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Impact of E-Hailing Motorcycle Services Adoption on Motorcycle Ownership Trends

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Abstract
The worsening transportation crisis in the Philippines has contributed to a significant rise in motorcycle ownership, particularly in urban regions. This study examines the factors influencing the surge in motorcycle ownership within the National Capital Region (NCR), focusing on Gross Regional Domestic Product (GRDP), labor productivity, and the emergence of e-hailing motorcycle services. Using regression analysis, specifically Ordinary Least Squares (OLS) regression, the study evaluates the relationships between these variables and motorcycle ownership. Diagnostic tests, including checks for autocorrelation, multicollinearity, heteroscedasticity, normality of residuals, the Chow test for structural breaks, and the Ramsey RESET test for model specification, were conducted to ensure the validity of the model. The findings indicate that GRDP, labor productivity, and the availability of e-hailing services each have a positive and statistically significant impact on motorcycle ownership. These results underscore the role of GRDP, labor productivity, and the presence of e-hailing services in shaping transportation choices in the region. The study provides insights that may inform policymakers in addressing the transportation challenges facing the Philippines.

Keywords
E-Hailing Motorcycle Services, GRDP, Labor Productivity, Income Disparity, Motorcycle Ownership

INTRODUCTION

Transportation has been important in human society because it is a fundamental mechanism for facilitating essential convenience and connectivity. This duality of purpose underscores the role of transportation as a bridge in the development that supports all economic activities in a way that allows people to access essential goods, services, and opportunities for a vibrant economy (Gudmundsson et al., 2016). However, many developing Asian cities are experiencing severe traffic congestion due to strong population growth, high density, and an increasing use of private vehicles (Boquet, 2019). The increasing number of vehicles on the road, resulting from more people moving into urban areas, worsens traffic congestion.

Several forms of public transit are available in the National Capital Region, including both formal and informal services. Even so, privately owned companies operate most of these services in Metro Manila due to insufficient government funding for public transportation options and the rising demand for urban travel (Cano, 2018). According to a 2017 study by the Boston Consulting Group commissioned by UBER Technologies Inc., Metro Manila is the most

congested city in Southeast Asia, causing people to spend an extra 66 minutes stuck in traffic (Chin et al., 2017). This has led commuters to seek alternative modes of transportation that are fast and reliable (Monchambert & de Palma, 2014). Consequently, flexible means of transportation have appeared as a direct response to the evolving needs of urban mobility.

One such transformative mode is e-hailing, which uses mobile applications accompanied by GPS to make it easier for service providers to reach their passengers (Chan et al., 2016). E-hailing or ride-sourcing are recognized as on-demand services with vehicle procurement systems that heavily rely on utilizing digital applications accessible via the Internet (Jais & Marzuki, 2020).

The E-HMS began its operations in the Philippines when Grab, a pioneer in transportation services, launched in the market in 2013 to compete with its counterpart, Uber, which made its entrance into the market in 2014. Grab quickly became a dominant player by offering transparent and accountable rides. Since then, other e-hailing services have emerged, including Angkas, JoyRide, Move It, and various other players, all contributing to the potential solution for the traffic congestion issue.

Before E-HMS was adopted, motorcycles were a popular form of public transport in the country, with options like tricycles, *habal-habal, motorela,* and *bajaj* available (Balaria et al., 2017). *Habal-habal* has become increasingly popular in Metro Manila, even though it is usually more common in the provinces. Advancements in information and communication technology have transformed *habal-habal* into a personalized public transport system that is accessible through wireless mobile applications (Hunaiti et al., 2018). As a result, motorcycles are now becoming a legitimate mode of transportation through a systematic and app-based transport method, similar to neighboring Southeast Asian countries such as Indonesia and Vietnam. (Asian Development Bank, 2020)

As mentioned earlier, the Philippines has undergone substantial population growth, rapid urbanization, and an increase in income levels over the past few decades. According to a report, 40.2% of Filipinos belong to the middle-income class, 58.4% belong to the low-income group, and only 1.4% belong to the high-income segment (Albert et al., 2018). A significant portion of the Filipino population belongs to the lower-middle income class, and they tend to use e-HMS for commuting. The trend toward private motorization is rising among the middle class in Manila. This shift is happening because they find public transportation inconvenient and inefficient, mainly due to its poor integration (Mabazza, 2017). Another study found that students and young professionals are the primary users of e-HMS (German & Cabacungan, 2021).

E-HMS applications offer an alternative to conventional taxi cabs, promising lower fares, faster service, quality, and accessibility during rush hours and when traditional taxicabs are unavailable. According to Lee (2019), these new e-hailing applications allow consumers to bypass traditional taxicabs. In many cities, picking up passengers on the street without the proper government license is illegal, leading to concerns about the reliability of taxi drivers. Beltran et al. (2019) indicate common complaints among commuters in Metro Manila when riding taxis, such as overcharging, rude drivers, and reckless driving.

In contrast, e-hailing drivers are considered more reliable and professional than traditional taxi drivers as they adhere to safety standards set by the companies they work for. The platform accurately calculates fares, often offering rates lower than those of traditional taxi rides due to competition among drivers. In fact, e-HMS companies implement fare control regulations, resulting in a common fare structure among ride-hailing companies in Southeast Asian countries (Chalermpong et al., 2022). Furthermore, e-HMS has expanded its services to address complaints and passenger feedback. Satisfaction and loyalty are strongly linked in e-HMS, reflecting the perceived benefits of the booking method and adherence to safety standards (Nguyen-Phuoc et al., 2020).

As claimed by Elnadi & Gheith (2022), e-HMS thrive due to the advantages they offer, including time and cost savings, avoidance of parking issues, and reduced need for car ownership. Passengers can now book a ride from anywhere with just a few taps on their smartphones, significantly reducing the wait time compared to hailing taxis or navigating public transportation schedules. By being affiliated with the routes on Google Maps, passengers find e-hailing services convenient and perceive booking apps' quality, such as information accuracy, functionality, design, and route detection (Nguyen-Phuoc et al., 2021). This helps both drivers and passengers in terms of convenience compared to traditional taxis, which face different problems in terms of passenger reliability due to the inaccuracy of information.

Tourists also find satisfaction with the safety and reliability of e-HMS applications (Jaman & Rahman, 2023). The Philippines has enforced e-HMS regulations nationwide to allow app-based transportation services to operate nationwide. This is in response to the growing demand for mobility, especially in cities like Metro Manila and Metro Cebu. However, due to safety concerns and regulatory issues, the Land Transportation Franchising and Regulatory Board (LTFRB) has yet to grant franchises for such e-ride hailing. Currently, a four-year pilot study is evaluating the safety and feasibility of motorcycle taxis as a mode of public transportation (Que, 2021).

