Impact Factor (SJIF): 5.301

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 5, Issue 6, June-2018

FACTORS AFFECTING THE USAGE OF LOCAL BUSES: CASE STUDIES FROM MAPUTO AND NAIROBI

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Abstract —***Despite the rapidly growing demand for transportation, public buses face a continued modal share decline in Sub-Saharan African cities. Unlike cities where the declining modal share of local buses is strongly associated with increasing reliance on private transport, private cars are not yet an alternative either in Maputo or in Nairobi. Using person-trip data, this paper attempts to investigate the factors affecting the use of local buses in Maputo and Nairobi by employing logistic regression models.***

Findings of this study can be summarized as follows. Household characteristics such as gender, age, occupation status, income, vehicle ownership, and residence location were found to affect the likelihood of the bus over the car in both cities. These findings are expected to contribute to improving public bus usage not only in Maputo and Nairobi but also in other developing cities facing similar problems.

Keywords: *Person Trip Data, Chapas, Matatus, Sub-Saharan Africa, Logistic regression*

I. INTRODUCTION

Conventional buses face a continued service deterioration in Sub-Saharan African cities despite the rapidly growing demand for public transportation. According to [1], the sources of the declining urban transport services in developing countries include the high concentration of urban population, economic activities and motorization or increase in car ownership in major cities, the limited supply side and weak regulatory institutions. Different cities adopted different approaches to tackle this problem, for example, Maputo managed to maintain bus operations by subsidizing the Bus Company *"Transportes Publicos de Maputo"* (TPM) while in the case of Nairobi *"Kenyan Bus Services"* (KBS) was privatized. Despite these measures, service declining seems relentless considering the modal share of buses.

Regrettably, a significant number of the existing studies in developing countries is more focused on how to replace the conventional bus systems with rapid transportation modes mainly Bus Rapid Transit (BRT) and less diagnosis is devoted to investigating the factors contributing to declining modal share of local buses. However, understanding these factors is critical at least for two reasons. First, many cities in the developing world are unable to replace the existing bus systems. Secondly, even in cities where rapid transportation modes have been established, conventional buses still can play a major role as feeder modes. In a study on the market share in South Africa, [1] argue that access to public transport in South Africa is reduced by long walking distances and long waiting times due to inadequate service and route coverage, as well as poorly arranged schedules. This study attempt to investigate the factors affecting the use of public buses in Maputo, Mozambique and Nairobi, Kenya. As case studies, Maputo and Nairobi are selected primarily because the two cities have a similar transportation background, in other words, they initially relied on public bus companies to provide the majority of public transport services, which were later largely replaced by para-transit services. Second, the two cities constitute a restrict group of African cities that managed to maintain publicly owned bus operation.

1.1. Objectives

Unlike cities where the decline in local bus services is associated with increases in the use of private transport [2], most of the people in developing countries have no choice than to use public transport [3] and are therefore considered a captive market for bus transport. Given this background the objectives of the study are set as follows: (1) to compare the travel behavior between Maputo and Nairobi; (2) to investigate the factors affecting the use local public buses in these cities.

1.2. Research structure

The paper is organized as follows. In section 2, previous studies are reviewed. Section 3 describes the evolution process of bus transport from the supply side perspective. Sections 4 to 6 explores in detail the demand for buses, preceded with a brief explanation of the person trip data or household (HH survey) used in the study. Section 7 is devoted to model estimation. Finally, the discussion and conclusion are presented in section 8.

II. FACTORS AFFECTING BUS SERVICE DEMAND AND SUPPLY

To understand the factors influencing the use of buses, it is necessary to review travel behavior literature. According to [4],[5],[6] transport mode choice is influenced by the characteristics of the decision maker or individual, the number, and attributes of alternatives and the decision rule. Under travel behavior theories a decision maker is assumed to rank possible alternatives in order of preference and choose the available alternatives the option which he or she considers most desirable, considering his preferences and the relevant constraints placed on decision-making. The decision maker can be an individual or a group of people. Individuals not only face different choice situations, they have tastes [4]. Any transport alternative is assumed to comprise a set of alternatives that are feasible and known during the decision process by the decision maker. The attributes of alternatives are measured on a scale of attractiveness such as speed, travel time or travel costs. Lastly, the choice of transportation mode follows some rules including dominate and satisfaction. Despite the appealing theoretical aspects of choice theories, their applicability in Sub-Saharan African context should raise concerns. The main reason is that most of the assumptions do not hold. For example, the decision maker does not have perfect information relative to the attributes of buses or paratransit. We now focus our attention on the studies conducted in the context of developing countries.

[7] provides one of the few studies of the bus in Sub-Saharan African cities. It was found that the decline in quantity and quality of bus services is either due to the deterioration of vehicle fleet or to inability to expand with rapid population increase. Similarly, [8] investigated public transportation in Dar es Salaam, Tanzania, and conclude that public services have deteriorated rapidly due to problems such as aged and obsolete fleet, maintenance and a shortage of foreign exchange to purchase spare parts. A study on mobility in 6 Sub-Saharan African cities by [9] revealed a relatively small public transport sector concentrated on the major radial roads on one hand, and an increasing informal sector or paratransit. Household ownership of motorized two-wheelers and the private car is reported to be very low. A comparison of urban transport systems across African cites by [10] identified affordability as the main concern for the use of buses and paratransit. A substantial share of urban dwellers was found to have no daily access to public transport services because these are expensive and not easily accessible.

