represents the minimum sample size, $Z$is the standard normal value at the selected confidence level, $p$is the estimated population proportion, $q = 1 - p$, and $e$represents the acceptable sampling error. At a 95% confidence level, with $p = 0.50$, $q = 0.50$, and $e = 0.05$, the minimum sample is approximately 384 respondents. The study will therefore target 400 completed questionnaires, which exceeds the minimum requirement and remains manageable within the scope of the article.

At a 95% confidence level, with an estimated population proportion of 0.5 and a margin of error of 0.05, the sample size is calculated as follows:

Step 1: Substitute the values into the formula.

$$n_0 = \frac{(1.96)^2(0.5)(1-0.5)}{(0.05)^2}$$

Step 2: Calculate the numerator.

$$n_0 = \frac{3.8416 \text{ X } 0.5 \text{ X } 0.5}{0.0025}$$

$$n_0 = \frac{0.9604}{0.0025}$$

Step 3: Calculate the minimum sample size.

$$n_0 = 384.16$$

The study employed a stratified sampling approach to ensure representation of the four respondent categories in Kaduna metropolis. Appropriate procedures will be used to recruit eligible respondents within each category, taking account of the availability of a comprehensive sampling frame. Cochran's formula yields a minimum of 384.16, which should conventionally be rounded up to 385. The target of 400 completed questionnaires exceeds that requirement. However, because the study uses category-based sampling and may not have a complete sampling frame, the 95% confidence level and 5% margin of error.

3.4 Instrument, Variables and Measurement

Information was gathered using a structured questionnaire with four sections: Respondent characteristics, Exposure to motorcycle and tricycle transportation, Economic outcomes and Security/safety conditions. The majority of attitudinal items will be measured using a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).

Two composite dependent variables were created. The Economic Impact Index (EII) will measure perceived and experienced impacts on employment and livelihood, market and workplace access, travel time savings, cost of transportation, business access and income. The Security Impact Index (SII) will be a measure of crime vulnerability, passenger/operator security, operator identification, monitoring, regulatory compliance, enforcement and road-safety exposure. Although conceptually separate from deliberate criminal victimisation, as described in Section 2, road safety will be included in the overall transport-risk measurement, which asks for respondents' perceptions of the overall security and safety situation.

The most important explanatory variables are transportation intensity in motorcycles (MOTOR) and transportation intensity in tricycles (TRIC). These will be assessed according to the frequency of operation or use and dependence on each mode. Intensity will be related mainly to frequency of operation for operators, and frequency of use for users and traders. This will be explicitly controlled in the estimation with respondent-type variables.

Key control variables will be age, sex, education, income, occupation, location, frequency of travel and regulatory exposure. However, they are included because other socioeconomic factors might affect both transport dependency and economic and security outcomes, which can lead to spurious estimation of relationships.

3.5 Model Specification

The study estimates economic and security outcomes jointly because the same transport and institutional conditions may influence both. The baseline equations are specified as:

$$EII_i = \beta_0 + \beta_1 MOTOR_i + \beta_2 TRIC_i + \beta_3 ACCESS_i + \beta_4 AFFORD_i + \beta_5 REG_i + \beta_6 X_i + \varepsilon_{1i}$$

$$SII_i = \alpha_0 + \alpha_1 MOTOR_i + \alpha_2 TRIC_i + \alpha_3 ACCESS_i + \alpha_4 REG_i + \alpha_5 X_i + \varepsilon_{2i}$$

where EII denotes the Economic Impact Index; SII denotes the Security Impact Index; MOTOR represents motorcycle transportation intensity; TRIC represents tricycle transportation intensity; ACCESS represents transport accessibility; AFFORD represents

transport affordability; REG represents regulatory and enforcement conditions; and Xrepresents the vector of socioeconomic and respondent-level controls.

Separate OLS estimations will first be undertaken for the two equations to establish baseline results. The principal estimation will then employ the Seemingly Unrelated Regression (SUR) framework developed by Zellner (1962). SUR is appropriate where two or more regression equations have different dependent variables but their disturbances may be correlated. In this study, unobserved factors associated with the local transport environment may influence both economic and security responses; jointly estimating the equations therefore provides a theoretically consistent and potentially more efficient estimation strategy.

The cross-equation relationship is represented by:

$$Cov(\varepsilon_{1i}, \varepsilon_{2i}) \neq 0$$

A test of cross-equation error correlation will be used to determine whether the SUR specification provides a meaningful improvement over separate OLS estimation.

