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Suburbanization and Inequality in Transport Mobility in Yaoundé, Cameroon: Drawing Public Policy for African Cities

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Abstract

This study sets to explore the nature of inequality in mobility in the metropolitan region of Yaoundé city using data from the urban displacement plan, to identify pertinent orientations in the transfer of competencies towards local councils. A series of methodologies are combined; Multiple Correspondence Analysis to construct a mobility index, the decomposition framework to explore the nature inequality of mobility in the different Councils of the Yaoundé city and the Regression-based decomposition to identify factors that determine both cost of mobility and inequality in cost of mobility. Results identify differences in mobility between the urban centre (CBD) and the different local councils as well as between these councils. Furthermore, whereas the variables motive, distance, time, speed, cost of fuel, owning a car and residing in the urban city centre also increases cost of mobility, price negatively relates to cost of mobility. In the regression-base decomposition analysis, we identify the sources using a motorcycle for movements, owing a vehicle and the cost of energy as largely explaining inequality in transport mobility. Policy suggestions points to the need for a better management of urban growth, the development of road infrastructure, the regulation of emerging means of transportation like motorcycles and the necessity to enacting mechanisms that reduce cost of mobility. These policy options should be the main points to be discussed by the decentralization committee in charge of ameliorating local governance of basic services like urban transport created in 2008.

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I. Introduction

Recently, spatial economists in associating the concept of justice and space question the role of the State in reducing spatial inequalities in the face of emerging negative externalities such as rampant agglomerations and unguarded urbanization. These spatial inequalities in territorial development of agglomerations like urban settings are simultaneously causes and consequences of inefficient redistribution of public policies (Offner and Pumain, 1996) regarding the amelioration of cities. Therefore, enacting equal development of urban cities like Yaoundé is some form of social justice (Rousseau, 1762) and fair redistribution of resources by the state (Musgrave, 1959). When this is not the case, resolving this injustice necessitates developing adequate mobility of urban inhabitants.

In an attempt to understand how the transport system has failed to meet up with rapid urbanization, this paper is outlined as follows. We first set the context of the study by looking at urbanization and suburbanization. Secondly, we explore the policy contexts of rethinking urban transport system in Cameroon within the decentralisation framework. Thirdly, we focus on assessing the scale and nature of urban transport crisis in Yaoundé. In the fourth section of the paper, we empirically verify the issue of unequal access to transport mobility and its determinants by using a series of techniques (Multiple correspondent Analysis, regression analysis and decomposition frameworks). In section five, we discuss our findings and draw conclusions in section six.

I.1. Context of the Study: Transport, Urbanisation and Suburbanization

Africa's rapid urbanization is one of the most powerful and insistent realities of the early twenty-first century. No aspect of urban life, including transport access, can be understood without a comprehension of the nature and extent of urban change, in general and in a local context. At this stage, two different trends in urban transport that flow from urbanisation should be highlighted. First, growth of the urban population is relatively high. Second, the low density spread of urban settlements is associated with suburbanisation (sometimes measured through the monitoring of land use cover change or the physical expansion of the urban footprint). The combined impact of urban expansion and urban sprawl has huge implications for transport provision everywhere, including in Cameroon.

In 2003, about 38.7 percent of Africa's total population (851 million) lived in urban areas. In 1950 sub-Saharan Africa (SSA) had about 20 million urban citizens. Between 1960 and 1990 SSA witnessed its urban population increase to about 96 million inhabitants (Arnaud, 1998). Since 2005, SSA urban population has attained about 330 million inhabitants with annual average urban demographic growth rate averaging 4.1% between 1990 and 2005 (World Bank, 2007). The United Nations projects that the annual average growth rate for urban Africa will be about 3.35 percent, the highest in the world by a substantial margin for the same period (Stern and Eyoh, 2011; Kessides, 2005). Nonetheless, uncontrolled urban growth causes more pressure on urban infrastructure, waste management and inadequate housing, indicating the importance of how the expansion of the city occurs through suburbanization.

Suburbanization is defined as a process by which the population of the urban core decreases due to migration from the city centre to the suburbs (Kok and Kovacs, 1999). This phenomenon has been increasingly witnessed by most cities south of the Sahara (World Bank, 2007). This is characterised by an important spatial, economic and social disequilibrium between the CBD and the peripheries (Ouedraogo and Piché, 1995), affecting the lives[1] of city inhabitants (see Dubersson, 1996 for aspects linked to fertility; Barbieri and Vallin, 1996 for aspect linked to life span and Sahabana, 2006 for aspects liked to health quality).

Cameroon has witnessed significant rapid urban growth since independence. The United Nation Statistic Division indicates that in 2011, Cameroon had an urban population of about 52.1% percent of the total population and an estimated average urban growth rate of 3.2% between 2010 and 2015 (UN-World Statistics Pocket Book, 2013). The "Schéma Directeur d'Aménagement Urbain 2000-2020" notes that the urbanised space of the Yaoundé Urban council increased significantly since the 1950s as expressed in Table 1.

Table 1: Evolution of the Yaoundé Urban Council urbanised surface area

Year	Surface Area in Hectares(ha)	Rate of Progression relative to the last period (in %)	Average annual progression rate relative to the last period (in %)
1956	1740	*	*
1980	5300	205	8.2%
2002	15 919	200	9.1%

Source: Plan de Déplacement Urbain (PDU 2010).

Cameroon's[2], efforts to respond to urbanisation have been inefficient for two reasons: inadequate resources (Tamo Tatiétsé, 1997) and poor institutions (Canel, 1989). This observation is even move peculiar for a city like Yaoundé and in the domain of transport. In this domain, government have been titled towards improving road networks and traffic fluidity aimed at reducing congestions, road accidents, traffic, while meeting demands created by the rapid expansion of the city (PDU, 2010). Failure to meet transport demands was due urban growth and constraints of the SAP mechanisms, which pushed government to devolve responsibility towards local communities through some form of decentralization and outsourcing of transport provision.

The government perceived increase participation of local communities, through a decentralization framework, as necessary in reducing inequality in mobility that emerged with the suburbanization. Kuate (2013) indicates that between 2004 and 2009 a series of laws were promulgated with the objective of increasing the effects of decentralization in Cameroon. In the domain of urban transport, we note law number 2004/018 that attributes to

[1] Rampant Urbanization affects poverty because urban pattern and/or suburbanization dictate how households' and individuals' behave (Amis, 1995; Moser, 1995; Sikod, 2001 and Martinez-Vasquez et al., 2009).

[2] Urbanization in Cameroon falls under the Ministry of Habitat and Urban Development (C.f. Degree N°2012/384 of September 14 2012) and Transport by the Ministry of Transport (C.f. Degree N°2012/250 of June 1st 2012 , under the Ministry of Transport).

local communities the following competences in the domain of transport: (a) the organisation and management of public transport; and (b) the creation and management of some local roads. Article 110 of the same law indicates that urban councils have the competence to plan urban circulation and displacement for the entire road network in the urban area and their maintenance. We also note regarding urbanization the decree number 2011/006/PM of the 13th January 2011 outlying the role of communities in urban planning.

It appears finally that in most cities like Yaoundé where the simple monocentric model states that a household chooses the location where the cost of land and commuting costs have the best trade-off (Mills, 1972; Mignot et al., 2009), suburbanization appear to be a mixed phenomenon. Both rich and poor households suburbanize, albeit for different reasons, highlighting the imperative of investigating inequality in transport mobility in the light of urbanization and the associated institutional or policy responses.

I.2. Policy Context for Rethinking Urban Transport Access in Cameroon

At the same time as there has been a huge shift in the macro demographic context of urbanisation, it is also possible to trace major shifts in policy that have impacted on how city growth and urban infrastructure have been managed. The origins of Cameroon's current urban transport challenges are in part a product of past policy decisions. In the 1980s, severe economic recession in sub-Sahara African countries led, based on external advice, to the adoption of Structural Adjustment Programs (SAPs). The SAPs advocated the reduction of state spending and the increase in the role of the private sector in development. These two aspects had direct impact on urbanization and transportation because without substantial state support, large scale private investments in transport were not significant enough to cope with urban population growth and transport demands (Becker et al., 1995).

The lack of investment in transport infrastructure at a time of the physical expansion of African cities, compounded tendencies for peripheral development and the disassociation of the suburbs from the Central Business District (CBD). The resulting effect of this form of suburbanisation was a situation where both rich and poor households made home on the periphery of African cities, leading slum formation and transport deficits. Thus, unguarded and unregulated urbanization has caused the development of uncontrolled slums and suburbs in some African cities such as Dakar and Abidjan (Antoine, 1996), Bamako (Kouma, 1993), Ouagadougou (Jaglin et al., 1992) or Dar es Salam (Calas and Bart, 1997).

The realities of urban development under SAP departed from the post independence ideal. As colonial rule came to an end, the government of Cameroon decided to construct houses at low cost for individual affected by the economic crisis through reinforcing and the role and objectives of the Cameroon Real Estate Corporation, created in 1952. Sustained efforts by government to inject very large sums of money into mass housing schemes were hampered by the limited public financing available and the urban poor were left to address their housing needs themselves. The absence of state support for housing caused spontaneous and 'uncontrolled development' of the unregulated and poor serviced urban peripheries. Because

these peri-urban or peripheral settlements were unplanned and beyond the urban edge, there was the unintended impact that public investment in transport infrastructure was not planned or budgeted for because it was beyond the jurisdiction of the city.

Reduction in public spending as consequences of the SAP also affected transport infrastructure and urban transport directly, winding back the post independence agenda for urban mobility. After independence in 1960, the government had opted to offer public transportation in urban agglomerations. It created the Cameroon Urban Transport Society (SOTUC) in 1973. Its objective was to link urban peripheries to the urban centre and provide affordable transport for the low waged urban poor. For over 25 years, despite SOTUC having the monopoly of urban transport, this society failed to meet government needs in satisfying urban transport due to inadequate planning and wrong investment decisions. Ngabmen (2002) indicate that at the moment of the bankruptcy government had invested over 47 billion FCFA (about 94 million US dollars) and SOTUC reported an operating loss evaluated at 60 billion FCFA (about 120 million US dollars).