[11] analyzed the rise in car use and the decline in bus services in developing countries. He states that although empirical evidence at the country level may suggest a strong relationship between the rising income and car use, at the urban level, local characteristics, traffic congestion, and policies do affect travel decisions. He highlighted the positive relationship between traffic congestion and car use as leading to deterioration of bus services. A common factor found to affect the use of local buses is the increasing reliance on private transport [2]. It is reported by [12] that public bus services in Japanese cities are less profitable compared to private operations. The main reasons is that there are restrictions imposed upon public bus operators to continue providing services on unprofitable routes.

One of the most informative literature on the travel demand in the context of developing countries is the publication on public transportation in developing countries by [13]. According to [13], the supply of public transport in developing cities is determined by various demographical, environmental, institutional, and economic factors. The author states that population density, distribution, and growth are three important factors determining the demand for transport. [10] identifies a serious demographic problem in developing countries in the form of the rising migration of the population from the rural areas to urban areas. [10] states that this leads to rapid and often uncontrolled growth in urban areas. Economic factors include low levels of Gross Domestic Product per capita, uneven distribution of income, both demographically and geographically, fluctuations in the world commodity prices, and poor availability of foreign exchange.

According to [3] the economic view of the car as a "free consumer desire" is inadequate to understand the demand for transport in developing countries. Due to market failures, the majority of people in the developing countries have no choice than to use public transport and are therefore considered a captive market for public transport.

Bus service supply is expressed in terms of capacity, i.e. frequency, headway, fleet size, subsidy availability, number of routes, coverage, and vehicle size. Bus service supply is mostly influenced by institutional and policy factors. Bus service demand is expressed in terms of urban structure, economic indicators, and demographic indicators. These are for example the density of population and economic activities, geographical distribution of income, economic growth and car ownership.

From the literature review we can, therefore, conclude that the factors affecting transport mode choice are as follows:

Characteristics of the trip maker

- Car ownership
- Possession of a driving license
- Household composition
- Income
- Residential density
- Other decisions

Characteristics of the trip

- Trip purpose
- Time of the day
- Individual or group trip

Characteristics of transportation mode

- Total travel time: walking and waiting times, in-vehicle, and transfers
- Monetary costs
- Parking costs
- Reliability of services
- Comfort, convenience, and safety standards

III. BUS SUPPLY: EVOLUTION OF BUS TRANSPORT

In order to understand the declining urban transport services either in Maputo or Nairobi City, it is important to review the foundations upon which urban transportation systems are built on. First, we analyze how urban transportation services evolved in Maputo followed by Nairobi.

3.1. Maputo

Mozambique is an independent country since 1975. Urban transportation systems were nationalized at the outset yielding to a regulated public transport system. Urban transportation services were exclusively provided by a state-owned bus company, *Transportes Urbanos de Maputo* (TPM). Fares were regulated with a purpose to ensure affordability of the majority of the population. At the beginning of the 1980s, Maputo witnessed an increased immigration of people from rural to the capital city [14], while the Bus Company had difficulties to provide bus services to economic policies. For example, the bus utilization ratio which is the proportion of the number of buses in services over the total bus fleet reduced from approximately 37% in 1975 to roughly 18% as of 2015 (**Fig.1**). For the purpose of this study nominal buses is the bus fleet owned Bus Company, while operating buses represent the effective number of buses in service. As a result of these problems, the number of passengers gradually declined from 60 million users in 1975 to 10 million or 17% in 2015 (**Fig.3**). [15] argue that in the beginning public bus companies were able to operate without subsidies in Africa, however, as deficits grew and subsidies did not grow commensurately, bus operators faced enormous difficulties either to maintain or to replace bus fleet.

According to [16], in order to meet the increasing demand in urban areas, individuals initiated the paratransit services and gradually their number increased. These new minibus operators were formally acknowledged at the end of the 1980s when the government gave them permission to operate urban transportation services. This yielded to the development of minibus *chapas* industry (**Fig.2**). The designation *chapas* refers to the flat fare system, that is, fares were non-distance based. The seating-capacity of chapas range from 15 to 25 passengers. By the beginning of the 1990s, *chapas* operators had a significant share of the market. As of 2013, the urban transport modal share is dominated by walk (45.8%), followed by *chapas* (32.9%), private car (10.2%), bus (9.2%), rail (0.6%) and others (1.3%).

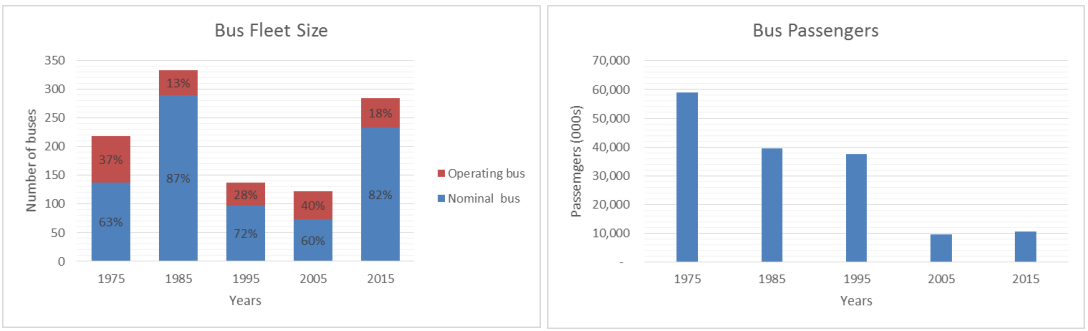

Figure 1. Bus fleet and passenger evolution (Source: Maputo municipality)