The table provides an overview of the key players of e-HMS companies that primarily operate in Metro Manila, Metro Cebu, and other urban areas within the Philippines, with the exception of Move It, which only operates in Metro Manila. Currently, four key players dominate the e-HMS industry. While they differ in terms of their primary service offerings and strategies, they collectively, aim to provide accessible, affordable, and efficient transportation solutions for urban residents

Table 1 E-Hailing motorcycle services in the Philippines

Key Players	Operating Areas	Launch Date
Grab	Metro Manila, Cavite, Laguna, Bulacan, Rizal, Baguio, Naga, Pampanga, Metro Cebu, Bacolod, Iloilo, Davao, Cagayan De Oro, Zamboanga	August 2013
Angkas	Metro Manila, Metro Cebu, Cagayan De Oro	December 2016 (Makati, Philippines)
Joyride	Metro Manila, Rizal, Bulacan, Cavite, Laguna, Metro Cebu	December 2019 (Metro Manila, Philippines)
Move It	Metro Manila	Launched in 2019, Acquired by Grab in August 2022

This study will address a research gap by focusing on the economic perspective of e-HMS adoption in the National Capital Region (NCR). While previous studies have examined the convenience and social aspects of e-HMS, there is a lack of detailed analysis regarding its aggregate impact on motorcycle ownership trends. This study aims to fill this gap by providing a comprehensive understanding of how the adoption of E-HMS influences the patterns of motorcycle ownership in the Metro City. Through providing empirical evidence on the impact of e-HMS adoption on motorcycle ownership trends, the study can inform the development of policies and strategies aimed at promoting efficient and sustainable transportation systems in the country.

Understanding the impacts of e-HMS on various transportation externalities is currently an active area of research, as highlighted by Bilgin et al. (2023). The rapid rise of e-HMS over the past decade has yielded diverse effects on the economic system. On the other hand, motorcycle ownership has significantly decreased due to the convenience that e-HMS offers to consumers, rendering them a reliable alternative to private cars (Hawkins & Kockelman, 2024).

Research on the consequences of ride-sourcing draws various conclusions. Some studies point to advantages such as shorter wait times (Rayle et al., 2016), avoidance of stress and time lost from driving, lower costs, reduced traffic, particularly when sharing rides (Etminani-Ghasrodashti & Hamidi, 2019), and improved access to public transportation, particularly for first and last-kilometer trips (Ghaffar et al., 2020; Habib, 2019).

The rapid urbanization in Southeast Asian countries has driven the expansion of transportation services, including e-HMS. Consequently, major companies like Grab need to ramp up their driver recruitment efforts to meet the growing demand from passengers.

Additionally, addressing safety concerns, research by Edelman & Geradin (2015) and Malos et al. (2018) underscores the importance of training drivers to mitigate risks by increasing their awareness of potential hazards and providing them with preventive measures. However, there are added risks associated with insurance, especially in ride-sourcing services like Uber. Despite the higher likelihood of accidents due to factors such as frequent driving, longer distances, passenger presence, and navigating unfamiliar and congested areas while using smartphone applications, drivers are often encouraged to opt for personal insurance over commercial insurance.

This study aims to investigate the relationship between the adoption of e-HMS and trends in motorcycle ownership in NCR. Additionally, it seeks to assess the impact of the study's findings on motorcycle ownership, specifically regarding increases or decreases in ownership rates. Specifically, this study intends to determine the relationship between e-HMS and motorcycle ownership levels. It interprets the results to understand the underlying factors influencing changes in motorcycle ownership due to e-HMS, addressing economic implications. More importantly, the study evaluates the effects of e-HMS adoption on motorcycle ownership in the National Capital Region, extends insights through comparative analysis to other studies, and makes recommendations for urban transport policy and planning to mitigate traffic congestion by balancing motorcycle growth regulation in the National Capital Region.

LITERATURE

Income and Motorcycle Ownership

The Gross Domestic Product (GDP) reflects the economic prosperity of a nation. This serves as an indicator of an individual's purchasing power as well as their ability to consume various goods, particularly their ability to procure motorcycle vehicles (Chu et al., 2022). As GDP rises, there's an associated increase in disposable income, which enables individuals to allocate more resources toward acquiring motorcycle vehicles. This correlation between rising GDP and increased motorcycle purchases underscores the influence of improved financial status on consumer behavior. This perspective is buttressed by empirical evidence demonstrating a surge in motorcycle ownership, particularly in Southeast Asian nations undergoing rapid urbanization, as elucidated by Chu et al. (2022).

Motorcycles dominate urban road traffic across Asia (Fevriera, 2021). According to Ngoc et al. (2022), in Southeast Asian countries with a rising economy, such as the Philippines, motorcycles are favored over car ownership due to their affordability and efficiency as a mode of transportation. Furthermore, in other Southeast Asian countries like Indonesia, various factors such as household size, income levels, and transportation costs have a positive association with motorcycle ownership, highlighting their impact on individual decisions to own a motorcycle (Suthanaya & Winaya, 2023). A similar trend is observed in Akure, Nigeria, where higher income and larger household size are linked to motorcycle ownership (Oyedepo, 2015).

Poi et al. (2021) states that numerous studies have covered the proportionate increase of motorcycle ownership to a country's GDP as development necessitates enhanced mobility. This highlights the principle that to further stimulate the economy, individuals require efficient transportation options other than the traditional modes of transportation. This trend can be observed in countries like Indonesia, Bangladesh, China, and some urban areas in the USA where ownership has gone up and even e-hailing motorcycle (E-HMS) systems are introduced due to the influx of motorcycle ownership. This further expounds on the fact that, as GDP increases, consumer behaviors are affected.

In less economically advanced countries such as Vietnam, Malaysia, and Cambodia, most individuals who are usually middle-income earners, opt to purchase motorcycles due to their affordability and practicality in everyday living, as highlighted by Law et al. (2015). The convenience brought upon by having a personal vehicle enhances the quality of life of middle-income earners who contend with constant stress caused by traffic congestion and other challenges associated with public transportation.

On the other hand, Bastos et al. (2020) underscore the correlation between motorcycle adoption and a nation's level of development, suggesting that factors contributing to an enhanced quality of life can curtail the reliance on personal motorcycle vehicles. Nishitateno et al. (2014) further elaborate on this dynamic, positing that motorcycle ownership experiences an initial ascent followed by a decline as countries transition from impoverishment to affluence. Moreover, a study by Wadud (2020) in Bangladesh stated that introducing online motorcycle taxis eliminates the necessity for individuals to own a motorcycle. This initiative was prompted by the densely populated capital city of Dhaka, which is currently grappling with severe traffic congestion issues (Jaman & Rahman, 2023)

In examining the global landscape, it becomes evident that the concentration of urban populations, particularly in capital cities, significantly shapes the ownership and utilization of motorcycles, aligning with the prevailing population dynamics. A notable illustration of this trend can be observed in Ho Chi Minh City, Vietnam, where motorcycles constitute over 80% of all transportation journeys (Chu, 2019). This statistic underscores the profound reliance on motorcycles within densely populated urban centers, reflecting the symbiotic relationship between demographic density and transportation preferences.

As nations forge ahead in industrial advancement, the imperative to embrace diverse mobility solutions becomes manifest. Urbanization emerges as a catalyst for heightened motorcycle ownership, precipitated by the burgeoning demands of burgeoning urban populations. This symbiotic relationship underscores the indispensable role of motorcycles in facilitating daily commutes and fulfilling diverse transportation needs amidst evolving socio-economic landscapes. The future demand for motorcycles hinges on countries' comprehension of the factors underpinning motorcycle ownership (Oyedepo & Etu, 2015).

Income disparity and e-HMS

Acheampong et al. (2020) observed an increase in prevalence of on-demand platform mobility services in cities, as noted by Southeast Asian countries, such as Malaysia, which have advanced their e-HMS to be on-demand, relying on network dependency and specific digital applications accessible via the internet (Jais & Markuzi, 2020). The integration of this transportation mode in the Philippines has notably eased traffic conditions in its urbanized cities.