The closure of SOTUC caused the, already vulnerable, public transport system of Yaoundé to collapse giving rise over the next decade to informal and unreliable minibuses who serviced the increase in transportation demands. To respond to the deficit in the supply of transport and correct irregularities in the sector, the solution adopted by the government was to further liberalize and promote private participation in the transport sector in 1995 (Ongolo Zogo, 2002a, 2002b). In 2006, after 10 years of absence, government decided to allow the creation in Yaoundé of an enterprise named “TIC Le Bus”, financed by public and private sector actors. Its portfolio was made up of 66% owned by Parker Transnational Industries LLC (latter on Transnational Automotive Group (TAUG)) and 34% owned by the State of Cameroon.

Nonetheless, government efforts to meet transport demands in urban cities have failed to produce the expected results because we witnessed an increase in informal minibuses that have developed to link peripheries to the CBD. Likewise, uncontrolled urbanization and the development of a dual city structure where the centre is heavily endowed with adequate transport infrastructure and the peripheries poorly endowed have increased inequality in transport mobility in Yaoundé. In this study, we define mobility as the different forms of movement of people in the city for divers’ reasons affected by aspects like urbanization.

I.3. Problem Statement and Objective of the Study

Set against the massive growth in demand for urban transport and shifts in policy commitments to the urban poor, the main research question of this study explores which policy mechanisms the decentralization Committee should focus on to reduce inequality in urban mobility? The matter of this study is to explore the nature of inequality in mobility in the metropolitan region of Yaoundé city using data from the urban displacement plan. To this end the sub-objectives include: (a) analyze inequality in mobility in the city of Yaoundé; (b) identify causes of immobility in the metropolitan city of Yaoundé; and (c) suggest policy

input on the bases of our findings. A fuller understanding of the role of urban transportation in Africa's urban development provides important context for the specific investigation as explored in the next section.

II. The Role of Urban Transportation in African Development

Studies that explicitly attempt to define profiles of inequality in mobility caused by urbanization in African metropolitan areas are limited. Among the limited studies, we can note the studies by Barwell (1996) and Starkey et al. (2002), investigating how transport can be designed to meet personal mobility and accessibility of low-income earners. Despite the importance of mobility and suburbanization, many developing countries have failed to investigate the relationship between urban poverty and transport.

Prompted by rekindled interest in the link between urban forms, social equity and human rights, there is renewed concern to improve mobility and understand how transportation and transport infrastructure explain urban social and spatial structures (Garcia-López, 2012). In this regard, Baum-Snow (2007a) indicates that transportation improvements affect spatial patterns of urbanization, consumption of resources (Kahn, 2000) and public services (Bertaud, 2002). Movement is at the core of our existence because it enables and determines our activities-work, leisure, education-as well as our emotional lives. The right to mobility is one of the primary source of freedom and the possibility for personal and collective development, which are sources of progress and well-being (Gay et al., 2011).

In Levy's (2011) contribution entitled *Mobility Models: Society at Stake*, the question of public space and public mobility is raised. These two aspect, have overwhelmingly pushed towards the recourse to public transportation for mobility as necessary by collectivities and individuals. On another front, Crozet's (2011) write-up on Mobility: Time Savings aren't What they Used to be …, puts the spotlight on the important link between mobility and time saving. The author argues that enhanced mobility saves time, reduces distance and enables further distances to be explored in relatively little time, therefore increasing potential opportunities for growth (Zahavi and Talvitie, 1980). Other studies investigate other aspects of mobility, like average travel time, for some developed countries like France and the USA (Schafer et al., 2009), the relationship between the increase in potential speed of transportation and telecommunication (Kesselring, 2011), and factors that affect how different groups of people move and get around in Latin American cities like Santiago de Chile (Ducci, 2011).

In Cameroon, very few studies exist on aspects of urban mobility. Ongolo Zogo and Afor (2010) identify factors that explain urban transport costs between operators using an operating cost function of urban transport in Cameroon. Their main policy heralds the need to define adequate policy frameworks on sharing technical expertise for car maintenance and licensing renewal, specific to particular groups or types of vehicle.

Nonetheless, several attempts to improve urban transport have been initiated by the government of Cameroon. We note state disengagement to reduce budgetary deficits and promote private initiatives in the transport sector, investments to ameliorate urban transport networks, the creation to committees to oversee transport activities, transfer of competencies in the domain of urban transport to some urban councils and the encouragement of the development of several scenarios (urban displacement plans, the urban development directory, etc.).

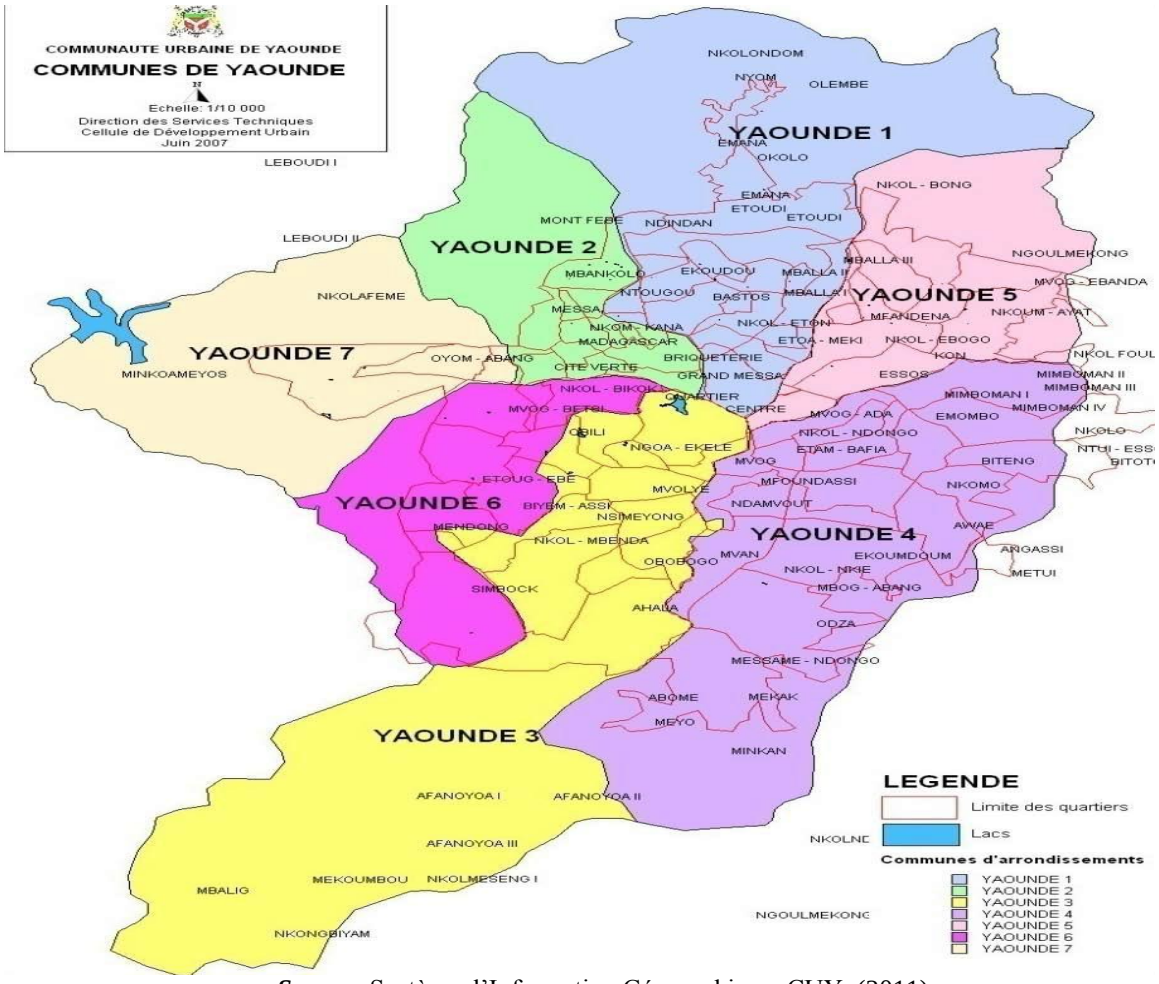
Despite these attempts, transport development has stalled and mobility problems are persistent for the city of Yaoundé, as illustrated in the next section exploring patterns of mobility in Yaoundé.

III. Pattern of Mobility in Yaoundé

Yaoundé is the political capital of Cameroon, the head quarter of the Centre Region and is situated in the Mfoundi Department. Yaoundé is the second largest city, after Douala and seat of the administrative structure and some enterprises. Its geographical location and transport infrastructure make the city of Yaoundé a hub in connecting the Republic of Central Africa and Chad from Douala.

Yaoundé has an urban delegate who oversees urban activities within the Yaoundé Urban Council. It is made up of seven Councils. Each Council is headed by a mayor, voted during municipal elections. Delimitations and boundaries of these Councils are defined by the administration of Cameroon. They are made up of several quarters, headed by quarter heads. In this study we adopt the Councils as defined by the constitution, including both the urban centre and peripheries. Figure 1 outlines the different Councils and quarters that that make-up the Yaoundé Urban Council.

<u>Figure 1</u>: The different Councils making-up the Yaoundé Urban Council



<u>Source:</u> Système d'Information Géographique, CUY, (2011).

III.1. Socio-economic Characteristics of Yaoundé

Socio-economic activities affect how and why people move (job locations, access to food and services, leisure, or affordability). Therefore, understanding some of these characteristics helps to appreciate the relationship between the transport systems and the needs of the population, when it comes to answering the question as to why they move. The transport system in Yaoundé has not evolved sufficiently to meet increase in population and the new orientations of movement that is influenced by socio-economic characteristics. This is because uncontrolled urbanization and the development of spontaneous habitations have developed without respecting any urban plan.