Figure 2. Public buses (left-hand side) and *Chapas* (right-hand side) in Maputo (Source: DMTT 2012)

According to [12], to meet the increasing demand in urban areas, individuals initiated the paratransit services and gradually their number increased. These new minibus operators *chapas* were formally acknowledged at the end of the 1980s when the government gave them permission to operate urban transportation services. By the beginning of the 1990s, *chapas* operators had a higher market share. The majority of the operators of *chapas* are not the owners of the vehicles, but hired drivers. They are hired under 3 main conditions: (1) to pay a daily fixed amount of revenue to the owners; (2) to meet their own salary and (3) to provide for the daily operating costs. Meanwhile, minibus drivers usually hire a conductor who collects the fares from the passengers. There are no formal contracts either between the owners and the drivers of "chapas", or, between drivers and conductors.

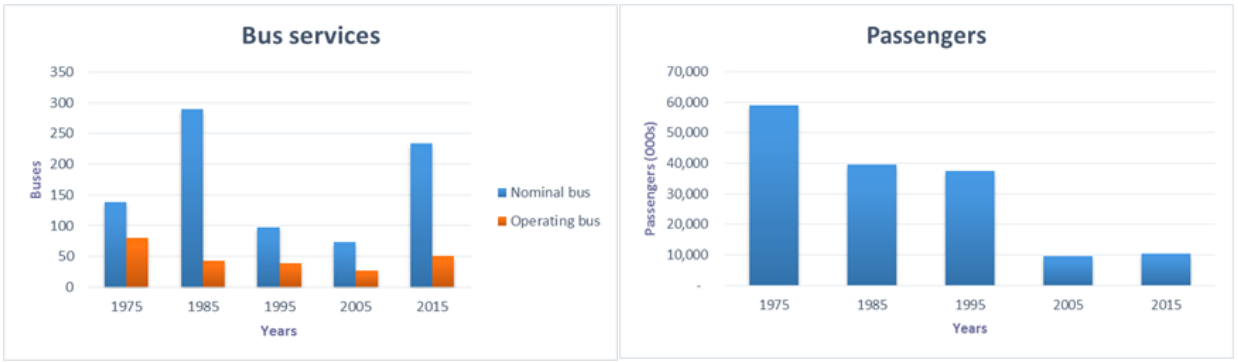

Figure 3. Public bus fleet and passengers (Source: Maputo municipality)

3.2. Nairobi

Urban transport services in Nairobi were exclusively provided by Kenyan Bus Services (KBS) until 1973 [17]. According to [17], Kenya Bus Services (KBS) was established in 1934 and it operated urban transport services utilizing high capacity buses (double-decker). Bus fares were controlled at the level that allowed the company to operate profitably and to expand [15]. Kenya Bus Services also encountered difficulties due to regulatory institutions which resulted in the declining market share. To meet the growing needs for transportation Kenyan authorities legalized the paratransit operators *matatus* in 1973 [15]. However, *matatus* are reported to have started their transport services in the 1950s and they were considered as illegal commercial operators [17]. Similarly, the seating-capacity of matatus ranges from 14 to 25 passengers.

According to [15] *matatus* were mainly used as a transportation mode of native Africans during the colonial period. The word *matatus* means 30 cents which were the standard flat fare that was charged. [15] state that even with the legalization of *matatus* Kenyan Bus Company retained the monopoly status which was only broken at the outset of the 1980s with the formation of another state bus company *Nyayo Bus services*. Similar to Maputo, the beginning of the 1990s witnessed an increasing transport modal share in favor of *matatus* (**Fig.5**).

[18] argue that the current public transportation is a complex paratransit system (**Fig.4**). Despite its demand flexibility, competitiveness, and spatial range, [18] claim that the paratransit system can never be sustained as the primary transport for the metropolitan area because the quantity of service supplied is completely disconnected from the capacity and quality of the infrastructure. In other words, there is demand for the high number of operating matatus, but the current road infrastructure cannot accommodate them. As of 2013, the modal share is primarily by walk (39.7%), followed by *matatus* (28.4%), private car (13.5%), bus (12.2%), rail (0.2%) and others (5.9%). Fig.4 also shows that from 2004 to 2013 the modal share of the main transportation modes has relatively increased. For example, the share of public buses increased from 329000 to 825000 trips; trips by matatus increased from 1.3 million to 1.9 million trips. The non-motorized mode also registered an increase from 2.3 million to 2.7 million trips.