In the Philippines, key players in e-HMS are rising in services rendered. Despite areas in need of improvement and investigation, rapid development in urbanized areas, driven by population growth, infrastructure expansion, and increasing land prices, tends to raise the demand for alternative transportation modes. Like in other Asian countries, the impact of e-HMS and their progressive evolution has captured the preferences of lower to middle-income commuters (Aritenang, 2024).

With the progressive growth of the population, the urban landscape of the Philippines has undergone significant transformation, marked by the emergence of innovative transportation solutions. This includes a rise in the number of commuters and motorcycle ownership, alongside the introduction of e-ride-hailing services particularly in urban cities. Metro Manila, the capital of the Philippines, leads the consumption of e-HMS services in the Philippines as its residents and everyday commuters utilize numerous e-HMS services such as Angkas, Joyride, Grab and Move It (Rith, 2020). The introduction of e-HMS has eased numerous challenges posed by the transportation system of Manila, most notably the pervasive traffic congestion.

However, alongside the praise for its convenience, it is imperative to consider government policies to strengthen the concept and mitigate traffic congestion. Even though traffic congestion is unavoidable and already exists, the Philippine government can, on the one hand, unite LGUs—first in Metro Manila—and establish traffic regulations. Coordination of traffic management initiatives is hampered by Local Government Units (LGUs) inconsistent traffic policies in Metro Manila (Francesca et al., 2019).

Innovative transportation initiatives are often implemented to alleviate traffic congestion, leading many developed and developing nations to adopt Bus Rapid Transit (BRT) systems. However, a study conducted in Jakarta by Chiu (2022) challenges the efficacy of BRT systems, suggesting that instead of increasing passenger ridership, they have led to a notable surge in motorcycle ownership. Despite efforts to enhance public transportation systems, urbanized areas in Southeast Asian regions continue to grapple with encouraging commuters to utilize BRT systems, despite their affordability. While some Southeast Asian countries, particularly Thailand, have achieved success with BRT systems in terms of time management, as noted by Satiennam (2016), their significant impact on commuters' mode choice perpetuates heavy reliance on private motorcycles.

In the Philippines, despite efforts to implement rail transport systems, existing lines suffer from insufficient capacity, speed, and service quality. Overcrowded trains and frequent breakdowns further exacerbate the unpleasant commuting experience, necessitating significant upgrades to urban transportation services and infrastructure in Metro Manila and Metro Cebu.

Moreover, in contrast to traditional jeepney vehicles, which require all passenger seats to be filled before departure (Cerio, 2017), motorcycles have emerged as a more practical option for daily commuters. Commuters have the flexibility to use their motorcycles for commuting to work or running errands, or they can opt to book a ride through e-HMS applications. Additionally, the rise of e-HMS services has increased the popularity of motorcycles among commuters. Instead of waiting for public transportation or dealing with the uncertainties of traditional jeepney routes, commuters may easily book a ride using e-HMS applications and experience personalized transportation services suited to their specific needs and timetable. This mix of personal mobility and on-demand transportation options has considerably improved many Filipinos' commute experiences, fueling the growing popularity of motorcycle ownership in the country's urban areas (Rith, 2020).

Furthermore, the rise in car ownership due to population growth and improving living standards has compounded traffic congestion in these urban centers (Boquet, 2019). Considering that private transportation accounts for a large portion of emissions that are harmful to the environment, it is essential that we learn more about the factors that influence people's choices between driving their vehicles and using more sustainable alternatives (Lanzini & Khan, 2017). In addition, Bria et al. (2021) asserted that environmental elements and the work environment affect the mode of transportation used for work visits.

According to Hamzah & Tanwir (2020), Asian countries, excluding Japan, have experienced significant growth in population and economy over the past three decades. However, this rapid expansion has coincided with a parallel increase in traffic congestion (Kitamura et al., 2018). Urban traffic and commute issues have become more severe due to a combination of growing urban mobility needs and dwindling public transit options. E-hailing transportation options have become well-liked solutions to deal with these problems, enabling commuters to schedule journeys through smartphone apps. Yet, the rise in the total number of motorcycles has worsened urban traffic congestion.

It makes sense that riding motorcycles and using e-HMS are both quite popular, given the environment that the nation has created. Considering that the Philippines has some of the worst traffic in the world. Daily commuters, including working individuals and even students, perceive their commutes as being challenging enough to tolerate by nature. Even with the creative adjustments made to the transportation system, the issue of long wait times persists. This might be attributed to several causes, including the number of people commuting daily, the surge of working people moving to Metro Manila, and the unavoidably long lines. As a result, commuter stress was made worse by traffic congestion in the Philippines (Tenorio et al., 2017).

Introducing e-HMS in the Philippines' busiest cities holds promise for reducing traffic congestion. However, it may inadvertently discourage motorcycle ownership, as e-HMS offer unparalleled convenience and time savings for commuters. This trend is evident in other Southeast Asian nations like Indonesia, where e-HMS implementation has garnered widespread public approval and yielded favorable outcomes (Almunawar et al., 2021).

The usage of e-HMS has increased significantly since its introduction in the Philippines. As the government strives to shift to more sustainable transportation solutions, motorcycle ownership becomes a focus of research, particularly in Metro Manila. A variety of factors determine the prevalence and features of motorcycles used as primary vehicles by e-HMS users. However, population density stands out as a crucial driver, with denser locations being associated with greater wages (Uy, 2022).

However, despite the success of e-HMS in the urban cities in the Philippines, the disparity in the prevalence of such service to the rest of the country, particularly in rural areas, has caused the persistence of traffic congestion. For instance, Grab does not provide e-HMS services in rural areas, the company solely focuses on food-delivery instead. In addition, Grab does not offer motorcycle options in their e-hailing services in rural areas in contrast to urban cities such as Metro Manila which are always readily available. Furthermore, key players in the e-HMS industry-Move It and Angkas-does not extend their services to other than urban cities in the Philippines.

Due to this, private vehicles dominate limited road networks and the population continuously grows exponentially, traffic congestion presents substantial obstacles to rural transportation. Even though the government, foreign creditors, and big businesses are making an effort to address the problem by modernizing public utility vehicles and developing new transportation infrastructure, these initiatives frequently put economic gain and technocratic expertise ahead of genuine civil society participation in transportation planning (Pojani, 2020).

The lack of e-HMS has contributed to the severe traffic congestion and pollution in rural areas. Instead of utilizing motorcycles, commuters are prompted to use private vehicles, taxis, or other multi-seater vehicles due to the lack of options offered which can lead to further traffic congestion and environmental pollution.

Truthfully, the evolution of e-HMS has generated significant market tension with conventional taxi services, impacting their demand (De Souza Silva et al., 2018). In the Philippines, the introduction and emergence of key players in e-HMS have profoundly affected the flow of services rendered by conventional taxis. For instance, motorcycles are perceived to enhance passenger convenience by providing predetermined fares before booking confirmation, thereby reducing fare issues and potentially minimizing road traffic (Ong et al., 2024).

As other cities continue to grow, introducing e-HMS to other regions of the Philippines may offer a viable way to improve passenger convenience compared to Metro Manila's approach to traffic systems and its evolving e-HMS plan. Adopting e-HMS leverages its efficacy in providing riders safety, workforce expansion, and employment opportunities. The introduction of e-HMS outside areas of Metro Manila has a good opportunity to mitigate traffic constraints and provide convenience and employment to numerous individuals, whether or not they own motorcycles.

