

Household Vehicle Ownership and Use in African cities: A Case Study of Maputo, Mozambique

Atanasio TEMBE¹, Fumihiko NAKAMURA², Shinji TANAKA³ Shino MIURA⁴
and Ryo ARIYOSHI⁵

¹ Member of JSCE, Doctoral student, Graduate School of Urban Innovation, Yokohama National University, Japan
(79-5 Tokiwadai, Hodogaya-ku, Yokohama 240-8501, Japan)

E-mail:tembe-atanasio-dz@ynu.jp

²Member of JSCE, Executive Director, Vice President, Graduate School of Urban Innovation, Yokohama National University, Japan

(79-1 Tokiwadai, Hodogaya-ku, Yokohama 240-8501, Japan)

E-mail:f-naka@ynu.ac.jp

³Member of JSCE, Associate Professor, Graduate School of Urban Innovation, Yokohama National University, Japan
(79-5 Tokiwadai, Hodogaya-ku, Yokohama 240-8501, Japan)

E-mail:stanaka@ynu.ac.jp

⁴Member of JSCE, Researcher Associate, Graduate School of Urban Innovation, Yokohama National University, Japan
(79-5 Tokiwadai, Hodogaya-ku, Yokohama 240-8501, Japan)

E-mail:miurashino@ynu.ac.jp

⁵Member of JSCE, Researcher, Graduate School of Urban Innovation, Yokohama National University, Japan
(79-5 Tokiwadai, Hodogaya-ku, Yokohama 240-8501, Japan)

E-mail: ariyoshi-ryo-np@ynu.jp

Over the last decade there has been a rapid increase in the number of private cars in Maputo despite the existing low incomes per capita. For the same period, while the modal share of minibuses “chapas” increased, the share by conventional buses has been decreasing significantly. In the context of Maputo where road network is very limited and the majority of the urban populations are “captive” users of public transport, rapidly increasing share of private cars widens the gap between demand and supply side. Although there is awareness about urban transportation problems, studies aimed to understand the underlying factors of rapidly rising private car use have not received a necessary attention. It is likely that determinants of private car growth are not fully understood yet. This paper is an attempt to identifying the contributing factors of motorization. This study used the household person-trip surveys administered by Japan International Cooperation Agency (JICA) in Maputo. The results of this analysis are expected to be beneficial to the planning authorities in Maputo.

Key Words : *Motorization, vehicle ownership, Sub-Saharan Africa*

1. INTRODUCTION

Over the last decade there has been a rapid increase in the number of private cars in Maputo (fig.1) despite the low incomes per capita in international comparison. For the same period, while the transport modal share of minibuses “chapas” increased, market share of the conventional buses has been decreased significantly. Figure 2 describes the modal share of public transport in Maputo. It can clearly be seen from fig. 2 that modal share of private cars is greater than the share of conventional buses.

With 2.3 million people (as of 2009), Maputo is the economic center and a major metropolis of the

country. As it would be expected, Gross Domestic Product per capita, GDP, is highest in Maputo and is expected to increase due to rapid economic growth of Mozambique. Similarly, geographical distribution of private cars follows the same patterns with Maputo being home of 80% of private cars nationwide (as of 2012). Figure 3 shows that the proportion of private cars is increasing. In addition, a comparison among developing countries with similar incomes per capita (fig.4) shows that private cars per 1,000 people are high in Maputo.

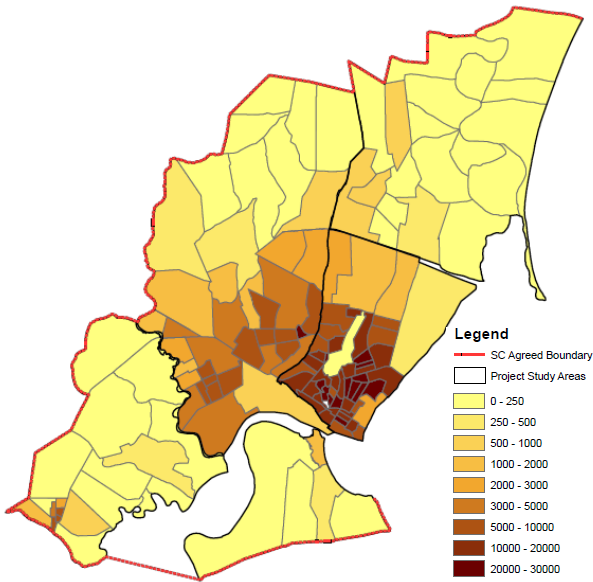


Figure 1: Urban density (persons/zone)

Source: JICA (2013)

Rapid economic growth, increases in the number of metropolitan populations, inadequate public transport and urbanization phenomena are the main determinants assumed to drive the motorization process in Maputo.