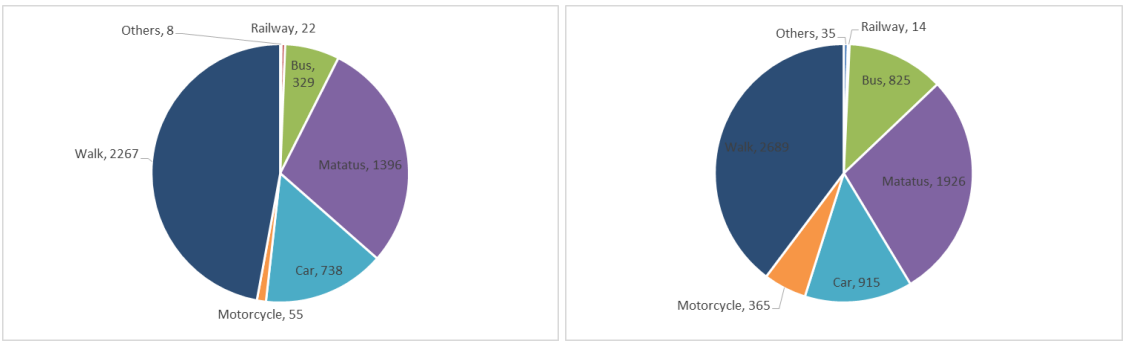

Figure 4. Number of trips (1000 trips) by transport mode between 2004 and 2013 (Source: HH survey)

Figure 5. Matatus (left-hand side) and Public buses (right-hand side) in Nairobi (Source: Kenyan bus services)

3.3 Comparison

Table 1. Characteristics of the cities

	Maputo Metropolitan Area	Nairobi City
Regulated to	Ensure Affordability	Operate profitably and expand
Subsidies	1 subsidized	2 competing privately owned
Difficulties	1980s – reduction in fleet size	1980s – increase in operational costs
Legal paratransit	1980s	1973
Paratransit fare system	Flat	Flat
Present bus mode share	Bus: Paratransit 9%:33%	Bus: Paratransit 12%:28%
Vehicle Size	Bus: Paratransit Normal: Minibus/Mid-bus	Bus: Paratransit Normal/Double-Decker: Minibus/Mid-bus
Fleet Size	Bus: Paratransit *Chapas* 280:4150	Bus: Paratransit *Matatus* 23000:72000
Route Coverage/number of routes	Bus: Paratransit 65:130	n/a

IV. BUS DEMAND: URBAN STRUCTURE DATA

In this section, we describe the geographic features of the cities, for example, the area, population. For a better understanding, we divided the cities into comparable zones. Zone 1 encompasses the Central Business Area (CBA), zone 2 is the built-up area, whereas zone 3 includes the suburban area. Lastly, zone 4 comprises the rest of the metropolitan area.

4.1. Maputo

Maputo, the capital city of Mozambique is the economic and political center of Mozambique (**Fig.6**). It is situated in the southern region of the country. The city was established as a main urban center following the development of transport infrastructures such as road and railway connecting Mozambique and South Africa. Maputo is still growing rapidly and expanding outwards. It is in Maputo where one of the major ports in southern Africa is located, the Maputo Port.

4.2. Nairobi

According to [19], Nairobi (**Fig.6**) is one of the most important economic centers in East and Central Africa. It accounts for 50% of formal employment in Kenya and generates over 50% of National Gross Domestic Product. Nairobi plays an important role, not only as the political center but also as a model for economic development. Dimitriou and Gakenheimer (2011) state that Nairobi was established as the colonial capital of British East Africa. It was initially a way station between the Port of Mombasa on the Indian Ocean and Uganda. From the initial settlement of the city, the British imposed a clear and distinct spatial segregation between European and African residents.

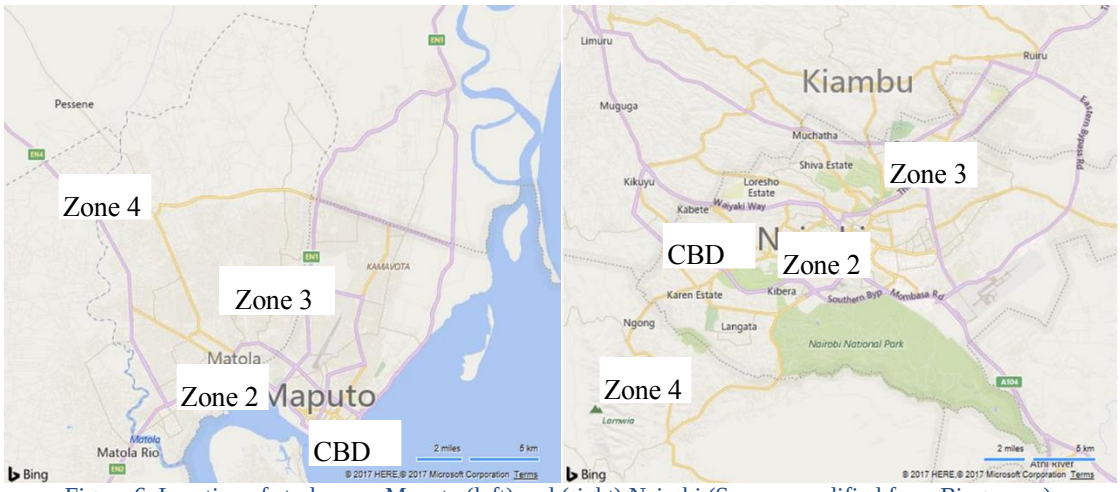

Figure 6. Location of study area: Maputo (left) and (right) Nairobi (Source: modified from Bing maps)