In 2005, the Cameroon Population Census indicated that the population of Yaoundé was about 1.8 million inhabitants[3], approximately 10% of the total Cameroonian population. The

[3] The 2005 Cameroon Census show that Yaoundé has an average age of 22 years and a media age of 20 years (BUCREP, 2006; 2010).

third Cameroon Household Consumption Survey (CHCS) indicates that Yaoundé (735 000FCFA) has the highest weighted on average expenditure per capita per annum in Cameroon. Between 2001 and 2007, expenditure per head witnessed a net decrease of 3.2%. The incidence of poverty for Yaoundé is 5.9% against 12.2% for national urban poverty. Inequality in Yaoundé is among the highest in the country. The ratio of the richest 20% to the poorest 20% is about 1:8. The Gini value for inequality in Yaoundé is 0.346 (NIS, 2007). Unequal levels of standards of living have caused poorer households to move towards slumps and the richer households to habitat relative well endowed areas of the city.

Exploiting the 2005 Employment and Informal Sector Survey (EISS), the public and semi-public sector employs about 17.3% of workers in Yaoundé, and the salary rate, on average, is about 11% higher than other cities. The informal sector in Yaoundé is dominant, like most cities in sub-Saharan Africa. This sector is predominantly made-up of individuals undertaking petty trading activities and working on their own account. The 2010 labour survey for Cameroon indicated that about 60% of active individual in Yaoundé are in the informal sector and 65% participate in the labour market. These individuals are concentrated in the main public markets situated in the centre of the town and some spontaneous markets that have developed in peripheries. The development of spontaneous markets in the peripheries have been due the development of reckless habitation and the difficulty for farmers that grow perishable food in these peripheries to sell their product in the main markets because of high transport cost. These market areas attract individuals to move towards market localities to purchase food items, affecting mobility patterns in Yaoundé.

Furthermore, the period for payment of salaries also affect mobility. During periods when salaries are paid to workers (at the end of the month), we observe a peak in the movement of people. By contrast, when salaries have been exhausted, we note a fall in the movement of people with traffic being low.

The 2007 Cameroon household consumption survey indicates that average spending per inhabitant on cost of transportation is about 10 000 FCFA for each month. This is about 14.2% of the total spent by each household each month. The main causes have been an increase in the prices of transport fares and the cost of fuel (petrol: 569 FCFA/litre; gasoline: 520 FCFA/litre). In Yaoundé, as indicated by the 2010 PDU survey, average cost of mobility is about 34487FCFA.Individuals in Councils that have experienced the highest spontaneous urbanization, pay higher transport fares to get to the city centre as compared to habitats situated in well planned localities in the city. These Councils are situated at the peripheries and their inhabitants move into the inner city core for diver's reasons like employment, leisure, etc. Pattern of mobility in Yaoundé is also linked to its monocentric form, accessibility and transport supply. In the next sections we observe the specificity of these aspects in relation to the Yaoundé city.

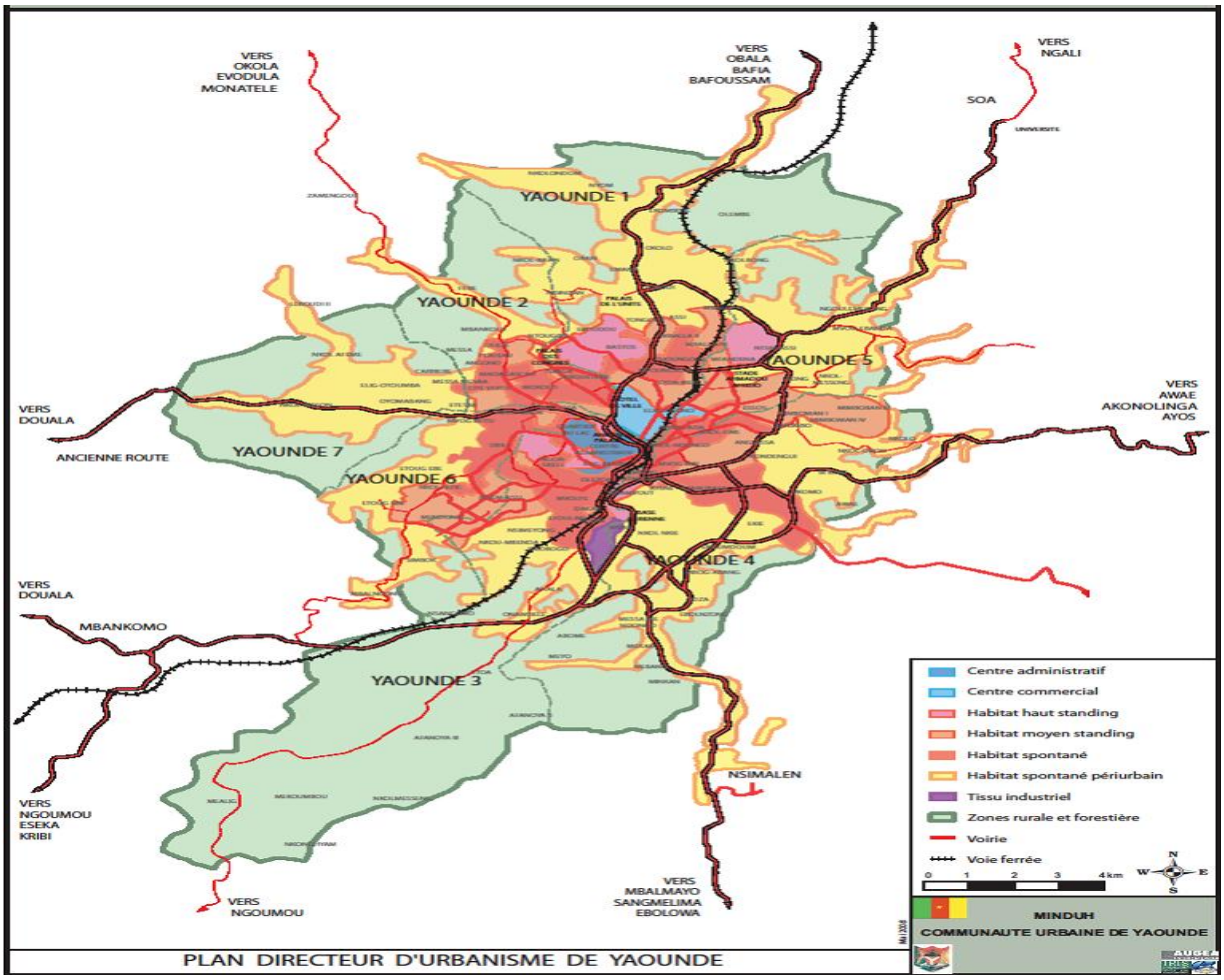
III.2. Mobility in a Monocentric City like Yaoundé

Urbanisation, a polysemous concept[4], is witnessed in Yaoundé around the centre of the town. Yaounde is divided into two distinct parts: the central administration area and the central commercial area. This zone is delimitated: in the north by the prefectural roundabout, the simplified flyover, Bastos and St. Anatasia roundabout; in the west by the central hospital and the central lake; in the south by the municipal warehouse and to the east by the railway and the Mfoundi market. The centre of the town is comprised of a large number of employments actors (light blue-central commercial segment and purple-industrial segments). Formal employment actors include the ministries, the central administration offices, public enterprises, private enterprises and formal commercial activities in the central commercial area. The Yaoundé central market and several informal traders also makes Yaoundé central market the principal zone of informal and small trading activities in the city. Figure 2 below indicates the different segments and the growth pattern of the city.

Suburban localities (coloured yellow) have been identified by the urban city council as peripheries that developed around the CBD as shown in Figure 2. Increasing suburbanization in Yaoundé is unique and make-up 50% of the surface area in Yaoundé. Suburbanization have been spontaneous and largely made up of precarious habitation and poor road infrastructures (Assako, 1997 and PDU, 2010). Figure 2 indicates this extension from the city centre (deep blue and sky blue) towards the North West areas (Yaoundé 1, 2 and 6 Councils) and towards the South East areas (Yaoundé 4 and 5 Councils).

[4] The spatial extension of the city cannot be seen as isolated, but should be considered as a stage of urbanization. Mieszkowski and Mill (1993) identified three forms of urbanization: monocentric radial in reference to the model developed by Alonso (1964), multicentry low density and the mixed model. According to the life course approach by Mulder (1993), migrating from the centre to suburbs is a rational choice subjected to factors like career, housing cost, household cost and gains in terms of trade-off between lost wages due to travel time and their preference for a better living condition.

<u>Figure 2</u>: Urban morphology of Yaoundé



<u>Source:</u> Yaoundé Urban Council : Yaoundé 2020, Plan Directeur d'Urbanisme, AUGEA INTERNATIONAL-IRIS CONSEIL-ARCAU PLAN, 2008.

The urban growth of Yaoundé is characterized by a horizontal expansion and a functional differentiation of the utilisation of urban space. Low levels of public infrastructural services are felt in the peripheries. Demographic and spatial growth is disordered and poorly managed due lack of accessibility and inappropriate road network.