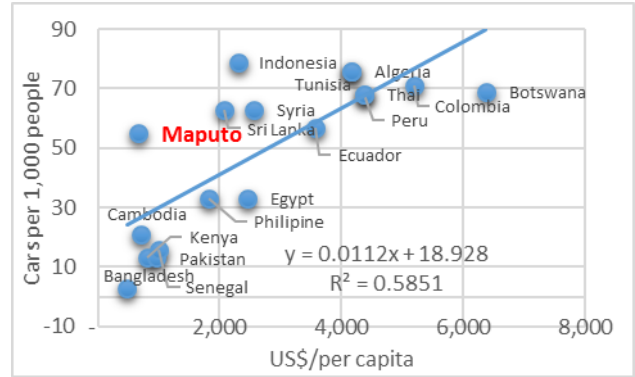


Figure 4: Car ownership in developing nations

Source: Author based on IMF/IRF data (2009)

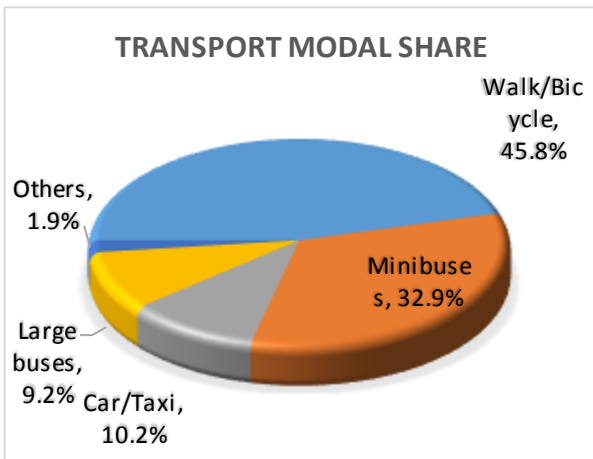


Figure 2: Urban transport modal share

Source: Author based JICA survey data (2013)

This paper begins with a brief description of urban transport in the context of Maputo. Section two reviews the previous studies. The remainder of this study is organized as follows. In section three data and model approach are briefly described. Sections four and five discuss household vehicle ownership and use. Finally, the last section provides insights about the expected results.

2. LITERATURE REVIEW

Motorization or increase of car ownership and use has long attracted attention of many researchers worldwide. ITO et al. (2013) examined the general mechanism of motorization in Asian developing mega-cities. ITO et al. (2013) found motorization to be influenced mainly by economic growth and urban structure change. They described motorization mechanism as follows. Initially, car ownership rises due to economic growth. Then, car ownership growth enhances the convenience of movement and accelerates the expansion of the urban area to suburbs. Dargay et al. (1999) used historical data for more than three decades worldwide and found a strong relationship between the growth of per-capita income and the growth of car ownership levels. Car and vehicle ownership are expected to continue growing as income per-capita increases. Fujiwara et al. (2007) investigated the motorization in terms of passenger cars and motorcycles in the Asian context. Their findings indicate that motorization is increas-

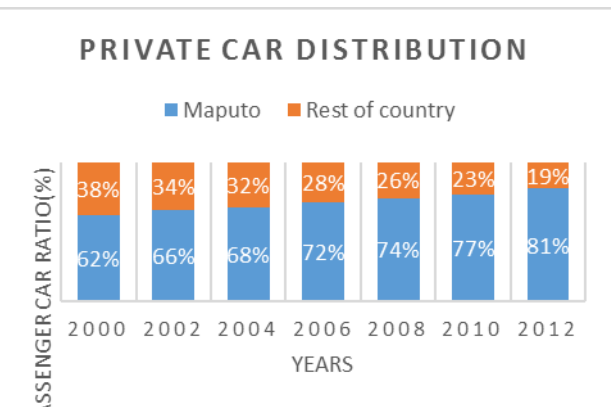


Figure 3: Private car per region

Source: Author based INATTER (2016)

ing rapidly in Asian context. With introduction of competition by Chinese and Indian car producers in the market, the authors expect acceleration of motorization in Asia.