1. 4.3 Comparison

Table 2. Summary description of the zones

	Maputo Metropolitan Area	Nairobi City
Area	1208 sqm	4784 sqm
Population	2.2 million (2007 Census)	5.0 million (2009 Census)
Established	1884	1907
Port	Yes	No
Zone 1 CBD		
Area	8 sqm	11 sqm
Population	45734	274607
Population Density	5614	24964
Employment Density	1.7	n/a
Zone 2 Build Up		
Area	10 sqm	12 sqm
Population	76863	261855
Population Density	7971	21821
Employment Density	2.1	n/a
Zone 3 Sub-Urban		
Area	605 sqm	555 sqm
Population	1 million	2 million
Population Density	960	4688
Employment Density	0.3	n/a
Zone 4 Metropolitan		
Area	605 sqm	4206 sqm
Population	1 million	2 million
Population Density	960	446
Employment Density	0.2	n/a

V. BUS DEMAND: DEMOGRAPHIC DATA

5.1. Maputo and Nairobi

The person-trip data that are used in this paper were conducted in 2012 and 2013 in both Maputo and Nairobi respectively by Japan International Cooperation Agency (JICA). The sample dataset for two cities are is described in Table 3. It should be noted that:

- Person-trip data only covered the Nairobi City while in the case of Maputo the whole metropolitan area was surveyed.

- The occupation status information from Maputo was more disaggregated than in Nairobi and we had to adjust for comparison purposes.

Fig.7 provides the age distribution and household size of the two cities. **Fig.7** shows that approximately 47% of individuals in Nairobi and 45% in Maputo are less than 19 years old. The proportion of individuals aged between 20 years and 60 years old is approximately 50% in both Nairobi and Maputo. Maputo, with 5% of individuals over 60 years old has a slightly higher figure Nairobi with 2%.

Household attributes are disclosed in **Fig.8**. Approximately 87% of households in Nairobi have less than 3 persons compared to 11% in Maputo. Less than 12% of households with at least 3 persons while the same figure amount to 89% of households in Maputo. With respect to occupation the combined ratio of persons with no job, housewives, and students, is at 67% in Maputo and 24% for Nairobi. As it would be expected under this situation, the proportion of employed persons is higher in Nairobi than Maputo, 57% to 20%, respectively.

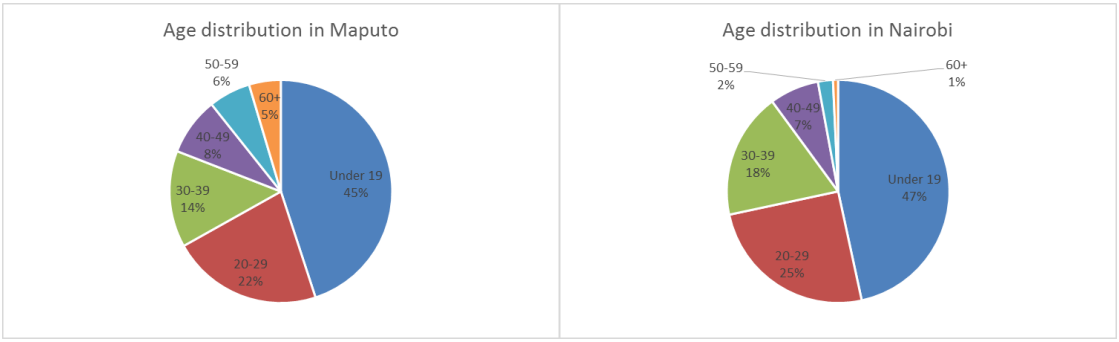

Figure 7. Age distribution in Maputo (left) and (right) Nairobi (Source: HH survey)

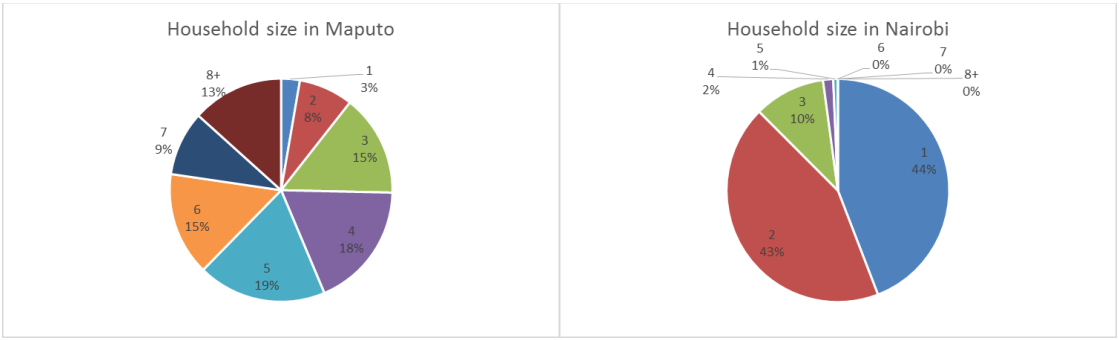

Figure 8. Household size distribution in Maputo (left) and (right) Nairobi (Source: HH survey)

5.2 Comparison

Table 3. Household attributes

	Maputo Metropolitan Area	Nairobi City
Population	2.2 million (2007 census)	5.0 million (2009 census)
Population Zone 1 – 3	1.1 million	3.1 million
Households Surveyed	9530	9973
Individuals Surveyed	43927	27618
Sample size	2%	1%
< 19 years old	45%	47%
20 – 60 years old	50%	50%
'> 60 years old	5%	2%
HH < 3 persons	11%	87%
HH> 3 persons	89%	12%
No job, housewives or students	67%	24%
Employed	20%	57%