III.2.1. Accessibility and the Road Network in Yaoundé

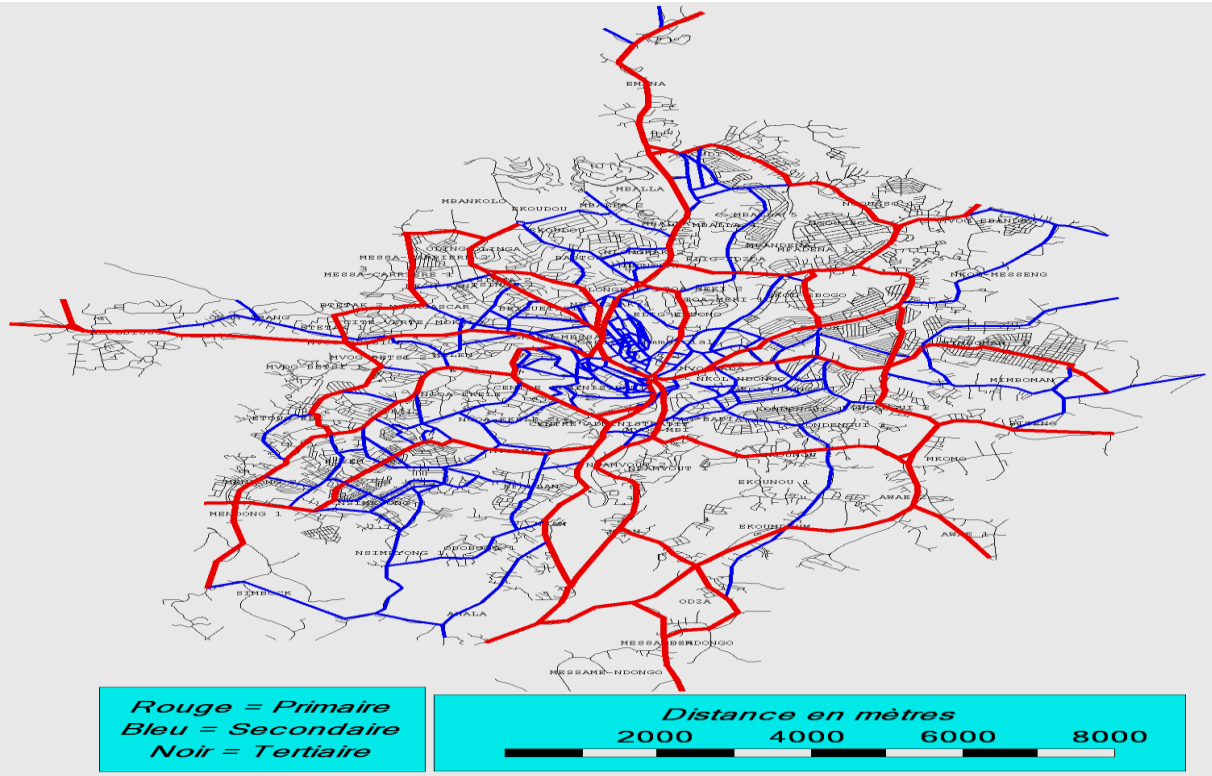
The surface area of the Yaoundé urban Council is approximately 30 000 hectares (YUC, 2010). Urban growth, according to the PDU (2010), is done in four fronts: in the North following the directions of the quarters Okola and Obala; in the North-East towards the University of Yaoundé II directions of Soa; towards the East on the Ayos front; and towards the south following the routes towards Douala and Mbalmayo, stretching towards the Nsimalen International Airport (see Figure 2).

The total Yaoundé road network in 2010 is estimated by the YUC Geographic Information System at 2536 km, of which the urban road network is 752.75 km. This link is decomposed into 61 Km of national roads, 159 km of primary roads which are concentrated in the city

centre, 57 Km of secondary roads which link the centre of the city to peripheral zones and 478 km of tertiary roads which inter-links peripheries as well as irrigates movement within these peripheries. Secondary and primary roads are concentrated in the inner core of the city with the latter extending from the CBD to the peripheries.

Some characteristics of transport infrastructure indicate that: (1) the density of the road network is 752.75 km/ 254km2 or 0.00037 km per inhabitant (estimate population in 2008, 1 800 000 inhabitants); (2) the average time to access a tarred road is about 11 minutes (CAVIE, 2002); (3) the percentage of road maintenance is 53.57%; and (4) the average speed on tarred is 40 km/h (PDU, 2010). Also, large portions of the tertiary road are earth roads. These roads are generally degraded and insufficient, fuelling traffic congestion and delays. This generally increases the cost of mobility, especially to the periphery, in terms of time, fuel consumption and displacement fares, pushing poor households to adopt other means of transportation like motorcycles. The road network of Yaoundé is expressed in Figure 3.

<u>Figure 3</u>: Yaoundé Road Network



<u>Source:</u> YUC (2010). Note: Red: primary roads; Blue: secondary roads and Black: tertiary roads. Distance in meters range from 0 to 8000 meters.

Despite efforts by the national government and the Yaoundé Urban council to extend the road network, the coverage rate is still weak (CHCS, 2007). The road network in Yaoundé has not kept pace with the urban growth rate (Ongolo Zogo, 1999; 2002a, b). The road networks linking the center of the town to the peripheries are few and degraded (Ngabmen, 2002). Average time needed by an individual living in Yaoundé to reach the closet tarred road is about 11 minutes against six in Douala (CAVIE, 2002). Results from the 2007 CHCS reveal

that 63% of households in Yaoundé indicated that efforts by the authorities to ameliorate transportation were poor (NIS, 2007).

III.2.2. Modal Repartition of Urban Transportation in Yaoundé

During the 2010 Urban Displacement Survey, about 2 183 000 vehicles were counted (see Table 2). This indicates that high urban growth rate compels individuals to move using collective or private cars for their daily activities. The proportion of taxi on the different routes varies from 19% to 72% of total traffic. The third type of vehicle is motorcycles. The use of motorcycles is highest in the peripheries and by poor households. Generally, these are used for very small distances.

Table 2: Repartition of traffic by type of vehicle in Yaoundé

Type of vehicle	Number	% Total
Motorcycles	133 163	6,1%
Personal cars	823 540	37,8%
Taxis	1 065 938	48,8%
Minibus	41578	1,9%
Bus	4366	0,2%
Small trucks	80771	3,7%
Medium trucks	13 098	0,6%
Big trucks	8 732	0, 4%
Trailers	7448	0,3%
Others	4 366	0,2%
Total	2 183 000	100%

Source: 2010 Yaoundé urban Displacement Survey (2010).

The CHCS III (2007) indicates that about 8% of households in the city own a vehicle and about 2.3% a motorcycle. However, this trend is expected to grow with the increase in utilization of motorcycles as means of transportation and source of income by the largely unemployed youths. In 2009, the Center Region witnessed an increased in the number of vehicles (over 10000) and motorcycles (over 6000) matriculated (TRANSTAT, 2010). The increase in the number of motorcycles used as means of transportation is a characteristic that mimics other cities like Douala (Ngabmen and Godard, 1998). This practice formerly predominant in rural areas, have been imported into Yaoundé because of the difficulty in accessing the periphery due to uncontrolled urbanization.

To conclude, our analysis on patterns of mobility in Yaoundé indicate that the urban transportation systems has been marked by the predominance of the informal and local sector, which have out grown the formal transport structures in the 1990s to offer mobility towards the peripheries. Furthermore, unequal modal repartition with rich households in the CBD and poor households in the peripheries within a monocentric structure raises the issue of inequality in transport mobility. In the next section we empirically attempt to find indicators to quantify profiles of inequality of transport mobility in Yaoundé.

IV. Empirical Analysis of Inequality of Mobility in Yaoundé

IV.1. Methodology

The methodology adopted for this study investigates reasons for mobility, determinants of cost of mobility, differences in mobility in Yaoundé and factors that account for unequal movements in Yaoundé. The methodology used in this study is a combination of three frameworks of analysis. First, we use the multiple correspondence analyses (MCA) approach to construct a synthetic indicator for mobility and then decompose this indicator to compare inequality in mobility for the seven councils that make up the city of Yaoundé. Second, we identify determinants of the cost of mobility. Third, we apply the regression-base decomposition technique to compute the share of determinants of mobility for policy suggestions.

IV.1.1. Mobility Indicator: The Multiple Correspondence Analysis Approach

Technically, by using the standard Correspondence Analysis on an indicator matrix, we obtain the MCA where the percentage of explained variance need to be corrected and the Correspondence Analysis inter-point distances specified (Abdi and Valentin, 2007; Greenace, 1984). The use of the MCA technique requires defining a unique numerical indicator and then specifying the MCA process proper.

The MCA is considered as a PCA process applied to the indicator matrix, but with a special case of the Mahalanobis metric (Saporta, 1980) on row/column profiles, instead of the usual Euclidean metric. In the case of the MCA for the distance between two observed profiles $i \, and \, i'$ in the R^j dimensional space takes the form:

$$d^2\left(f_J^i, f_J^{i'}\right) = \sum_{j=1}^{J}\left(1/f_j\right)\left(f_J^i - f_J^{i'}\right)^2 \qquad (1)$$

The difference between the Euclidean and indicator matrix resides in the term $\left(1/f_j\right)$. This term permits small categories to receive a higher weight in the computation of distances. Asselin (2005) identify the properties of marginalization bias and reciprocal bi-addivity (duality), as key in showing the superiority to the MCA. Regarding the first property, the MCA overweight the smaller categories within each primary indicator. These weights can be expressed as:

$$W_{j_k}^{\alpha,k} = \frac{N}{N_{j_k}^k}\operatorname{cov}\left(F_\alpha^*, I_{j_k}^k\right) \qquad (2)$$

where $W_{j_k}^{\alpha,k}$ is the score of category j_k on the non-normalized factorial axis α. $I_{j_k}^k$ the binary variable which takes the value 1 when the population unit has the category j_k. F_α^* is the normalized score on the factorial axis α. $N_{j_k}^k$ is the frequency of the category j_k of indicator k. cov is simply the covariance. Concerning the second property, the concept of duality indicates that the MCA can be applied on the indicator matrix either to observations (row-profiles) or categories (column-profiles). This property, expressed for the row-profile is:

$$F_{\alpha}^{i} = \frac{\sum_{k=1}^{K}\sum_{j_k=1}^{J_k}\frac{W_{j_k}^{\alpha,k}}{\lambda_{\alpha}} I_{i,j_k}^{k}}{K} \quad (3)$$

Where, K is the number of categorical indicators. J_k is the number of categories for indicator k. $W_{j_k}^{\alpha,k}$, the score of category J_k on the non-normalized factorial axis α. I_{i,j_k}^{k} the binary variable taking the value 1 when the unit i has the category J_k. F_{α}^{i} the score (non-normalized) of observation i on the factorial axis α. Reciprocally, the score of a category (column-profile) can be expressed as:

$$W_{j_k}^{\alpha,k} = \frac{\sum_{i=1}^{N_{j_k}}\frac{F_{\alpha}^{i}}{\lambda_{\alpha}}}{N_{j_k}^{k}} \quad (4)$$

Assuming, that the first factorial axis meets the consistency conditions, we can consider this axis as the composite indicator of mobility since it most informs on the behavior of the different factors (indicators) used to construct our indicator.