Labor Productivity and Motorcycle Ownership

In metropolitan cities such as Metro Manila and Metro Cebu, the transportation system significantly impacts labor productivity. It allows individuals to move from one place to another, whether it is commuting to and from work or by communicating with one another in different areas of the city; transportation plays a big role, particularly for ordinary commuters (Paronda et al. 2017). The daily activities of these workers in metropolitan cities highly rely on transportation, which can impact their labor productivity and can translate to higher wages and better working conditions (Bayon et al. 2023).

Labor productivity is defined by Pugel (2020) in his book International Economics as the number of units of output a worker can produce in an hour. It is calculated by dividing the total output by the total number of hours worked. The International Labour Organization (ILO) emphasizes the importance of labor productivity in a highly productive economy. Employment can be significantly impacted by labor productivity. As businesses and firms become more productive, they can produce more goods and services, which often leads to business expansion and a greater demand for workers. This will result in higher tax revenues as well in which the government highly benefits from (Latief et al. 2023).
However, in metropolitan cities in the Philippines, numerous obstacles hinder an increase in labor productivity. According to Abasiz & Sezer (2012), logistics is a major economic industry, and its significance is growing with globalization. This industry is vital to global economic growth, as most other industries depend on efficient logistics. E-hailing services have grown at an exponential rate as a response to the challenges that commuters encounter in metropolitan regions (Najiha & Herman, 2023).

Access to employment opportunities is crucial for both employers seeking workers with the right skill sets and job seekers looking for suitable positions. However, data indicates that, on average, commuters are finding it increasingly difficult to reach available jobs, whether due to distance or extended commute times (Barkley et al. 2018). Commuters are increasingly turning to motorcycles to avoid the inconveniences of traffic congestion and long wait periods associated with traditional modes of transportation. By using e-hailing, commuters can better manage their time, preventing tardiness to work and reducing the negative impact on their labor productivity (Tang et al. 2019).

Furthermore, the flexibility of e-hailing motorcycle services allows workers to manage their time more efficiently due to the option of on-demand or advanced booking, thus increasing their outputs and productivity in the office. A comfortable and secure commute can foster a more positive outlook, resulting in better focus and productivity once at work. Shorter commute times are also linked to increased economic mobility across generations (Wu et al. 2021).

The expansion of motorcycle services has completely transformed transportation while also creating employment opportunities for an increasing number of people (Wang et al, 2018). In the Philippines, Grab leads the list with 40,000 riders, followed by Angkas with 30,000, Move It with 6,000, and Joyride with 1,800 riders, according to their respective statistics in 2023.

Due to high competition from other riders, labor productivity is mainly influenced by the number of trips completed per day and the amount of income generated. (Chalermpong et al, 2022). These factors work together to ensure the success and long-term viability of both individual riders and the e-hailing industry. An increase in labor productivity of these riders, also means a boost in economic activity in the Philippines (Limpin, 2018).

Labor productivity in the motorcycle industry has a significant impact not only on the customers who use these services, but also on the drivers themselves. Increased productivity for drivers means greater earnings, work satisfaction, flexibility, and opportunity for professional development (Davidescu et al. 2020). It allows them to successfully manage their schedules, balance work and life commitments, and provide excellent service to passengers. Finally, initiatives to increase labor productivity benefit both passengers and drivers, contributing to the overall profitability and sustainability of the e-hailing motorcycle industry (Zhong et al. 2022).

E-Hailing Motorcycle Services and Motorcycle Ownership

E-HMS facilitates economic sharing activities by allowing community members to offer their services to consumers via online platforms. This dynamic not only generates employment prospects for local individuals in metropolitan areas, but also contributes to the sharing economy's quick expansion and prosperity (Yapp & Yeap, 2023).

E-HMS is utilized by the public as it poses the potential to offer a range of benefits to individuals needing to combine multiple activities (Ahmed & Hyland, 2022). Alongside this matter, motorcycles are a primary mode of transportation for students (Chun et al., 2019). This benefits students and contributes to the efficient utilization of the fuel by e-HMS drivers.

Furthermore, since Metro Manila and other NCR areas are densely populated, the majority of employed individuals choose to live there for convenience and proximity to the workplace. These individuals often employ the service of e-HMS compared to other modes of transportation due to the convenience e-HMS brings. According to

Adriano & Su (2017), e-HMS companies that use motorcycles to transport passengers, such as students and working adults, to their destinations seem to favor their applications, albeit only slightly.

While the trend of e-HMS and the growing number of motorcycle owners tend to develop gradually, factors such as safety and regulation are also considered by commuters. E-HMS companies are legally binded to carry passengers to their destinations with the assurance of safety, comfort, and security making it a dependable means of transportation. According to Gumasing et al. (2023) Angkas, one of the leading e-HMS services in the country has an insurance coverage of P200,000 medical reimbursement in case any passenger and rider gets into an accident as well as a P500,000 coverage for death and dismemberment. This insurance policy also added favor to utilizing e-HMS than acquiring a personal vehicle, most especially to middle-income earners.

Similarly, Grab, a major player in Southeast Asia's e-HMS transportation sector, has prioritized safety, thereby enhancing customer relationship engagement (Park & Kim, 2022). As e-HMS continues to grow exponentially across Southeast Asian countries, they are reshaping lifestyles and commuting patterns by expanding services and creating unique value propositions for passengers within the digital supply chain.

In support of this, there are additional reasons why passengers choose to use e-HMS these days rather than own a motorcycle or other private vehicle. These include factors such as peer influence, the amiable demeanor of drivers, and the desire to circumvent the inconvenience associated with auto or motorcycle maintenance and repairs (Rayle et al., 2016).

According to Chuenyindee et al. (2022), the dependence of commuters to e-HMS are evident even with the absence of legitimate e-HMS services in some areas. Instead of procuring personal motorcycles, some individuals in an attempt to save money and ease their daily commutes, commuters choose to use the illicit ride-hailing service known as "*habal-habal*," provided by users who are not affiliated with ride-hailing services.

Despite the inherent risks of commuting via unregistered motorcycle services, some commuters continue utilizing them because of the convenience they provide in the face of heavy traffic congestion. Furthermore, this mode of transportation is well-known for its significantly lower cost as well as short wait periods. For low- to middle-income Filipinos, the perceived benefits of using *habal-habal* outweigh the potential risks, as it provides a preferable alternative to dealing with chronic stress caused by the deteriorating public transportation system along with the added burden of purchasing, maintaining, and driving a personal vehicle.

While these services offer an alternative to private vehicle ownership and solve issues in congested areas, they also frequently function as a supplement, providing convenience, independence, dependability, and comfort to select travelers. These changing trends suggest that e-HMS are part of a larger shift toward shared mobility solutions, rather than a direct replacement for private motor vehicle ownership. Government policies play a crucial role in shaping the success of e-HMS. For instance, the Indonesian government has implemented various policies regarding online transportation systems, including e-HMS apps. The effectiveness of these policies largely depends on their implementation (Ambarwati, 2020). Therefore, governments must formulate and enforce policies that support the sustainable growth of e-HMS while addressing potential challenges such as traffic congestion. Alongside this matter, Pojani (2020) emphasizes the need to acquire knowledge on urban transport sustainability in Southeast Asian countries like the Philippines, Thailand, and Indonesia, as problems with transportation planning tend to occur while innovative transportation modes like e-HMS platforms continue to develop, and key players continuously opt to expand their services in other urbanized areas.