The data confirms:

- The Findings of Howe et al. [20] who considered East African cities as being "young cities" with a substantial proportion of the population being the first generation of the urban dwellers.
- Households surveyed in the Maputo Metropolitan Area were relatively big compared to the smaller households in Nairobi City. This may seem surprising because in a study on urban travel behavior in Nairobi, [21] it was stated that the households in Nairobi City are relatively large with an average of 3.5 or 4 people. However, [21] also noted that many Kenyans often move out of Nairobi City when they retire, and considering that the survey only covered Nairobi City and not the metropolitan area, the findings can, therefore, be substantiated.
- Unemployment in Maputo Metropolitan Area is significantly higher than in Nairobi City.

VI. BUS DEMAND: MODE CHOICE

6.1. Relative to Time of Day

Fig.9 provides some insights to understand the temporal distribution of trips in both cities. Unlike the commonly two peak-hour periods found in Nairobi City, the temporal distribution of trips in Maputo is characterized by three peak-hour periods, namely, at 6 a.m. and 5 p.m. and around 12:00 respectively. According to (Howe et al. (2000), the increasing importance of the informal sector activities as a source of income in the developing cities is changing the nature of travel behavior. These authors state that even though commuting peaks remain, they are overlaid in both space and time by more complex irregular movements associated with trading, hawking, and employment-seeking. However, to better understand differences in trip patterns between the two we investigate purpose in the next sub-section.

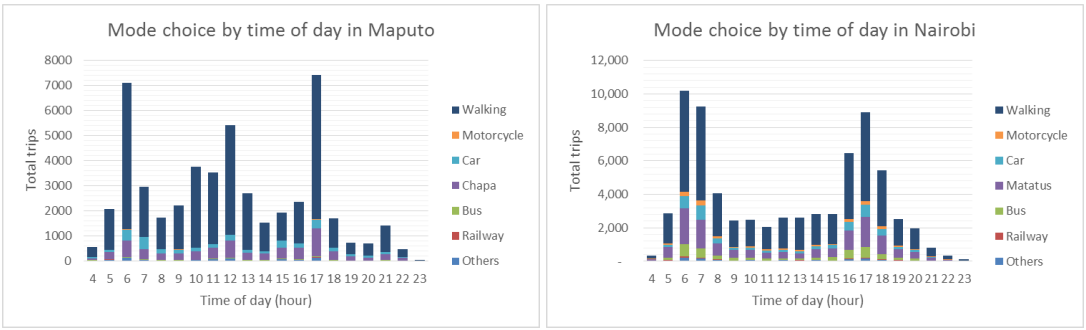

Figure 9. Mode choice by the time of day in Maputo (left) and (right) Nairobi (Source: HH survey)

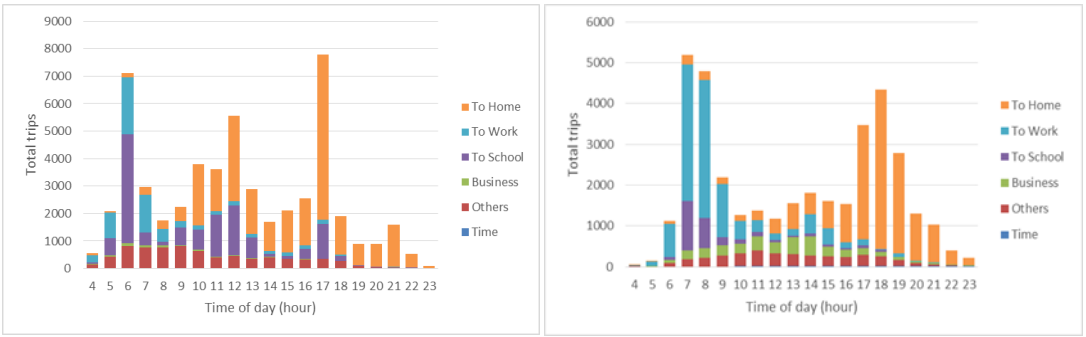

Figure 10. Temporal trip distribution in Maputo (left) and (right) Nairobi (Source: HH survey)

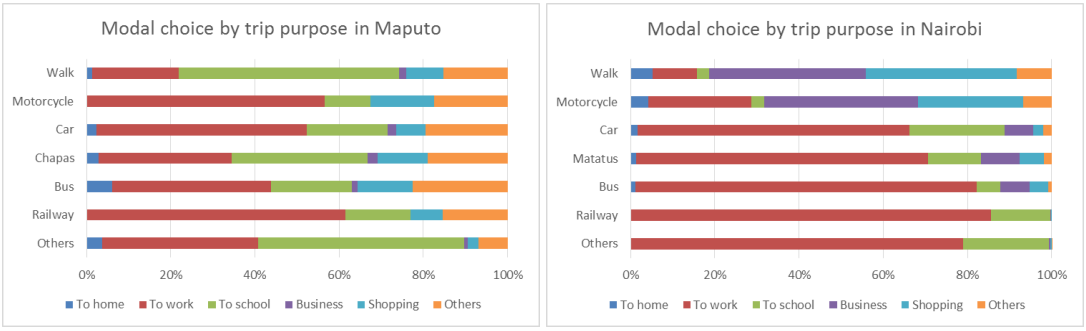

Figure 11. Mode choice by trip purpose in Maputo and Nairobi (Source: HH survey)