After constructing the mobility indicator, we compute inequality in mobility for each Council as well as the between-and within-group inequality. The different groups represent the seven Councils in Yaoundé plus the CBD. We undertake this endeavor by computing the Gini coefficients for each Council. This is expressed as:

$$G(\rho=2)=\frac{2\text{cov}[Q(P),P]}{\mu} \quad (5)$$

where Q(P) is the level of acceptable mobility below which we find a proportion P of the population. P $\in$ [0, 1] is the proportion of individuals/households in the population who enjoy a relatively good state of mobility less than or equal to Q(P). ρ is a parameter of inequality aversion that determines our ethical concern for the deviation of quantiles from the mean at various ranks in the population. The Gini coefficient for ρ=2 can be portrayed graphically as twice the area lying between the lorenz curve and the 45° line divided by the total area in such a diagram. The denominator ensures that this measure will vary between 0 (perfect equality) and 1 (perfect inequality). We then further our analysis by applying the Shapley value approach (Araar 2006; Shorrocks, 1999) to generate the within-group inequality component (G_W^{Sh}) and between-group inequality component (G_B^{Sh}), given by:

$$G(mobililty\,index) = G_W^{Sh} + G_B^{Sh} \quad (6)$$

VI.1.2. Regression Model: Determinants of the Mobility Function

To identify determinants of mobility in Yaoundé, we expose the econometric model we use before exploring the regression-based inequality decomposition (RBD) framework. The RBD framework captures the shares of the various correlates that determine mobility in accounting for inequality in transport mobility in Yaoundé. To generate reliable parameter estimates, the mobility function is expressed as:

$$Mob = \alpha + \sum_{k=1}^{K}\beta_k X_k + \varepsilon \quad (7)$$

where Mob is the dependent variables that captures mobility, alpha the constant term, beta the estimated coefficients, X's the covariates of interest (mobility indicator, distance, time, speed, price, etc.) and epsilon the error term. To control for potential endogeneity we use the robust command.

VI.1.3. Applying the Regression-based Decomposition Framework to Investigate the Shares of Factors of Mobility in Explaining Inequality in Transport Mobility

In this section we adopt the decomposition framework developed by Morduch and Sicular (2002) and Araar and Duclos (2009). Without loss of generality, we adopt the estimating econometric model in Equation 7. Since the econometric results yield estimates of the sources attributed to mobility variables, they allow us to undertake decomposition of the mobility function. By construction, total mobility is the sum of the estimated sources of mobility (plus the predicted regression residual) for each individual:

$$Mob_i = \sum_{k=0}^{K+1} \ddot{\hat{m}}_{i,k} \tag{8}$$

where $\ddot{\hat{m}}_{i,k} = \hat{\beta}_k X_{i,k}$ for k=0,1, 2, …, K and $\ddot{\hat{m}}_{i,k} = \hat{\varepsilon}_i$ for k=K+1.

We then express the share of inequality attributable to the mobility factor, $\ddot{\hat{m}}_{i,k}$ as:

$$S_k = \frac{\hat{\beta}_k \sum_i a_i(m) x_{i,k}}{I(Mob)} \tag{9}$$

$\hat{\beta}_k$ is estimated coefficient associated with mobility factor k, $x_{i,k}$ is the mobility factor k attributable to individual *i*, $\sum_i a_i(m)$ is the sum of the ethical weights attributable to individuals and, *I(Mob)* is the total mobility-inequality index.

Adopting the framework by Wan (2004), using $I\left(Mob\right)$ as an inequality measure, overall inequality in mobility can be decomposed into the contribution of the constant term $I(\alpha_0)$, the contribution of the estimated factors of mobility $I\left(\tilde{m}\right)$ and the contribution of the predicted residual $I(\hat{\varepsilon})$ as follows:

$$I(Mob) = I(\alpha_0) + I(\tilde{m}) + I(\hat{\varepsilon}) \tag{10}$$

The contribution of the estimated constant to measured income inequality: $I(\alpha_0) = I(Mob) - I(\tilde{m})$ and the contribution of the predicted residual to measured income inequality: $I(\hat{\varepsilon}) = I(Mob) - I(predicted\ Mob)$. Computing the share of the residual term is important because it represents factors or determinants other than those included in the regression model and can inform policymakers on how much included factors can explain the overall inequality. In general, there are two main approaches for the decomposition of total inequality by sources: the analytical approach and the Shapley value approach. In this study we adopt the Shapley value. This approach is based on a set of axioms (see Shorrocks, 1999) and has the merit of computing the weighted marginal contributions of an estimated source in

various coalitions of sources of mobility. These weighted contributions exactly sum up to the considered inequality measure. In terms of inequality indices, we use the Gini coefficient.

IV.2. Data Description

Data used in this study combines data obtained from the 2010 Urban Displacement Plan (UDP) study effectuated by the Yaoundé Urban Council and complementary data from interviews with local authorities. Other sources included government ministries such as the Ministry of Habitat and Urban Development, Ministry of Transport, Ministry of Economy, Planning and Regional Development, National Institute of Statistics, Syndicates of transporters, etc.

The PDU was conducted by the Yaoundé Urban Council (YUC) with the aim of gathering information, measures, defining the structure of traffic in Yaoundé and evaluating factors that affect circulation. Another objective of this survey was to understand why people move. About 18 000 individuals were interviewed. Data was collected between May and June 2010 and comprised multimodal (cars, buses, minibus, taxis and motorcycles) estimates on displacement in Yaoundé, motifs for displacements, the volume of circulation, origins and destinations of commuters, volume of traffic, and ways of displacement.

To evaluate the structure of traffic flows and surveys on movements from the point of origin towards a destination, 34 roundabouts were considered as counting points. To assess movements of people, Yaoundé was divided into areas based on the Geographic Information System used by the Yaoundé Urban Council. The repartitioning was comprised of 89 internal areas and 9 external areas. They were defined as parts of an agglomeration that either attracts, or displaces people from another area. Variables used for our analysis are reported in Table 3.

Table 3: Descriptive statistics obtained from the Urban Displacement Plan (UDP)

Variables	Mean	SD	Min	Max
Cost of mobility for respondent (log)	10.131	0.7967	6.7720	12.481
Mobility indicator^{+++}	1.5831	1.0065	0	2.8897
Distance (km)	0.1488	0.1132	0.035	2
Time (hours)	0.0918	0.0302	0.055	0.1428
Speed (km/hour)	28.043	19.988	0.15	120.08
Cost of fuel	133.27	36.427	113.67	511.06
Respondent (1=Owner/driver of vehicle and 0=otherwise)	0.2709	0.4444	0	1
Price (1=yes and 0=otherwise)	0.5955	0.4908	0	1
By motorcycle (1=yes and 0=otherwise)	0.0296	0.1697	0	1
By car (cluster mean)	0.3169	0.0748	0.1569	0.4708
By Taxi (cluster mean)	0.5570	0.0898	0.3328	0.7585
By Bus/mini-bus (cluster mean)	0.0632	0.0603	0.0125	0.2408
Urban city center (1=yes and 0=otherwise)	0.5486	0.4976	0	1
Suburbs (1=yes and 0=otherwise)	0.4513	0.4976	0	1

Source: Computed by the authors from the 2010 UDP and complementary statistics using STATA 10. The variable with +++ is synthetic variable obtained by the MCA approach.

The table above indicates some descriptive statistics for variables used in the regression. Cost of mobility is calculated in FCFA. Average distance covered by the respondent is 0.15km. Average time of mobility is 5.5minutes (0.09 hours). Speed to get from one location to the

other averages at 28km/h. 27% of respondents own a car and 59% pay for transportation. Average fuel price per respondent is 133FCFA. About 54% of respondent move towards the city center either from their point of origin towards their destination or vice versa. Prices paid for transportation are highest in the Councils that experienced a high development of spontaneous habitations.

Descriptive statistics for variables used to construct the mobility indicators in Table 4 show that about 91% of respondent indicated that a sunny weather increases their mobility. Regarding the choice of transportation about 26% indicate that they have no main reasons that dictate their choice. However, for individuals that choose their means of transportation, the factor time (20%), followed by owning their mode of transportation (21%) and the cheapness of mobility (14%) appear as important. The main motive for leaving their place of origin is for residential (47%) and work (24%) purposes. Regarding motive for going towards a destination the principal diver is for work purposes (31%) or residential motives (29%). Visits make up about 11%, indicating the important role family or social ties play in pushing individual to be move from one point of the city to another.