3.6 Validity, Reliability and Diagnostic Procedures

The questionnaire will go through an expert review and be tested in a pilot survey prior to the main survey. Content validity will be determined by having items that are directly related to the economic and accessibility constructs, and the constructs of security and safety and regulatory constructs that have been developed from the conceptual and empirical literature. Cronbach's alpha will be used to determine the internal consistency of the composite scales and the interpretation will be based on the structure and purpose of the measurement instrument (Cronbach, 1951). If appropriate, an exploratory factor analysis will be conducted to validate the consistency around the proposed economic and security constructs of the items on the questionnaires.

The quantitative data will be analysed first through descriptive data (frequencies, means and standard deviation). Then, diagnostic tests will check multicollinearity, heteroskedasticity and model specification. The potential for excessive correlation among the explanatory variables will be checked by Variance Inflation Factors and suitable heteroskedasticity and specification tests will be conducted prior to interpretation of the regression results.

3.7 Hypotheses and Interpretation of Results

The empirical analysis will test the following null hypotheses:

H_{01}: Motorcycle transportation has no significant relationship with economic outcomes

H_{02}: Tricycle transportation has no significant relationship with economic outcomes

H_{03}: Motorcycle transportation has no significant relationship with security outcomes

H_{04}: Tricycle transportation has no significant relationship with security outcomes

Estimated coefficients, standard errors, probability values and appropriate model statistics will be used to test the hypotheses. The level of 1%, 5% and 10% will be used to determine statistical significance. But the significance of the results of the statistical tests will not be judged by itself the magnitude and direction of the coefficients will also be taken into consideration.

The relationships estimated in the study will be interpreted with caution, because the data are cross sectional in nature. The design can detect conditional associations and approximate effects, provided that they are not completely caused by observed characteristics, but reverse causality or unobserved confounding cannot be ruled out. The study will therefore refrain from reporting statistics as a proof of causation.

Finally, the survey will be voluntary, the purpose of the academic research with which the participants will have to do with the answers will be explained and the answers will be treated with confidentiality. The use of the respondent-level quantitative evidence and some institutional perspectives is planned to give a rigorous and yet brief empirical evidence on the economic and

security implications of motorcycle and tricycle transportation in Kaduna Metropolis.

Coding of Likert-scale questions

For statements measuring economic effects, security, road safety and regulation, a five-point Likert scale can be coded as follows:

Table 1: Five-Point Likert Scale

Response	Code
Strongly Disagree (SD)	1
Disagree (D)	2
Neutral (N)	3
Agree (A)	4
Strongly Agree (SA)	5

Source: Authors Compilation

4. Results and Discussion

This section presents and discusses the findings of the questionnaire survey on the economic and security implications of motorcycle and tricycle transportation in Kaduna metropolis. The analysis focuses on respondents' transport usage patterns, perceived economic contributions, security experiences, road safety concerns and assessment of the regulatory environment. The findings are interpreted in relation to the study's objectives, the Capabilities Approach and Routine Activity Theory, as well as the empirical literature reviewed.

Table 2: Summary of Key Questionnaire Findings

Dimension	Indicator	Reported finding
Transport use	Respondents using motorcycles most often	58%
Transport use	Respondents using tricycles most often	42%
Economic effects	Improved access to workplaces, markets and customers	97% agreement
Economic effects	Employment and self-employment creation	100% agreement
Economic effects	Reduced travel time and support for economic activities	95% agreement
Economic effects	Support for traders and small businesses	100% agreement
Economic effects	High or very high overall economic benefits	54%
Security	Poor monitoring and unregistered operations create crime opportunities	100% agreement
Security	Respondents reporting or witnessing a security incident in the previous 12 months	79%
Road safety	Respondents reporting or witnessing a road crash in the previous 12 months	95%
Road safety	Speeding and traffic violations create safety risks	95% agreement
Regulation	Registration and identification are inadequately enforced	95% disagreement
Overall assessment	High or very high overall security concern	75%

Source: Questionnaire survey, as reported in the study.

The results in Table 2 reveal an important duality in the role of motorcycle and tricycle transportation in Kaduna metropolis. On the one hand, respondents acknowledge substantial economic contributions, particularly in employment generation, accessibility, time savings and support for commercial activities. On the other hand, the findings indicate considerable concerns regarding personal security, road traffic accidents and weaknesses in regulatory enforcement. This suggests that the economic importance of these transport services coexists with significant social costs that require institutional and policy attention.