6.2. Relative to Trip Purpose

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Fig.10 shows the trip distribution relative to trip purpose. The morning peak-hour periods in both cities mostly comprise work and school trips, whereas the evening peaks are dominated by home trips. As it was noted, a day peak is observed in Maputo and it is constituted by trips to school and to work. Due to an increased number of children in the school age and limited supply capacity, the Government introduced in the 1980s 3 distinct school periods; a substantial proportions of students have classes from 7:30 a.m. to 12:30, the second and third periods from 12:30 to 17:30 and 17:30 to 22:30 respectively. From **Fig.11** it can easily be seen that work dominates all trip purposes in Nairobi, whereas in the case of Maputo trip purposes comprise mainly both work and school trip.

6.3. Relative to Zone

In contrast, gender, occupation status, household size, and location were found to influence positively the likelihood of public transport over private transport. These findings suggest that transport planners can positively influence travel behavior of low-income by making NMT more attractive while gradually introducing travel demand management measures. **Tables 4-5** show mode choice by residential location. From **Table 4**, the majority of residents commuting by walk, *chapas* and car originate from zones 3 and 4. For Nairobi, a substantial proportion of people commuting by walk and driving originate from zones 2 and 3. In the case of Maputo, *Chapas* constitute the most popular mode. Part of this explanation is that the service area of buses is constrained by the limited road coverage in Maputo (0.24 km per 1000 people) and Nairobi (0.22 km per 1000 people). [9] investigated mobility in 6 African cities (Bamako, Conakry, Dakar, Douala, Niamey, and Ouagadougou) and conclude that public transport services in these cities are concentrated on the major paved radial roads. On the other hand, paratransit services are operated far beyond the service area of buses.

Table 4. Travel mode by zone in Maputo

			Zones				Total
			Zone 1	Zone 2	Zone 3	Zone 4	
Mode	Bus	N	13	14	298	259	584
		%	2.2%	2.4%	51.0%	44.3%	100.0%
	Car	N	252	241	612	512	1617
		%	15.6%	14.9%	37.8%	31.7%	100.0%
	Chapas	N	134	243	4350	3468	8195
		%	1.6%	3.0%	53.1%	42.3%	100.0%
	Motorcycle	N	0	3	8	15	26
		%	0.0%	11.5%	30.8%	57.7%	100.0%
	Others	N	29	43	267	323	662
		%	4.4%	6.5%	40.3%	48.8%	100.0%
	Rail	N	0	0	9	38	47
		%	0.0%	0.0%	19.1%	80.9%	100.0%
	Walk	N	283	469	6881	6952	14585
		%	1.9%	3.2%	47.2%	47.7%	100.0%
Total		N	711	1013	12425	11567	25716
		%	2.8%	3.9%	48.3%	45.0%	100.0%

Table 5. Travel mode by zone in Nairobi

			Zones				Total
			Zone 1	Zone 2	Zone 3	Zone 4	
Mode	Bus	N	254	171	1592	6	2023
		%	12.6%	8.5%	78.7%	0.3%	100.0%
	Car	N	102	107	1979	1	2189
		%	4.7%	4.9%	90.4%	0.0%	100.0%
	Matatus	N	1059	548	4672	11	6290
		%	16.8%	8.7%	74.3%	0.2%	100.0%
	Motorcycle	N	62	45	797	5	909
		%	6.8%	5.0%	87.7%	0.6%	100.0%
	Others	N	40	56	546	0	642
		%	6.2%	8.7%	85.0%	0.0%	100.0%
	Rail	N	0	0	58	0	58
		%	0.0%	0.0%	100.0%	0.0%	100.0%
	Walk	N	4371	1978	12923	100	19372
		%	22.6%	10.2%	66.7%	0.5%	100.0%
	Total	N	5888	2905	22567	123	31483
		%	18.7%	9.2%	71.7%	0.4%	100.0%

VII. MODEL ESTIMATION

The literature reviewed suggests some associations between transport modes and socio-economic characteristics of individuals. In this section, a binary logistic regression is applied to investigate the factors affecting the use of buses in Maputo and Nairobi cites, respectively. Only individuals commuting by buses and paratransit modes were included in the models. The following assumptions are made:

- The dependent variable is transport mode – public buses and paratransit mode
- Explanatory variables are socioeconomic characteristics of individuals – gender, age, employment status, vehicle ownership, income and residential location.

Table 6. Variables in the models

Transportation mode	**1= Bus; 0= Paratransit (Chapas or Matatus)**
Characteristics of the Trip maker	
Age	Age is years
Gender (Female)	1 = Female; 0= Male
Worker	1 = Yes; 0 = No
Motorcycle Owner	1= Yes; 0 = No
Car Owner	1= Yes; 0= No
Residence Location	Distance between zones and City center 1 = 0-5 km 2 = 5-10 km 3 = 10-20 km 4 = 20 km or more
Income (Kenyan shillings)	Income levels (Kshs) 1 = Kshs 4999 less 2 = Kshs 5000-14999 3 = Kshs 15000-29999 4 = Kshs 30000-49999 5 = Kshs 50000 over

Next, we present the results of the estimated logistic regressions. Overall, statistical indicators show that the performance of the models is low (Pseudo R-Square ranges from 0.075 to 0.085). However, [22] argues that the Pseudo R-Square value is not a measure of the proportion of the variance in the regressand explained by the regressors included in the model. Therefore, the Pseudo R-Square value should be carefully considered. Most of the variables included in the models are statistically significant with their p-values (the exact level of significance level) being practically zero.