Table 4: Descriptive Statistics for variables used to construct the mobility indicator

Variables	Number of individuals	Frequencies (%)	Min.	Max.	Mean	Standard deviation
Weather	**16209**	**100**	**1**	**3**	**2.906**	**0.3093**
1 : Rainy (Wet)		0.51				
2 : Cloudy		8.41				
3 : Sunny		91.08				
Reason for choice of Transport mode	**16208**	**100**	**1**	**8**	**3.555**	**2.006**
1 : Owner		21.40				
2 : Cheap		14.56				
3 : Fast		20.56				
4 : Luggage		0.79				
5 : No choice		26.31				
6 : Comfort and security		9.58				
7 : Borrowed car		3.21				
8 : Other reasons		3.59				
Motive for leaving place of origin	**16209**	**100**	**1**	**10**	**2.541**	**2.241**
1 : Residence		47.50				
2 : Work		24.62				
3 : School		3.46				
4 : Business		6.43				
5 : Market		6.32				
6 : Administration		1.15				
7 : Visit		6.48				
8 : Hospital		1.39				
9 : leisure		0.08				
10:Other reasons		2.57				
Motive for going to a destination	**16209**	**100**	**1**	**10**	**3.311**	**2.629**
1 : Residence		29.38				
2 : Work		31.13				
3 : School		4.81				
4 : Business		6.88				
5 : Market		6.98				
6 : Administration		1.37				
7 : Visit		11.68				
8 : Hospital		1.39				
9 : leisure		2.26				
10:Other reasons		4.12				

Source: Computed by the authors using data from the Urban Displacement Plan (UDP) and complementary data.

To undertake the decomposition analysis (section V.2) of the mobility index we developed in section V.1, we construct zones based on the repartition of the different quarters in Yaoundé. These zones represent the urban centre (CBS) and the seven local councils that make up the

city (See Figure 1). In this study, using the different sources of data, we generated average distance, cost of mobility, speed and a mobility index. Energy consumption is a function of the age of the vehicle and the speed of displacement. The cost of mobility was calculated based on the methodological relation budget/cost energy consumption and the number of individuals being transported by a given vector (means) of transportation by each interviewee (See Gallez, 2002).

We asked stakeholders to indicate reasons why inequality of mobility was an issue in their councils. The main objective was to perceive how local authorities appreciated government's efforts, post SAP, to resolves issues linked to unequal access to transport facilities in their respective localities based on an approach that decentralizes power. We carried out the interview on a one-to-one basis where each local authority or his representative was asked some questions. We questioned these local Councils officials on aspects associated to their role in terms of managing transportation in their local council. Some other aspects included decongesting government prerogatives in the domains of transport and urbanization, difficulties faced in implementing government directives, difficulties due to overlapping of competencies in the domain of transportation and urbanization, etc.

From these interviews, the main points raised by those interviewed were: (1) there exist inadequate finances at the local council level to effectively target transportation and urbanization issues; (2) there is still a weak level of understanding of the text governing the transfer of competences and thus the necessity to organise training for workers in these local councils; (3) there is the necessity to fine-tune legislation to clearly outline the role and responsibilities of the different actors involved; (4) that the level of devolution of prerogatives of these local councils regarding the management of transport and urbanisation needs to be increased despite some efforts made by the government.

V. Empirical Results

To analyze profiles of inequality in mobility in the metropolitan region of Yaoundé city we structure this section as follows. First, we comment on the factors that make-up the mobility index. Second we decompose this mobility index per the seven councils (considered as zones). Third we comment on determinants of the cost of mobility. Fourth, we compute the shares of the different variables in explaining inequality in mobility (cost of mobility) and simulate various policy scenarios and how this can impact on inequality in the cost of mobility.

V.1. Determinants of the Mobility Index

Table 5 in the next page indicates the shares of the factors used to construct the mobility index. Results indicate that motives (reasons) for either leaving the origin or going to the place of destination largely accounted for the mobility of individuals. This corroborates the argument that people move because they want to satisfy a desire or demand. Reasons why they move vary, indicating that the importance of the right to move.

Regarding motives for leaving their place of origin, only the modalities residence and administration were positive. This may indicate that the majority of residence leave their homes or leave the central administration towards a destination (for business purposes, employment, etc). Considering motives for going towards a destination modalities that contributed positively to the mobility indicator were going to the residence, market, administration, hospital and other motives. This may reveal that people will displace themselves for either economic, work, health or other motives.

Table 5: Synopsis of the Mobility Indicator

Variable	*Scores*		*Correlation*		*Contributions*		*Total % Inertia*
	First	*Second Axis*	*First Axis*	*Second Axis*	*First Axis*	*Second Axis*	
Weather					***0.002***		6.8%
Rainy (Wet)	0.145	0.268	0.000	0.000	0.000	0.000	0.037
Cloudy	0.158	0.235	0.001	0.002	0.001	0.001	0.034
Sunny	-0.015	-0.023	0.001	0.003	0.001	0.000	0.003
Reason for choice of Transport mode					***0.026***		***24.1%***
Owner	-0.526	0.007	0.038	0.000	0.011	0.000	0.029
Cheap	0.582	-0.406	0.029	0.013	0.009	0.004	0.032
Fast	0.078	0.363	0.001	0.016	0.000	0.005	0.029
Luggage	0.325	-0.705	0.000	0.002	0.000	0.001	0.037
No choice	0.127	0.159	0.003	0.004	0.001	0.001	0.027
Comfort and security	0.402	-0.267	0.009	0.004	0.003	0.001	0.033
Borrowed car	-1.405	0.009	0.033	0.000	0.011	0.000	0.036
Other reasons	-0.489	-0.778	0.005	0.011	0.002	0.004	0.036
Motive for leaving place of origin					***0.339***		***38.1%***
Residence	1.377	0.381	0.871	0.062	0.160	0.012	0.019
Work	-1.656	0.486	0.455	0.037	0.120	0.010	0.028
School	-1.154	-0.337	0.024	0.002	0.008	0.001	0.036
Business	-0.293	-4.293	0.003	0.602	0.001	0.204	0.035
Market	-1.208	0.106	0.050	0.000	0.016	0.000	0.035
Administration	1.181	-1.538	0.008	0.013	0.003	0.005	0.037
Visit	-1.557	1.687	0.085	0.094	0.028	0.032	0.035
Hospital	-1.087	-0.166	0.008	0.000	0.003	0.000	0.037
Leisure	-0.859	-0.231	0.000	0.000	0.000	0.000	0.037
Other reasons	-0.325	-4.231	0.001	0.224	0.000	0.079	0.036
Motive for going to a destination					***0.329***		***31%***
Residence	1.410	0.422	0.419	0.035	0.104	0.009	0.026
Work	-1.517	0.122	0.528	0.003	0.125	0.001	0.026
School	1.520	0.416	0.059	0.004	0.020	0.001	0.035
Business	-0.329	-4.762	0.004	0.795	0.001	0.269	0.034
Market	1.103	0.333	0.046	0.004	0.015	0.001	0.034
Administration	1.352	0.404	0.013	0.001	0.004	0.000	0.037
Visit	-1.482	1.314	0.147	0.108	0.046	0.035	0.033
Hospital	1.343	0.465	0.013	0.001	0.004	0.001	0.037
Leisure	1.299	0.449	0.020	0.002	0.007	0.001	0.036
Other reasons	0.901	-1.293	0.018	0.034	0.006	0.102	0.036
TOTAL					**0.696**		**100%**

Source: Computed by the authors with data from the Urban Displacement Plan and complementary data using STATA 10.

Regarding the variable choice of mode of transportation, the modalities borrowing a car or owning a car contributed to reducing the effect of this variable in explaining mobility. Lastly, we generate the cumulative distribution of the mobility indicator by the urban center and the suburbs. The distribution is identical for both areas except the middle portion which shows a gap between the 37th and 80th percentiles (see Figure 2A of Appendix).

V.2. Zonal Decomposition of the Mobility Indicator

To further our investigation, we decompose the mobility index by area of residence. We divided Yaoundé into the urban center and the seven councils (see Figure 1). Overall inequality associated to the mobility index was 0.54 (Table 6). This high value corroborates the observation that inequality in mobility in Yaoundé is high. Second, the within-area components has a higher value that the between-area. This may indicate that the mobility index is more unequal within the different areas of residence than between these areas. Nonetheless, the between area values are relatively close to the within area showing that though targeting inequality should be both within each locality as well as between the different localities.

Table 6: Decomposing the mobility index by urban center/suburban locations in Yaoundé

Location	Population Share	Mobility Share	Absolute Contribution	Relative Contribution
Urban center	0.5703	0.5319	0.1740	0.3182
	(0.0432)	(0.0443)	(0.0235)	(0.0453)
Yaoundé 1	0.0351	0.0583	0.0001	0.0001
	(0.0118)	(0.0186)	(0.0001)	(0.0001)
Yaoundé 2	0.0373	0.0311	0.0007	0.0012
	(0.0089)	(0.0089)	(0.0003)	(0.0006)
Yaoundé 3	0.1179	0.1660	0.0048	0.0088
	(0.0353)	(0.0548)	(0.0026)	(0.0047)
Yaoundé 4	0.1193	0.0936	0.0076	0.0139
	(0.0210)	(0.0140)	(0.0026)	(0.0047)
Yaoundé 5	0.0306	0.0265	0.0005	0.0009
	(0.0050)	(0.0045)	(0.0002)	(0.0003)
Yaoundé 6	0.0832	0.0840	0.0038	0.0070
	(0.0200)	(0.0204)	(0.0019)	(0.0035)
Yaoundé 7	0.0062	0.0085	0.0000	0.0000
	(0.0017)	(0.0023)	(0.0000)	(0.0000)
Within-group inequality			0.1915	0.3503
Between-group inequality			0.1484	0.2714
Overlap			0.2069	0.3784
Total values	1.0000	1.0000	0.5468	1.0000
	(0.0000)	(0.0000)	(0.0076)	(0.0000)

Source: Computed by the authors with data from the Urban Displacement Plan and complementary data using the DASP software by Araar and Duclos (2009) and STATA 10.

Looking at the different locations, the CDB overwhelmingly accounts for the within area inequality component as per the mobility index. As indicated in Figure 2, urban sprawl largely affected the local councils Yaoundé 6, 2 and 1 to the northwest and Yaoundé 4 and 5 to the southeast. The CBD is characterized by the central administration, the industrial segment and the high, moderated and planned habitations as indicated in Figure 2. In the CBD road infrastructure is good and urban planning is respected. Both transport network and urbanization are better than the peripheries. This entails therefore a high rate of movement of people because they either move into, or out of the CBD for diver's reasons.