The effects of legislation on the quality of service provided by e-HMS transportation types in Metro Manila, Philippines cannot be overseen. Efficiency, security, affordability, and lessening of traffic are the criteria used to assess their potential for environmentally friendly transportation. When utilizing Transportation Network Vehicle Systems (TNVS), commuters emphasize convenience, safety, dependability, and reduced wait times, according to previous insights.

With the growing demand for e-HMS services among Filipino commuters, many people have seen this as a profitable revenue opportunity. By investing in comfortable motorcycles, an increasing number of riders are entering the e-HMS sector to satisfy the needs of Filipino commuters. This tendency is highlighted by Angkas' ambitious objective of creating one million job possibilities in the e-HMS industry according to Gumasing (2023).

This rise in the economy is discussed by Chu (2019) in which she states motorcycle ownership in the Philippines tends to increase throughout the early phases of the Consumer Price Index (CPI), as purchasing power rises. However, after a certain threshold level is reached, greater CPI (showing lower purchasing power) has the opposite effect, resulting in a decrease in motorcycle ownership. Notably, as urbanization increases, so does the turning point for this tendency. Estimation results show that the inverse-U association between motorcycle ownership and GDP in the Philippines changes with purchasing power and urbanization levels.

In addition to job prospects, Filipinos were prompted to own motorcycles to avoid the problems of public transit, including long wait periods and dealings with difficult e-HMS drivers. Individuals who owned their own vehicles had more control over their schedules and felt more comfortable when traveling. The tension associated with canceled reservations or troublesome riders was reduced by possessing a personal motorcycle, which gave people control over their source of transportation (Ngoc et al., 2023).

Another significant benefit of owning a motorcycle was the ability to travel to remote or inaccessible sites, particularly in rural areas with few public transportation choices. Due to the lack of e-HMS in rural areas, there is only a

limit of destinations an individual can go to with these services. Hence, motorcycles also provided a sense of freedom and empowerment, especially for people who had to travel long distances on a regular basis either for work or leisure.

As the world continues to adopt innovative technologies, so does the transportation sector. With the socioeconomic transformation of cities worldwide continuously booming due to increasing urban sprawl, the sustainability of transportation systems needs assessment (Dingil et al., 2021). The provision of e-HMS applications has significantly changed consumers' preferences which also makes its platforms a huge competitor of traditional taxi services (Bilgin et al., 2023). With improvements in lifestyle, technology savviness, and social influences, the usage of e-HMS applications has shaped public perceptions toward the evolution and improvement of public road transportation (Olayode et al., 2023).

E-HMS has evolved economically as it progressed throughout the years, benefiting both riders and commuters. While transportation platforms and systems are poised for a brighter future and economic growth (Sun & Ertz, 2021), the regulation of traffic laws and policies for these riders remains open for examination. According to Mårtensson et al. (2023), e-hailing applications are expected to contribute to a more sustainable transportation future, potentially providing positive decision-making toward enhancing transportation systems for passenger convenience.

MATERIALS AND METHOD

Research Design

This research used a quantitative research design, as it was the most suitable approach for its specific objectives. The highlight of this study was to determine the changes occurring in the number of registered motorcycles in NCR after the introduction of e-hailing motorcycle services in 2016 measured by a dummy variable, which constituted the first model. The study also examined the underlying relationships between the independent variables: Gross Regional Domestic Product (GRDP), labor productivity and the dependent variable: The number of registered motorcycles. To achieve its objectives, econometric testing was performed using GretL. The analysis involved a regression analysis, particularly an ordinary least squares or OLS regression, and specific diagnostic tests such as Autocorrelation, Collinearity Test, Chow Test, Heteroskedasticity, and Normality of Residuals. It was expected to generate numerical results that will show the significance of the relationships among variables and to measure the strength and direction of these relationships.

Study Site

The study conducted a time series analysis focusing on the National Capital Region (NCR). The observation period spanned from 1981 to 2022, totaling 42 observations. Apart from analyzing motorcycle ownership trends, the researchers intended to determine whether e-hailing services are substitutes for traditional transportation or encourage more vehicle ownership despite existing congestion issues.

Data Collection

This study used secondary data obtained from several sources. The number of registered motorcycles in the NCR were taken from the Land Transportation Office (LTO) database. This variable was measured in terms of the total number of registered motorcycle vehicles annually. This included both motorcycles and tricycles that have undergone the registration process with the LTO and did not include the number accumulated since the previous year. Regional Domestic Product (GRDP) was used as a proxy variable of income, as it measures the income per person within a specific region (Ramadhan et al., 2023). It reflected the average economic output or income generated per individual in that region by dividing the total Gross Regional Domestic Product (GRDP) of a region by the total population of that region. The labor productivity by region at current prices was obtained from the Philippines Statistics Authority (PSA) and was used to measure the efficiency of labor in producing goods or services.

Model

This econometric model was used as a statistical framework to analyze how the independent variables affect the dependent variable. The analysis from this model was then used to support the hypotheses.

$$N_i = B_0 + B_1 GRDP + B_2 LP + B_3 EHMS + \epsilon \qquad (1)$$

N represents the number of registered motorcycles, which is the outcome the researchers are trying to predict. *GRDP* is the income variable, measured as the Gross Regional Domestic Product (GRDP), representing the income level of individuals. β_0 is the intercept, which signifies the expected number of registered motorcycles when the independent variable is zero. $B_1\ GRDP$ represents the impact of Income on the number of registered motorcycles. A positive β_1 suggests that as GRDP increases, the number of registered motorcycles will also likely increase. Labor productivity is measured as the output produced per unit of labor input. It reflects the efficiency and effectiveness with which labor is used in the production of goods and services. A positive β_2 means an increase in labor productivity is associated with a rise in the number of registered motorcycles. Lastly, β_3 E-HMS measures the impact of the dummy variable on the number of registered motorcycles. A positive β_3 suggests that as the industry flourishes, the number of registered

motorcycles might increase as the industry flourishes due to the demand for such services. ε represents the error term, which captures the influence of other unspecified factors that affect the number of registered motorcycles in the model.

Diagnostics Test

This study used Ordinary Least Squares (OLS) regression, which according to Ariza et al. (2021), is used to determine whether one or more independent variables (X) can predict or explain the variation in a dependent variable (Y). The diagnostic tests are the following that tested the assumptions of the econometric model:

The autocorrelation test examined the correlation between variables and their lagged values. It measures the correlation between the current value of a time series and its values at different time points. In essence, it quantifies the degree of similarity between observations based on the time lag separating them (Ke & Zhang, 2019). Since the study is a time series, it is essential to detect any patterns or trends in the data. Through this test, it indicated the strength and direction of the relationship between the variables.

$$\rho k = \frac{\sum_{t=k+1}^{n}(Y_t - \bar{Y})(Y_{t-k} - \bar{Y})}{\sum_{t=1}^{n}(Y_t - \bar{Y})^2} \quad (1)$$

The multicollinearity test is used to assess the presence and severity of multicollinearity in a regression model. According to, Shrestha (2020), this is utilized in in multiple linear regression analysis when several independent variables are significantly correlated not only with the dependent variable but also with one another. This phenomenon can render some significant variables statistically insignificant, complicating the interpretation of their effects on the dependent variable. The purpose of conducting multicollinearity tests is to identify the degree of correlation among the independent variables and determine if it is significant in the regression analysis.