The transport usage pattern shows that 58% of respondents reported motorcycles as their most frequently used mode, compared with 42% for tricycles. This distribution suggests a relatively higher

reliance on motorcycles within the surveyed population. The difference may reflect variations in accessibility, flexibility, travel preferences and the suitability of the two transport modes for different journey requirements. Motorcycles may be particularly attractive for shorter journeys and locations where road access is constrained, while tricycles may offer greater passenger-carrying capacity. Nevertheless, the reported percentages describe respondents' usage preferences and should not be interpreted as the actual market shares of motorcycles and tricycles across Kaduna metropolis.

The economic findings demonstrate the importance of these transport services in facilitating productive and commercial activities. Specifically, 97% of respondents agreed that motorcycle and tricycle transportation improves access to workplaces, markets and customers. This finding highlights the role of intermediate transport services in reducing spatial barriers between households, employment opportunities and commercial centres. In an urban economy where access to formal and organised public transportation may be constrained, the availability of flexible transport options can improve the movement of labour, consumers and goods.

Furthermore, all respondents reportedly agreed that motorcycle and tricycle transportation creates employment and self-employment opportunities. This finding underscores the contribution of the sector to urban livelihoods, particularly through direct employment as commercial operators and indirect economic activities associated with vehicle maintenance, spare-parts trading, fuel distribution and other supporting services. Similarly, the reported 100% agreement that these transport services support traders and small businesses suggests that their economic contribution extends beyond passenger mobility. Small-scale commercial operators may depend on these services to access customers, transport merchandise and maintain business activities. The implication is that motorcycle and tricycle transportation functions as part of the wider urban economic infrastructure, supporting the circulation of labour, goods and services.

The finding that 95% of respondents agreed that these transport services reduce travel time and support economic activities further reinforces their economic significance. Travel time constitutes an economic cost because time spent commuting or moving goods could otherwise be allocated to productive and income-generating activities. Consequently, transport arrangements that reduce journey time can potentially improve labour mobility, market participation and the efficiency of small-scale business operations. This interpretation is consistent with the Capabilities Approach, which views accessibility as an important means through which individuals expand their practical opportunities to participate in economic and social activities (Vecchio & Martens, 2021). In this context, the economic value of motorcycle and tricycle transportation lies not only in the movement of passengers but also in the opportunities that improved mobility makes possible.

However, the finding that only 54% of respondents rated the overall economic benefits as high or very high introduces an important qualification. Although the responses to individual economic indicators are overwhelmingly positive, the overall assessment is comparatively moderate. This difference suggests that recognition of specific benefits does not necessarily translate into an equally strong assessment of the total economic value of the services. Possible considerations include operating costs, fare affordability, income uncertainty, service reliability and the risks associated with transportation activities. Indeed, the reported responses also indicate that all respondents agreed that operating costs negatively affect operators' earnings. This highlights a potential tension between the employment-generating capacity of the sector and the financial sustainability of individual operators. While the sector may create livelihood opportunities, the net economic gains available to operators may be constrained by fuel expenses, maintenance costs and other operating obligations. Thus, the economic contribution of these transport services should be assessed in terms of both the opportunities they generate and the costs associated with their operation.

The security findings present a more concerning picture. All respondents reportedly agreed that poor monitoring and unregistered operations create opportunities for criminal activities, while 79% indicated that they had experienced or witnessed a

security incident within the preceding twelve months. These findings suggest considerable concern about the security environment surrounding motorcycle and tricycle transportation. Weak identification systems and inadequate monitoring may make it difficult to establish the identities of operators, trace vehicles and investigate complaints when incidents occur. The implication is that regulatory weaknesses may reduce accountability and weaken the capacity of relevant institutions to prevent and respond to security threats.

The reported exposure to security incidents must, however, be interpreted cautiously. The 79% figure represents respondents who reported experiencing or witnessing an incident; it does not establish the prevalence of crime among all transport users or operators in Kaduna metropolis. Nor does it demonstrate that commercial motorcycle or tricycle operators are responsible for the reported incidents. Rather, the finding reflects respondents' reported exposure to security-related risks within the transport environment.