Barter (2000) also put forward a mechanism to describe motorization phenomena. This mechanism is known as simple generic model of urban transport and land use evolution in developing cities. The model is intended to describe the paths taken or potentially to be taken by cities in the developing world or which were in the developing world until the 1960s or so. Barter (2000) stressed that some cities in Asia have moved rapidly from transport systems in which walking, non-motorized vehicles and rudimentary, low-cost, bus-based public transport systems catered for the majority of transport needs, to a situation where cars and motorcycles are beginning to dominate. The result, in places such as Bangkok and Kuala Lumpur has been what he called traffic-saturated “bus cities and motorcycle cities”. Furthermore, Barter (2000) underlines that these outcomes are influenced not only by the decisions of individual consumers and private firms, but also by governments policies towards motor vehicle ownership and use, road supply, urbanization and suburbanization, traffic restraint and relative investments in roads, public transport and non-motorized modes. Kutzbach (2009) analyzed the rise in car use and decline in bus services in developing countries. He stated that although empirical evidence at the country level could show a strong relationship between rising income and car use, at the urban level, local characteristics, congestion, and policies affect travel decisions. He highlighted the positive feedback between congestion and car use leading to deterioration of bus use. On the other hand, Vasconcellos (1997) suggests that an approach to understanding the rapid rising of private cars in developing nations should put into perspective the specific social, economic and political conditions of the developing world.

3. DATA

(1) Basic statistics

This study uses the person trip survey conducted by JICA (2013) to understand the travel patterns of the residents of metropolitan area of Maputo. 9983 households are used as the research sample. Household Information survey included the following data. Socioeconomic and trip information, namely, number of vehicles owned, age and sex, occupation, work and residential location, origin and trip destination, trip purpose, and mode of transport

and costs.

(2) Aggregate models

This paper aims to investigate the contributing factors for rapid growth of private cars in Maputo. To achieve this purpose regression models are applied. Modeling variables were selected based on the previous studies review and data availability. The dependent variable is the quantity of trips demanded. Household socioeconomic attributes, transportation system and residential location constitute the explanatory variables.

4. HOUSEHOLD VEHICLE OWNERSHIP

As it was noted previously, geographically, private cars are concentrated in Maputo (fig.3). A detailed analysis, however, shows that private cars are unevenly distributed even within Maputo. According to JICA (2013), 9983 was total number of household interviewed in Maputo. The total number of households owning cars is 1297 (13%). 3.3 million trips were made in one day. It is in the central area where households with at least one car are located. Figure 5 shows the share of trips originating from households with and without cars. The number of trips originated in households with at least one car accounted for 17% of total trips. On the other hand, the number of trips from households with no cars was 83%.

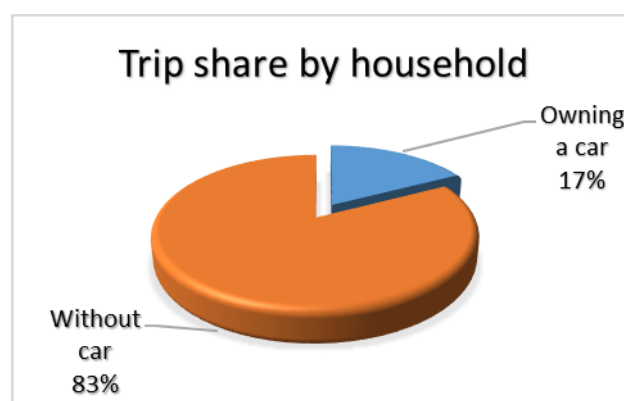


Figure 5: Trip share by household

Source: Author based JICA survey data (2013)

5. VEHICLE USE CHARACTERISTICS

Urban transport services are provided by public and private operators. Conventional buses, with seating capacity for at least 50 passengers, and minibuses “chapas” with capacity ranging from 15 to 25 passengers are the main mode for urban commuters. Public transport modal share (fig.2) is

characterized by two opposite trends: on the one hand, a rising share of minibuses “chapas” and a declining share of conventional buses. In the context of Maputo, where road network is extremely limited and the majority of urban populations depends on the public transport, continued increase of private car use raises concerns by widening the distance between the supply and demand sides.