$$VIF_j = \frac{1}{1-R_j^2} \quad (2)$$

The Chow test is used to detect structural breaks in data. According to Binkley and Young (2020), the Chow test evaluates group effects by comparing the error sum of squares (ESS) from regressions conducted on individual groups with the ESS from a pooled regression, utilizing an F-test for comparison. While it is typically characterized by two groups, the test can be readily extended to accommodate multiple groups. Since this study was employing a dummy variable, the Chow test was useful in determining whether the coefficients of the regression model change significantly when the dummy variable is introduced. It also verifies whether the coefficients of the regression model are consistent across different categories represented by the dummy variable or if there is a significant change in the relationship being modeled.

$$F = \frac{\left(ESS_{pooled} - \left(ESS_{group\ 1} + ESS_{group\ 2}\right)\right)/\ m}{\left(ESS_{group\ 1} + ESS_{group\ 2}\right)/\ (n-k)} \quad (3)$$

The heteroskedasticity test includes the Breusch-Pagan test to detect and correct for the presence of varying error variances in the data. According to Astivia and Zumbo (2019), heteroskedasticity is commonly defined as "non-constant error variance." This concept suggests that, after incorporating the predictors into the regression model, the residual variability changes based on factors not included in the model. The purpose of heteroskedasticity is to identify and assess the presence of errors in datasets with extensive observations. This test can determine if there is evidence of varying levels of dispersion in the error terms across different values of the independent variable.

$$JB = \frac{n}{6}(S^2 + \frac{(K-3)^2}{4}) \quad (4)$$

The normality of residuals test, specifically the Jarque-Bera test, will be used to assess the distributional properties of the residuals. According to Aslam et al. (2021), the Jarque-Bera (JB) test is a widely used test that assesses the distributional structure of data. This test validates the normality assumption by comparing the skewness and kurtosis of the sample data to those of a normal distribution. It evaluates whether the error terms in a regression model follow a normal distribution. This is important for the validity of statistical analysis and the interpretation of regression results, as it ensures that the residuals are normally distributed.

The Ramsey RESET test is used to assess the functional form specification in a regression model and identify potential misspecifications. According to Sapra (2019), Ramsey (1969) developed the regression error specification test (RESET) to identify misspecification in regression models. RESET is a widely used test that routinely detects omitted variables and incorrect functional forms in linear regression. It employs an artificial regression that incorporates the predicted values of the dependent variable y and their higher powers among the regressors, testing the statistical significance of these terms. It helps in detecting potential misspecifications in the functional form of the regression model, such as omitted variables or incorrect functional forms.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + \gamma_1 \hat{Y}^2 + \gamma_2 \hat{Y}^3 + \cdots \gamma_m \hat{Y}^m + \epsilon \quad (5)$$

RESULTS AND DISCUSSIONS

Numerical Results

Table 2 Ordinary least squares results
OLS Model 1: using observations 1980 – 2019 (T = 40)

Dependent Variable: Number of Motorcycles in NCR				
	Coefficient	Std. Error	t-ratio	p-value
const	10.9354	0.210002	52.07	1.72E-05***
d_GRDP	5.67E-05	1.83E-05	3.096	0.0038***
d_LP	2.22E-05	3.88E-06	5.725	1.62E-06***
d_EHMS	1.79142	0.847761	2.113	0.0416**

Mean dependent var	12.11697	S.D dependent var	1.237876
Sum squared resid	22.22111	S.E. of regression	0.785655
R-squared	0.628168	Adjusted R-squared	0.597182
F(3,36)	20.27264	P-value (F)	7.26E-08
Log-likelihood	-45.00081	Akaike criterion	98.00162
Schwarz criterion	104.7571	Hannan-Quinn	100.4442
rho	0.255693	Durbin-Watson	1.462071

Results showed that all variables are statistically significant in their impact on the number of motorcycles in NCR. The constant term, significant at the 0.01% level, indicates that when all other variables are held constant, the baseline number of motorcycles in the NCR increases by 10.9354 units. For Gross Regional Domestic Product (d_GRDP), it revealed that each unit increase in regional GDP leads to a positive increase of 5.67E-05 units of motorcycles. Likewise, Labor productivity (d_LP) is associated with a rise of 2.22E-05 units of motorcycles for each unit increase in productivity. Moreover, the presence of e-hailing motorcycle services (d_eHMS) showed a positive relationship with motorcycle numbers, where the presence of e-hailing services contributes to an increase of 1.79 units of motorcycles.

Table 3 Summary Diagnostic Test

Diagnostic Test	**Results**	
Autocorrelation (Breusch-Godfrey Serial Correlation LM Test)	*Null hypothesis: No serial autocorrelation* Test statistic: LMF = 3.802340, with p-value = P(F(1,35) > 3.80234) = 0.0592	P-value is > 0.01
Normality Of Residuals (Jarque-Bera)	*Null hypothesis: Error is normally distributed* Test for null hypothesis of normal distribution: Chi-square(2) = 0.899 with p-value 0.63809	P-value is > 0.01
Multicollinearity (Belsley-Kuh-Welsch collinearity diagnostics)	*Null hypothesis: No multicollinearity* The 3 independent variables are less than 10 VIF: (RGDP = 1.528), LP = 2.556), (EHMS = 3.359)	Values < 10.0
Heteroskedasticity 1) White's test 2) Breusch-Pagan	*Null hypothesis: Heteroskedasticity not present* Test statistic: TR^2 = 12.680774, with p-value = P(Chi-square(6) > 12.680774) = 0.048395 Test statistic: LM = 2.694798, with p-value = P(Chi-square(3) > 2.694798) = 0.441112	P-value is > 0.01
Stability (Chow Breakpoint)	*Null hypothesis: No structural break* Chow test for structural break at observation 2016 F(3, 33) = 0.930987 with p-value 0.4367	P-value is > 0.01
Specification Error (Ramsey's RESET)	*Null hypothesis: No specification error* Test statistic: F = 1.049415, with p-value = P(F(2,34) > 1.04941) = 0.361	P-value is > 0.01

The following tests constitute a conclusive evaluation of the regression model. The Breusch-Godfrey or Autocorrelation test showed that the f-stat's p-value exceeds the 0.01 significance level, indicating there is no significant evidence of serial autocorrelation in the residuals. The Jarque-Bera test reveals that the f-stat's p-value exceeds the 0.01 significance level, suggesting no significant non-normality in the residuals when using the first differences. This shows that residuals are normally distributed. Since the VIF values below 10 indicate that there is no significant multicollinearity among the independent variables. This means the variables are not highly correlated with each other, and the coefficients are stable and not distorted by multicollinearity. On the other hand, both White's test and the Breusch-Pagan test show the f-stat's p-value greater than the 0.01 significance level that supports the absence of significant heteroskedasticity. This suggests that heteroskedasticity is not a major concern in the model. With this, the residuals are homoscedastic. The Chow Breakpoint test at the 2016 observation produces an f-stat's p-value greater than 0.01 alpha, meaning that the model is stable over

time in as much as no structural change has taken place over the recent years. Lastly, Ramsey Reset results exhibit no misspecification error as the f-stat's p-value is greater than 0.01 significance level.