For peripheries, we identify Yaoundé 4 and 3 councils as having the highest values (see Table 6 and Figure 1A of Appendix). Movement is high in these areas because if the proximity of

the industrial segment along the border between Yaoundé 4 and 3. This may indicate that people move into this area for job purposes. Figure 3 also indicates that these areas have a number of secondary and tertiary roads.

Finally, the overlapping component presents a relatively high value (Table 6). This may show the mobile nature of the residents of Yaoundé and the possibility that the respondents do not confine themselves to a particular group. Therefore furthering our analysis to confront other factors that affect the cost of mobility with the mobility index is useful. In the next section we apply the regression based approach in this endeavor.

V.3. Determinants of Cost of Mobility in Yaoundé

In this section we comment on determinants of the cost of mobility in Yaoundé. The model was globally relevant with the Fisher test being significant at a percentage point and the adjusted R-squared 0.58 (See Table 7).

Table 7: Estimation of Determinants of mobility in Yaoundé (dependent variable: log of cost of mobility)

Variables	Weighted estimates
Mobility indicator	0.0156***
	(3.38)
Distance (km)	0.4558***
	(11.69)
Time (hours)	0.8195***
	(5.35)
Speed (km/hour)	0.0012***
	(4.18)
Cost of energy(fuel) consumed per individual	0.0049***
	(34.47)
Respondent (1=Owner/driver of vehicle and 0=otherwise)	0.7384***
	(66.83)
Price (1=yes and 0=otherwise)	-0.0182*
	(-1.86)
By motorcycle (1=yes and 0=otherwise)	-2.0791***
	(-77.73)
By car (cluster mean)	1.5457***
	(16.95)
By Taxi (cluster mean)	1.7264***
	(24.72)
By Bus/mini-bus (cluster mean)	2.1774***
	(22.59)
Urban city centre (1=yes and 0=otherwise)	0.0450***
	(5.34)
R-squared/ Adjusted R-squared	0.5836/0.5833
Fisher test [p-values]	1833.9[0.000]

Source: Computed by authors from the 2010 PDU and complementary statistics using STATA 10. ***,** and * represent 1, 5 and 10 percent levels of significance. Variables in bracket are the t-students.

The mobility indicator was positive and significant at a percentage point. This indicates that individuals with higher values of this index are likely to spend more on mobility. Other variables that relate positively to cost of mobility are distance, time, speed, cost of fuel, owning a car and residing in the urban city center also increases cost of mobility.

Regarding distance, the increase in the peripheries around the city (generally having cheaper houses) has increased the distance covered by inhabitants to go to their job sites. The variables speed, cost of fuel and owing a car are generally associated to spending. Increase in cost of fuel is shifted of individual commuting by an increase in transport fares, thereby increasing their cost of mobility. Individuals owning a car spend more on transport cost associated to servicing his vehicle.

Concerning the variable revealing the different modes of transportation like cars, taxi, minibuses, buses and motorcycles, we note that whereas cars, taxi, minibuses and buses related positively to the cost of transportation, there variable motorcycles rather related negatively to cost of transportation. This may indicate that whereas the usage of cars, taxi, minibuses and buses are generally expensive, cover long distances and their respective transportation cost higher, the cost of transportation using motorcycles is less expensive and used largely to cover small and inaccessible distances in the peripheries. The peculiarity of motorcycle is explained by the observations that as individuals get wealthier they tend to use other forms of transportation rather than motorcycles.

Lastly, paying a price is negatively related to cost of mobility. This is because as prices (fare) of transportation increases individuals tend not to move because they cannot pay such transport fares.

V.4. Regression-based Inequality Decomposition Results

To decompose measured inequality in transport mobility by regressed-income sources, we compute contributions of the various estimated factors using the Shapley value-based approach (see Table 8 below).

Table 8: Decomposition of total inequality in Transport Mobility in Yaoundé by sources

Sources of mobility	Shapley value
	Gini value
Mobility indicator+++	0.001[0.003]
Distance (km)	0.006[0.011]
Time (hours)	0.003[0.005]
Speed (km/hour)	0.003[0.006]
Cost of energy(fuel) consumed per individual	0.036[0.071]
Respondent (1=Owner/driver of vehicle and 0=otherwise)	0.064[0.126]
Price (1=yes and 0=otherwise)	0.0003[0.001]
By motorcycle (1=yes and 0=otherwise)	0.160[0.317]
By car (cluster mean)	0.009[0.018]
By Taxi (cluster mean)	0.026[0.053]
By Bus/mini-bus (cluster mean)	0.014[0.027]
Urban city centre (1=yes and 0=otherwise)	0.001[0.002]
Residual	0.182[0.360]
Total Inequality	0.505[1.000]

Source: Computed by authors from the 2010 UDP and complementary statistics using DASP 2.1 and STATA 10. The variable with +++ is synthetic variable obtained by the MCA approach. Values in bracket are relative contributions.

An overview of the different factors indicates that the sources using a motorcycle for movements, owing a vehicle and the cost of energy largely explain inequality in transport

mobility (about 51%). The relative contributions of the other regressed sources sum up to 13% and the residual 36%.

The component motorcycles account for about 31% of total inequality revealing the growing use of this means of transportation. Some motivations given by respondents include (a) it is relatively cheaper than a car; (b) it is cheaper in terms of fare; (3) it is largely used in the periphery or suburbs where the road network is poor and neither cars nor buses go to these areas; (4) it is used for very small distances and by a larger number poor households and (5) this sector employs a large amount of young people who cannot have a job.

Owning a vehicle accounts for about 12.6% of total inequality in transport mobility revealing that individuals that own their vehicle are likely to be more mobile because they can displace themselves at will and might be wealthy individuals. Regarding the source cost of fuel, it accounts for about 7% of total inequality in the cost mobility in Yaoundé. This may indicate the importance of fuel prices in explaining difference in transport mobility of individuals in Yaoundé. Fuel affects directly owners of vehicles because an increase in fuel prices increase cost of consumption of fuel and therefore transportation cost. Fuel increase also affects individual indirectly through increase in prices of transport fare. When fuel prices increases, taxi owners, minibus owners or motor cycle owners increase the prices of transport fare. This affects the transport cost of individuals and households situated furthest from the CBD highlighting the issue of spatial.

Other sources that marginally account for total inequality in transport mobility are the factors distance, time, speed, willingness to pay a price and the mobility indicator individually. The relatively small contribution of these standard factors that explain mobility is likely due to the small urbanized surface area of Yaoundé, the time taken to move from one point to another (except during peak hours) and the relatively small distances. The mobility index also marginally accounts for inequality indicating that modalities that make up this index (motives, choices and weather), i.e. generally personal variables, may be less significant than economic factors or transportation infrastructure.

The modal choice (motorcycles, taxis, minibuses and buses) explains about 41.5% of total inequality in transport mobility. This highlight the key role transportation plays in explaining inequality in mobility. In addition to motorcycles, minibuses also explain inequality in transport mobility given the key role the plan in the Yaoundé city. These minibuses have grown in prominence with the collapse of mass urban transportation in the city of Yaoundé.

The residual term accounts for 36% of inequality in transport mobility in Yaoundé. This value may policy makers on as to how much enacting policies may be with some confidence. However, more investigations are needed to increase the margin of confidence in addressing the problem of inequality in transport mobility in a city like Yaoundé.

The marginal contributions of the different sources are expressed in Table 9. These contributions are generated by the Distributive Analysis Stata Package (DASP 2.1) software

package. The level of entry indicates the position in which a regressed source is introduced to a set of already existing sources. The introduction of each source into a coalition of sources can be envisaged as a policy-mix.

Regarding the variable using motorcycles for movements of about 0.160 to total inequality in transport mobility of 0.505, about 0.016 is realized at level 1, that is, in the absence of other sources. Including other source for a potential policy-mix scenario (level 2 through level 13), the sum of the remaining weighted marginal contributions of was 0.144. The progressive decrease in its marginal contribution indicates that by promoting mix-policies that harness the effects of this factor on inequality in transport mobility the effectiveness of this policy is more acute. Therefore combining policies that resolve issues of motorcycle with other policy scenarios associated to the other factors may reduce the effect of this factor on total inequality.

The effects of owning a car and cost of fuel in accounting for inequality in the cost of mobility portray similar results. Their respective marginal contributions at the first level of entry of their respective resources in accounting for total inequality were 12.5% and 13.8% respectively. The remaining shares of these variables form the second to the thirteenth level of entry in explaining total inequality in transport mobility sums to about 87.5% and 86.2%, respectively. This indicates that by combining policies that target simultaneously aspects linked to car owners and cost of fuel with other potential policies drawn from other factors, government significantly reduce inequality in transport mobility cause by aspects linked to car ownership and fuel prices by 87.5 and 86.25 respectively.

Therefore, blending policies which target both the main contributors and other sources that explain inequality in transport mobility reveals the following: (a) policy mix will not only reduce the individual effects of each source, but also their collective effects in resolving issues associated to inequality in transport mobility in the city of Yaoundé; and (b) the necessity is observed for all variables irrespective of the degree of their contributions in explaining total inequality in transport mobility in Yaoundé. Given the need to decentralize policy approaches where “small political entrepreneurs” or local authorities share responsibilities with state authorities, adequate coordination frameworks should be established.