Table 1: Modal share by trip purpose

		work	School	Business	Private	Home	Total
		1. Walk/Bicycle	247,740 9.7%	244,983 9.6%	10,769 0.4%	143,948 5.6%	636,685 24.9%
2. Motorcycle		27,113 1.1%	7,213 0.3%	24,285 1.0%	13,878 0.5%	48,215 1.9%	120,704 4.7%
	3. Public transport	293,057 11.5%	123,442 4.8%	108,495 4.2%	106,782 4.2%	523,217 20.4%	1,154,993 45.1%
Total		567,910 22.2%	375,638 14.7%	143,549 5.6%	264,608 10.3%	1,208,117 47.2%	2,559,823 100%

Source: Author based JICA survey data (2013)

Vehicle ownership levels are low in international comparison. However, according to IMF and IRF (2009), even though income per capita was less than \$US 1000 (as of 2009), private car per 1,000 persons were higher in Maputo than in other cities with similar income per capita.

Modal share by trip purpose (table 1) uncovers important information on travel patterns. Most trips by households without cars are straightforward. Most of trips made by households without cars are predominantly work trips. Non-motorized transport comprise major proportion of total trips (50%), followed by public transport (43%).

Finally, modal share by trip purpose of the households' owning cars is shown in table 2. Similarly, households owning cars make trips mainly for working purpose. As it would be expected, the number of trips made by public transport is highest for the households without cars. Private car seems to be a preferred mode than public transport.

Table 2: Modal share by trip purpose

		work	School	Business	Private	Home	Total
		1. Walk/Bicycle	25,180 4.7%	28,573 5.3%	1,077 0.2%	14,958 2.8%	68,717 12.7%
2. Motorcycle		56,870 10.5%	14,545 2.7%	43,882 8.1%	17,581 3.3%	88,997 16.5%	221,875 41.1%
	3. Public transport	37,125 6.9%	31,705 5.9%	16,349 3.0%	12,899 2.4%	81,715 15.1%	179,793 33.3%
Total		119,175 22.1%	74,823 13.9%	61,308 11.3%	45,438 8.4%	239,429 44.3%	540,174 100%

Source: Author based JICA survey data (2013)

6. EXPECTED RESULTS

This study analyzes the contributing factors of rapid motorization growth in the context of Maputo. Household person-trip surveys administered by Japan Cooperation Agency (JICA) in 2013 are used.

Aggregate demand models are applied in order to investigate the factors influencing rising of private cars. This paper relied on the previous studies conducted in the South East Asian developing countries taking into account their similarities and differences. Since most developing nations share some common characteristics (i.e., rapid increases of urban population, urbanization phenomena and economic growth), similar factors influencing motorization process are expected to hold in the context of sub-Saharan African. The results of previous studies show that socioeconomic variables such as age, income, occupation, residential location and public transport accessibility are the main contributing factors for rapid motorization in the South East Asian developing countries. It is expected that this analysis can be beneficial for the planning authorities in Maputo and other cities of sub-Saharan Africa.

ACKNOWLEDGMENT: the authors would like to acknowledge the support of Japan Cooperation Agency (JICA) and PADECO co. Ltd. for the data provided.

REFERENCES

- 1) Ito, K., Nakamura, K., Kato, H., and Hayashi, Y. : Influence of Urban Railway Development Timing on the Long-term Car ownership in Asian Developing Mega-cities, Journal of the Eastern Asia Society for Transportation Studies, Vol.10, 2013
- 2) Dargay, J. and Gateley, D. : Income's effect on car and vehicle ownership worldwide: 1960-2015, the Journal of Transport Research Part A 33 pp.101-138, 1999
- 3) Barter, P. : Urban Transport in Asia: Problems and prospects for high-density cities, Asian-Pacific Development Monitor, 2000
- 4) Kutzbatch, M. : Motorization in developing countries: Causes, consequences, and effectiveness of policy options, Journal of Urban Economics 65 154-166, 2009
- 5) Vasconcellos, E. A. : The Demand for Cars in Developing Countries, Transport Research Part A 31, 1997
- 6) JICA : Comprehensive Urban Transport master plan for the Greater Maputo, Final report, executive summary, 2014
- 7) JICA : Comprehensive urban transport master plan for the Greater Maputo, Final report, vol. 1, Master Plan Report, 2014
- 8) JICA : Comprehensive Urban Transport Master Plan for the Greater Maputo, Final report vol. 2, Pre-Feasibility Study Report, 2014
- 9) JICA: Comprehensive Urban Transport Master Plan for the Greater Maputo, Final report, vol. 3, Technical reports, 2014
- 10) IMF, International Monetary Fund, World Economic outlook, 2009
- 11) IRF, International Road Federation Statistics, 2009