Discussion of Results

Gross Regional Domestic Product (GRDP) positively correlated with the number of registered motorcycles, indicating that economic growth directly influences motorcycle purchases. A higher GDP facilitates increased motorcycle ownership. According to Chu et al. (2022), rising GDP is linked to increased disposable income, allowing individuals to allocate more resources toward acquiring motorcycles. This is supported by research that has observed a trend where motorcycle sales are on the rise, particularly in the rapidly developing Southeast Asian nations, as pointed out by Chu et al. (2022). Ngoc et al. (2022) further elaborated that a similar trend is witnessed in emerging economies such as the Philippines, where motorcycle is preferred over cars because of their cost-benefits and utility of the product.

This relationship is further supported by Poi et al. (2021), who emphasized that growing economies demand more efficient transportation alternatives, which is reflected in higher GDP levels. This trend can be observed in countries like Indonesia, Bangladesh, China, and some urban areas in the USA where ownership has gone up, and even e-hailing motorcycle (E-HMS) systems have been introduced due to the influx of motorcycle ownership. This underscores the principle that stimulating economic growth requires enhanced mobility beyond traditional transportation modes.

Additionally, the availability of motorcycles as transportation options became more appealing during times when the general state of the economy was getting better as it helped to meet increased transportation demand in developing areas at a comparatively lower cost. While there have been continuous attempts at implementing rail transport in the Philippines, the existing line suffers from challenges like inadequate capacity, slow pace, and poor performance. The commuting experience is further complicated by crowded trains and train breaks, thus highlighting the need for and the development of needed improvements to transport systems for urban centers, especially the Metro of Manila and Metro Cebu. Also, motorcycles are now more convenient than traditional jeepneys since they do not have to wait for all seats to be occupied before they set off, unlike jeepneys, which further delay movement in the city (Cerio, 2017). Motorcycles are more flexible as far as commuting is concerned as one can go to work or carry out other activities without being delayed. It also provides a means to avoid traffic jams and, therefore, reduce the amount of time one has to spend in traffic, thus allowing more economic activity to flourish (Rith, 2020).

Labor productivity has a positive relationship with the increase in motorcycle ownership. The positive relationship indicates that with improvements in productivity, accessibility and demand for motorcycles also increase. According to the International Labour Organization (ILO) labour productivity plays a central role in promoting a high level of efficiency within an economy. It is closely related to employment because enhanced labor productivity leads to an increased production of goods and services; hence, the business expands, requiring more employees. In this regard, it increases the tax revenues thereby helping the government in many ways that are also economically advantageous (Latief et al., 2023).

In addition, the availability of employment openings is significant as it is a matter of concern of both employers, seeking applicants who fit the required skills with the job offer and job seekers, who are in search of employment opportunities in the market. Yet, in recent years, the problem of accessing available jobs seems to be evolving and increasing in terms of the distances travelled as well as the time spent in transit (Barkley et al., 2018). Thus, people are more often choosing motorcycles, which allows them to avoid traffic jams and other problems characteristic of traditional public transport means. Motorcycles are more beneficial for mobility since they allow faster and more flexible movement in large cities compared to traditional cars and regions with inadequate or slow public transportation.

Bayon et al. (2023) support this view by noting that workers in metropolitan areas rely heavily on transportation for their daily activities. It follows that improved labor productivity is synonymous with increased wages and improved employee conditions, increasing the purchasing power per head and, therefore, their capacity to purchase motorcycles for investment purposes. In addition, higher labor productivity can create a more active and greater economy, and thus increasing its need for personal transport.

The presence of e-hailing motorcycle services positively correlates with motorcycle ownership, suggesting that expanding these services directly increases motorcycle ownership by enhancing their utility and appeal.

E-HMS also contributes to the economic sharing activities because the members of the community are allowed to offer their services through the online platforms. This system not only creates employment for the residents of urban areas but also increases the rate of growth as well as the success of the sharing economy (Yapp & Yeap, 2023) and thus increases the number of motorcycles owned in the specific region.

Therefore, the general public has adopted E-HMS, as it has the potential to offer different benefits to its users, especially for those with numerous things to accomplish within a short time (Ahmed & Hyland, 2022). Moreover, motorcycles are widely in use today and are a common means of transport used by students (Chun et al., 2019), therefore making it easier to commute and at the same time facilitating fuel economy to the respective E-HMS drivers.

Furthermore, the significance of this factor is evidently seen in highly urbanized areas like Metro Manila and the rest of the National Capital Region, where the majority of the workforce prefer living close to their places of work. These people often opt to use E-HMS more than other means of transport because of the flexibility that comes with it. The transportation of passengers by motorcycle has also slowly evolved in regions that organize their E-HMS companies with

students and working people as main customers. The choice of such services confirms the importance of the E-HMS in coping with the problems of urban transport.

According to Ngoc et al. (2013), Filipinos are motivated to own motorcycles to avoid issues with public transit, such as long wait times and challenging interactions with e-HMS drivers. Individuals who own personal motorcycles have more flexibility over how they commute. The e-hailing service demonstrates an on-demand business model for transporting service and also contributes to the increased demand for motorcycles both for the drivers to make a living and for other individuals' personal use. This developing trend is important to understand how motorcycle purchasing is increasing to meet the change in urban mobility needs and how e-hailing services are influencing motorcycle ownership.

CONCLUSIONS

The positive link between GRDP and motorcycle ownership in NCR demonstrates how economic expansion influences transportation choices. As the area economy improves, the residents' greater financial capacity and mobility needs drive up motorcycle purchases, making motorcycles an important mode of transportation in the region. Analysis of the research conducted reveals that there exists a positive relationship between labor productivity and the adoption of motorcycles in heavily polarized cities such as Metro Manila. Transportation is important for economic growth, given its role in easing the movement of goods and people, especially in areas of high population and traffic density. Efficient transportation is essential in such areas because it allows for the smooth transport of goods and services to meet the ever-changing needs of businesses and individuals. In metropolitan cities, where mobility hitches can dramatically slow economic activity and decrease labor productivity, adequate transportation systems are crucial enablers to continued economic growth and major contributors to global economic value. Many industries depend heavily on effective transportation networks, and motorcycles have emerged as a vital solution to meet the transportation needs of these urban environments, thus resulting in increasing motorcycle ownership in these regions.

Motorcycles are flexible and convenient and thus appeal to working individuals as they need to get to their places of work or business within the shortest time possible. Moreover, because traveling by motorcycle is known to be more flexible than traditional commuting options, workers reduce their stress from long and unpredictable hours of travel. This enables employees to balance their working time with other enriching activities that matter outside their work, hence enhancing their eagerness to enhance work efficiency during work hours. This results in the improved interest and purchase of motorcycles in these regions.