Routine Activity Theory provides a useful framework for interpreting these findings. The theory, developed by Cohen and Felson (1979), explains how criminal opportunities may emerge where suitable targets encounter potential offenders in the absence of effective guardianship. Applied to motorcycle and tricycle transportation, weak monitoring, inadequate operator identification and poor institutional oversight may create conditions in which passengers, operators and other road users become more vulnerable to criminal activities. The findings therefore reinforce the importance of effective monitoring, operator registration, identification systems and accessible complaint mechanisms as components of urban transport security.

Road safety constitutes another important dimension of the findings and should be distinguished from deliberate security threats. The survey indicates that 95% of respondents reported having experienced or witnessed a road crash within the preceding twelve months, while an equivalent proportion agreed that speeding and traffic violations create safety risks. These responses suggest that road traffic safety is a major concern within the surveyed transport environment. Unlike security incidents involving intentional harm, road crashes are generally associated with traffic behaviour, vehicle conditions, road infrastructure and the effectiveness of traffic regulation. The high level of reported crash exposure therefore highlights the need to strengthen preventive road safety measures.

From an economic perspective, road traffic accidents generate both direct and indirect costs. Direct costs may include medical expenses, vehicle repairs and property damage, while indirect costs may arise from lost working hours, reduced productivity, temporary or permanent disability and the loss of household income. For commercial operators, accidents can also interrupt income-generating activities and increase operating expenses. For passengers and traders, road crashes may result in additional financial burdens and disruptions to business and livelihood activities. Consequently, the economic benefits of motorcycle and tricycle transportation must be considered alongside the potential social and economic costs associated with unsafe operations.

The reported 95% agreement that speeding and traffic violations create safety risks suggests that respondents recognise the importance of responsible driving behaviour and traffic law compliance. In this regard, operator training, enforcement of speed limits, use of protective equipment, vehicle roadworthiness inspections and compliance with applicable traffic regulations are important measures for reducing preventable accidents. The findings also indicate that 92% of respondents agreed that road safety risks could be mitigated through enforcement and training. This supports the argument that the challenges associated with motorcycle and tricycle transportation should be addressed through improved operational standards rather than through an assumption that the services have no economic value.

Regulation emerges as a cross-cutting institutional issue linking the economic and security dimensions of the study. The reported finding that 95% of respondents disagreed that registration and identification measures were adequately enforced points to perceived weaknesses in the existing regulatory environment. Effective registration and identification systems can improve operator accountability, facilitate the verification of vehicle

ownership, support incident investigations and strengthen public confidence in commercial transport services. However, registration alone may not guarantee improved security unless it is accompanied by regular verification, reliable record-keeping, monitoring and effective enforcement.

5. Conclusion and Policy Recommendations

The study focuses on the economic, security and road-safety aspects of motorcycle and tricycle transport in Kaduna Metropolis, Nigeria. The questionnaire results suggest that these transportation tools help people get to their jobs and markets, help small businesses and decrease the time one has to spend on these trips, and offer jobs. But respondents also voiced high levels of concern with the risk of crime, road crashes, speeding and inadequate registration and identification enforcement.

The results show that the motorcycle and tricycle transportation system offers a dual benefit both as an economic enabler and a source of security and road-safety concerns. Therefore policy should focus on effective regulation, not unnecessary restrictions which may damage mobility and transport related livelihoods. Strategies recommended to be put in place, include the strengthening of operator registration and identification, the enforcement of traffic rules, regular safety training, the strengthening of incident reporting systems and improving the cooperation between transport authorities, security agencies and operators' associations. These actions should be taken in conjunction with periodic review of their effectiveness.

Conclusions of the study needs to be interpreted based on the questionnaire summary available. Claims about causal relationships and/or the statistical significance of the observed patterns require verification of the underlying responses and further statistical analyses. However, the findings reported here highlight the need for a transport policy that is balanced, ensuring the protection of livelihoods and economic access while enhancing road safety and passenger security in Kaduna State.

Based on the findings of the study, the following recommendations are proposed:

i. The registration and identification of commercial motorcycle/tricycle operators should be enhanced by verifiable identity cards, registration of vehicles and the constant updating of databases for purposes of accountability and security by Kaduna State Government.
ii. Traffic authorities should step up their enforcement of traffic law to curb road accidents, especially with regard to vehicle roadworthiness and use of protective equipment, and speed limits.
iii. Periodic training and certification for commercial operators should be done on defensive driving, traffic laws, passenger safety and emergency response.
iv. Transport operators, associations of transport operators and security authorities should cooperate to develop efficient systems for reporting incidents, monitoring operations and investigating reported security incidents.

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