Table 7 shows the likelihood of choosing public bus over *Matatus* (paratransit) in Nairobi. From Table 7, we observe that the following variables are significant when choosing public bus:

- gender (female),
- employment status (worker),
- income,
- residence location and
- motorcycle ownership.

In Maputo Metropolitan Area Table 8 shows the odds of selecting public bus over Chapas (paratransit). The choice of bus depends on different variables, namely:

- ages between 6 and 56 years old,
- employment status (worker) and
- residence location

A positive coefficient suggests increased odds of an alternative over the other whereas a negative coefficient implies the opposite. From Table 7 we observe that in Nairobi City gender (female) and employment status (worker) decrease the odds of the bus over the *Matatus*, holding other variables constant. This might indicate that public buses are less popular when compared to *Matatus.* According to [21] the middle-income group in Nairobi City who cannot afford private cars are completely dependent on the informal public transportation. In contrast, income, residence location, and motorcycle ownership increase the likelihood of bus over *Matatus*. This finding is consistent with our expectation for [13] states that developing countries are characterized by a highly skewed distribution of income, with a large majority of the population receiving low incomes, and a small minority earning very high incomes. Most people depend on public transportation in their daily commute. Increases in incomes allow more people to use public buses.

Table 8 shows that for Maputo Metropolitan Area individuals between 6 and 56 years of age are less likely to commute by buses but *Chapas*, holding other variables constant. Part of the explanation is that bus services are poorly provided in the outlying areas. For example in 2012 road network coverage in Maputo city was at about 1001 kilometers (km), of which only 359 km comprise paved roads whilst the remaining 642 km of the of the road are unpaved roads. [23] states some people have to walk up to 7 km to access bus routes. On the other hand, employment status (worker) and residence location of the traveler increases the odds of buses over *Chapas*. The relative preference for buses over *Chapas* can is related to the fact that bus routes being longer than paratransit routes. This means that paratransit users, particularly from zones 3 and 4, are required to transfer in order to reach their destination and no transfer is needed for bus users.

Table 7. Logistic regression for Nairobi

Variables	Coefficient	P-value
(Intercept)	-1.180	0.000 ***
Gender (Female)	-0.163	0.000 ***
Age (6 – 56)	-0.018	0.932
Worker	-0.393	0.000 ***
Income	0.074	0.004 **
Residence location	0.005	0.000 ***
Motorcycle Owner	0.339	0.032 *
Car owner	0.121	0.369
Number of observations: 14851 Log likelihood: -5696.176 (8 df) Chi-square p-value: 0.000 Pseudo R-Square: 0.085 Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1		

Table 8. Logistic regression relative to Maputo

Variables	Coefficient	P-value
(Intercept)	-2.646	0.000 ***
Gender (Female)	-0.140	0.196
Age (6 – 55)	-0.433	0.012 *
Worker	0.449	0.000 ***
Residence location	0.001	0.042 *
Motorcycle Owner	0.359	0.408
Car owner	-0.129	0.450
Number of observations: 8780 Log likelihood: -1499.996 (6 df) Chi-square p-value: 0.000 Pseudo R-Square: 0.079 Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1		

Table 9. Comparison

Attribute	Significant Bus Coefficient Relative to Paratransit	
	Maputo Metropolitan Area	Nairobi City
Gender (Female)	n/a	-
Age (6 – 56)	-	n/a
Worker	+	-
Income	n/a	+
Residence Location	+	+
Motorcycle owner	n/a	+
Car owner	n/a	n/a

VIII. DISCUSSION AND CONCLUSION

This study has investigated the factors influencing the use of public buses in Sub-Saharan African cities specifically Maputo and Nairobi. The study has found some similarities and differences which are not found in the literature and need to be discussed carefully. The employment status (worker) and residence location increase the odds to use bus users in Maputo, whereas for Nairobi these include income, residence location, and motorcycle ownership. In contrast, the likelihood of selecting public buses was found to be influenced by the age (6-56) variable in Maputo, and gender (female) and employment status (worker) for Nairobi. Overall, the results confirm the findings of the previous studies in Sub-Saharan African cities [24].

The results of this study are indicative of policy strategies which can be implemented by public bus companies. In both cities, public bus operators should also target commuters residing in zones 3 and 4 who make longer trips. In the case of Maputo, the demand for transportation by commuters residing in zones 3 and 4 is such that during the afternoon peak, along the main bus stops there are regularly long queues of people awaiting buses heading out of town. There are also many people waiting for buses heading into town, most of whom are intending to remain on the bus for the outward trip, in order to be sure of getting a seat. In addition, the reduced competition by *chapas* in the long routes can contribute significantly to increase bus ridership.

Finally, as this paper only investigated the effect of the socio-economic variables on the use of public buses, further analysis is needed to understand the factors underlying the observed bus use. In addition to socio-economic characteristics of the decision maker, transportation mode choose is influenced by a wide range of factors such as general transport costs, trip purpose, time of day and individual or group trip.

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