The availability of e-hailing services has a positive correlation to motorcycle ownership, as shown in the study. In the Philippines, popular e-hailing platforms such as Grab, Angkas, JoyRide, and Move It have had a considerable impact on the transportation system, especially in urbanized regions with heavy traffic congestion. These services have offered a practical and affordable means to address congestion and other congestion challenges during commuting in comparison to other commuting means like personal cars, taxis, and jeepneys. The services offered by e-hailing motorcycle services have made individuals realize the benefits of owning personal motorcycles, thus increasing their demand. This aspect has made the individuals living and working in these metro cities more inclined towards motorcycles as they realize their efficiency and affordability. Hence, the users become willing to procure motorcycles for their own use since they enjoy the convenience afforded by swift and flexible transportation. The outcome of this study shares the same result as the research of Wadud (2020), which states that the introduction of motorcycle e-hailing services has caused a statistically significant increase in motorcycle ownership and motorcycle numbers in Dhaka, the capital of Bangladesh, around 7.45%. This further supports the idea that e-hailing motorcycle services like Grab and Angkas have a positive correlation with motorcycle ownership in metropolitan cities such as Dhaka and Metro Manila. This can be explained by the fact that motorcycles are a more efficient method of transportation than traditional public vehicles in dealing with traffic congestion, which is frequent in many cities. As a result, people are more willing to purchase motorcycles for personal use after learning how convenient and inexpensive it is to get around the highly congested city. On the same note, the correlation between e-hailing services and motorcycle ownership shows how current transportation solutions have transformed how people choose their mode of transport to work. These services have helped individuals to face traffic jams, thus increasing people's interest in motorcycle ownership.

This research can provide facts on the issue that transportation authorities have when deciding whether to spend money on upgrading roads or increasing the availability of public transportation. DOTr may want to reconsider its policy and concentrate on enforcing more stringent laws on car ownership or providing assistance for other forms of transportation. This strategy may result in a more economical use of resources, lessen traffic, and enhance the effectiveness of urban transportation systems as a whole. Through the study's statistical results, the LTO can use this to develop a regulatory framework that ensures a fair and equitable balance between private vehicles and e-HM services. This framework can include guidelines for vehicle requirements, licensing procedures, and operational restrictions to prevent an imbalance in the transportation ecosystem. The findings can serve as a signal for them when making tactical business choices. Motorcycle taxi companies can take advantage of the market opportunity to grow their business when the evidence suggests that the convenience of e-HMS has led to a decrease in private vehicle ownership. These businesses can adjust their strategy to match the changing needs of consumers in terms of mobility.

The study was designed with the aim of planting valuable insights for policymakers by offering evidence-based recommendations for addressing transportation issues that plague metropolitan areas, particularly in the National Capital Region (NCR). The findings highlight the positive relationships between Gross Regional Domestic Product (GRDP),

labor productivity, and the patronization of e-hailing motorcycle services, all of which significantly impact motorcycle ownership, thus highlighting the fact that motorcycle ownership in the Philippines is brought upon the need to circumvent numerous problems in regards to transportation. Traffic congestion, which has been a constant problem in the transportation system of the Philippines, continues to worsen in metropolitan cities. The rise in population and, in turn, vehicles, whether private or public modes, has not been matched by a corresponding scale-up in infrastructure. Roads, parking spaces, and designated lanes for these vehicles remain inadequate, further intensifying traffic issues and road safety concerns. This lack of scalable infrastructure creates challenges for both the riders and the general traffic flow. This issue calls for policymakers to prioritize substantial investment in infrastructure development that can accommodate the increasing number of vehicles on the road. Widening and improving existing roads, constructing new thoroughfares, and creating bypass routes are essential steps to ease traffic congestion in major areas. Daily commuters, including professionals and students, often find their commutes to be inherently challenging. Despite various innovative changes to the transportation system, long wait times continue to be a persistent issue. This problem is exacerbated by several factors: the large number of people who travel on a daily basis, new employees who transfer to workplaces in Metro Manila, and the expected long queues. As a result, traffic congestion in the Philippines greatly enhances the stress level of commuters (Tenorio, et al., 2017). Furthermore, there are challenges regarding the availability of public transport and general traffic congestion that only serve to exacerbate the pressure on the road, meaning those who commute daily face even greater struggles. Therefore, besides the car-oriented highways, infrastructure for pedestrians and bicycle-only lanes should also be considered in the organization of metropolitan areas. Promoting the use of walking or bike in short distance travel does not only lessen the reliance on motorized transportation but also encourages the use of healthier and sustainable modes of transport, possibly reducing the stress that short-distance commuters face. Transportation infrastructure is the other key component through which public transportation upgrades fall into. Improving the coverage and frequency of rail transport, including MRT, LRT, and the use of bus solutions, will efficiently eliminate the imperative use of private cars and motorcycles. While traffic congestion is an unavoidable problem, it is essential to understand that the Philippine government can step forward to solve it by joining Local Government Units (LGUs) in Metro Manila and employing coherent traffic rules. As of today, because of the disjointed traffic policies of the different LGUs in the Metro Manila area, coordination on traffic management initiatives is still lacking. New solutions to transport are most often implemented to improve the flow of traffic, and many developed and developing countries implement Bus Rapid Transit (BRT) systems. Some Southeast Asian nations, like Thailand, have achieved positive results using BRT systems in terms of time optimization, but the perceived trends in commuters' transportation still heavily rely on private motorcycles. Policymakers need to target the integration, availability, and price of the public transport system to ensure citizens are discouraged from using personal cars. The increase in e-hailing motorcycle services has definitely improved the lives of public transport commuters in urbanized areas, but this has also brought out a series of new challenges, especially with the lax government regulation regarding these types of services. As transportation platforms and systems continue to advance, they hold great potential for future growth and economic development. However, the rapid expansion of E-HMS also brings regulatory challenges, particularly regarding traffic laws and policies that govern these services. There is a lack of effective regulation in controlling the increasing number of drivers, which contributes to road congestion and accidents. To mitigate these challenges, policymakers must implement stronger regulations aimed at ensuring road safety and efficient traffic management.

Furthermore, policymakers need to impose a quota system and zoning restrictions for the proliferation of e-hailing services in metropolitan areas with heavy traffic congestion as a technique to reduce traffic jams and work on road safety. These measures will regulate the e-hailing motorcycles and cars to operate in line with road capacity and, hence, demand. There should be the use of quotas in the e-hailing industry, whereby the number of drivers allowed on the road should be controlled in relation to road capacity, traffic patterns, and demand. It should be an adaptable system that can be adjusted for the conditions, for instance, new institutions or changes in population density. In this way, it will avoid excessive competition among the drivers, which will lead to traffic jams and dangerous stunts in an attempt to outcompete the other players. Further traffic regulation will be enforced by zoning regulations, which will restrict the number of e-hailing cars during rush hours and in over-saturated zones within the city. This approach assists in equal distribution of traffic flow, thus avoiding the overcrowding of particular areas. Areas for pick and drop should be prescribed to minimize the time the lane is blocked and thus minimize the congestion.

With the current upsurge in e-hailing motorcycle services, proper management by private firms becomes important, and hence, there is a need to regulate them. In this sector, deregulation has posed a number of risks, such as safety concerns and the possibility of criminal activities; this has underlined the need for effective policies in place to enhance security for both passengers and drivers. The current deregulation of e-hailing motorcycle services has allowed many aspiring drivers to enter the market. But this has also meant that it has attracted drivers with little or no regulated controls, hence raising a lot of concerns so far as the safety of the passengers is concerned. To overcome these concerns, it is requisite for the regulators to impose stringent controls on the private companies operating e-hailing services. Some of the basic actions towards these firms include having strict criteria for checking the background of these drivers. Private firms should legally require the applicants to submit guidelines that reflect on the findings on drivers' criminal records, prior driving records and employment history. That will mean only people without a record of any criminal activities and with the right qualifications will be allowed to operate. Drivers are a decisive factor in firms. Thus, there will be fewer major or minor accidents or misconduct that may occur if all the drivers are trained and developed adequately.

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