Table 9: Marginal contributions of the various estimated sources of mobility based on the Shapley Value Approach

Estimated Sources of mobility	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	Level 9	Level 10	Level 11	Level 12	Level 13
Mobility indicator+++	0.0007	0.0002	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	-0.0000	-0.0000	-0.0000
Distance (km)	0.0017	0.0009	0.0006	0.0005	0.0004	0.0003	0.0003	0.0002	0.0002	0.0002	0.0001	0.0001	0.0000
Time (hours)	0.0010	0.0004	0.0003	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000
Speed (km/hour)	0.0009	0.0004	0.0002	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Cost of energy(fuel) consumed per individual	0.0055	0.0043	0.0036	0.0032	0.0028	0.0026	0.0024	0.0022	0.0020	0.0020	0.0018	0.0017	0.0016
Respondent (1=Owner/driver of vehicle and 0=otherwise)	0.0080	0.0071	0.0064	0.0059	0.0054	0.0050	0.0047	0.0043	0.0040	0.0037	0.0034	0.0031	0.0028
Price (1=yes and 0=otherwise)	0.0004	0.0001	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	0.0000	0.0000	0.0000	0.0000
By motorcycle (1=yes and 0=otherwise)	0.0164	0.0152	0.0144	0.0138	0.0132	0.0126	0.0121	0.0117	0.0112	0.0108	0.0103	0.0099	0.0095
By car (cluster mean)	0.0046	0.0029	0.0018	0.0011	0.0006	0.0003	0.0000	-0.0002	-0.0003	-0.0004	-0.0004	-0.0004	-0.0005
By Taxi (cluster mean)	0.0066	0.0048	0.0036	0.0028	0.0022	0.0017	0.0013	0.0011	0.0008	0.0007	0.0005	0.0004	0.0003
By Bus/mini-bus (cluster mean)	0.0035	0.0024	0.0017	0.0013	0.0010	0.0008	0.0007	0.0006	0.0005	0.0004	0.0003	0.0003	0.0002
Urban city centre (1=yes and 0=otherwise)	0.0009	0.0003	0.0001	0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
Residual	0.0227	0.0200	0.0181	0.0166	0.0153	0.0142	0.0132	0.0123	0.0115	0.0107	0.0100	0.0093	0.0087

Source: Computed by authors using DASP 2.1 distributive software slotted in STATA 10.
Notes: Levels indicate the point of entry of an estimated source into a coalition of sources. Results are reported in four decimal places.

VI. Conclusion and Policy Recommendations

This study attempted to define profiles of inequality in mobility in the metropolitan region of Yaoundé city using data from the urban displacement plan. Specifically we investigate (a) reasons for mobility; (b) determinants of cost of mobility; (c) differences in mobility in Yaoundé and (d) factors that account for unequal movements in Yaoundé.

Results identify that mobility varies between the urban center (CBD) and the different local Councils, with access to the former appearing to be differentiated in mobility. We also find that among that inequality in transport mobility is present with the various localities as well as between these localities. In a attempt to identify determinants of cost of mobility, whereas the variables motive, distance, time, speed, cost of fuel, owning a car and residing in the urban city center also increases cost of mobility, price negatively relates to cost of mobility. In the regression-base decomposition analysis, we identify the sources using a motorcycle for movements, owing a vehicle and the cost of energy as largely explaining inequality in transport mobility. The regression-based decomposition framework also identifies the value addition for defining policy mix scenarios and multi-level interplay of the authorities associated to transport and urbanization issues. We voice the observation that given the different roles and impact of the various factors that account for unequal transport mobility there is need for and integrated and inter-related approach combining the different policy actors. This could be through a decentralized framework that defines the role of the different policy actors as per their competencies.

Our results point to the need for formulating policy orientations within an adequate decentralization framework in the following domain:

(a) One strand of our results indicates that the area of residence positively relates to the mobility indicator, which increases cost of mobility. Therefore, there is the need to build up frameworks that adequately manage urban sprawling as well as develop a compensation mechanism that reduces the cost of transport for individuals who live at the peripheries. A hypothecated transport tax levied on structures situated in the city center, in which capital raised will be used to finance investment in local public transport infrastructure or rather subsidies transportation cost of poor individuals could be established. The funds could be controlled by the local government authority responsible for organizing public transport.

(b) The different modes of transport explain about 40% of inequality in the cost of transport mobility. Coupled with inadequate road infrastructure in the peripheries and degradation of roads resulted the development of anarchy in this sector. Generally, the drivers are poorly trained and accidents occur in which victims are not covered by insurance. A mass transportation system could be developed within a decentralized framework in which the roles are shared between decentralized territorial collectivities and the central authority. In this framework, tertiary roads may be constructed and managed by the urban council, and primary and secondary by the central authority or transport governing body. Road maintenance in the suburbs can be governed by the local councils through a participative approach in which local

inhabitants operated and manage funds attributed to the maintenance of the tertiary road and control for revenue collected from such roads in terms of toll fees.

(c) The component motorcycles accounts for about 30% of inequality in the cost of mobility. Uncontrolled the informal nature of this sector prevents it from being regulated, posing serious risk in terms of security. Decision making to regulate this sector posse's problem because structural deficiencies and overlapping of prerogatives to regulate this sector between the different authorities exist. Given the growing importance of this sector in the transport map of Yaoundé, a legal framework should be drawn delimiting the number of passengers, type of goods and security equipment's used by individual operating within this segments. Within a decentralized framework, transportation by motorcycles can be regulated within a framework where local authorities are given finances to organize training and sensitization activities among the motorcycle divers. Furthermore, given they are active in the peripheries which are areas of competence of local councils, the ministry in charge of issuing driving license may establish special partnerships with local authorities on the issuance of driving licenses specific to a given sector.

(d) Decentralization provides opportunities of checks and balances if well articulated. The transfer of competencies to local authorities in terms of transport needs to be undertaken adequately. These local councils do not always have the necessary skilled personnel to deal with transport issues. Given the competences of the urban council and expertise of development committees that deal with issues on Yaoundé like the "Great Yaoundé" committee, transfer of competences to deal with urban transport issues could in the short and medium term be transferred these organ with the view of drawing a timeframe and defining mechanisms that will incorporate local councils in the long term.

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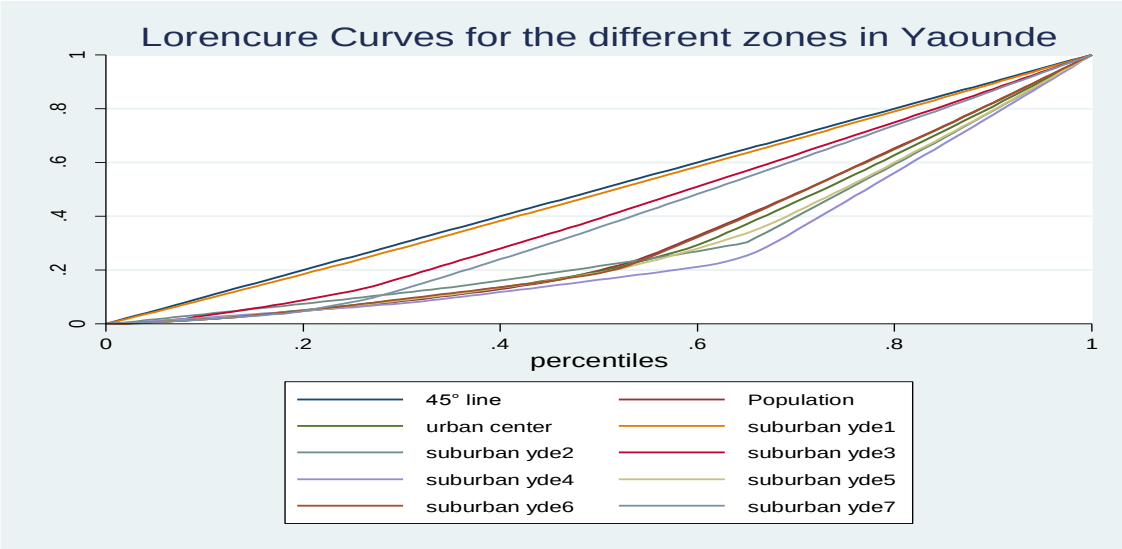
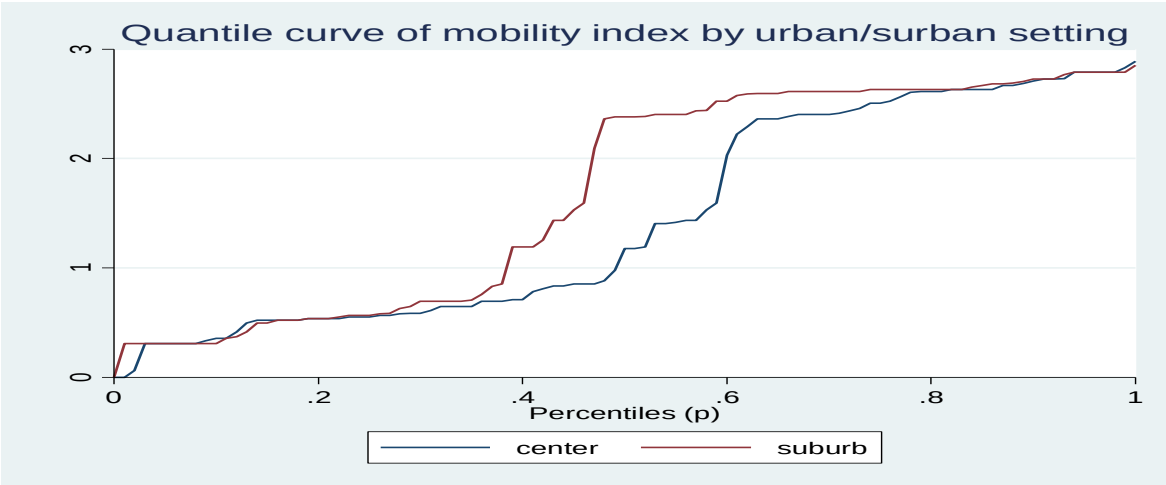
Appendix: List of Figures

Figure 1A: Lorenz cure by urban center/suburban zones



Source: computed by the authors using the DASP 2.1 software.

Figure 2A: Quantile Curve for the Mobility Index



Source: computed by the authors using the DASP 2.1 software.