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Is informal transport flexible?

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Abstract: Informal transport is often described as flexible, reactive, demand responsive, niche-filling, and in-tune with passenger needs. This paper proposes expanded definitions of flexibility in the operations of informal transport networks and presents a theoretical framing for understanding the growth and change in the locations of routes and terminals. Based on surveys and interviews of transport workers and regulators in four African cities, it argues that individually competing vehicles encounter coordination failures that limit their incentives for searching out niche services. Meanwhile, in cities with localized, route-based associations, organizations of multiple vehicles are able to take on the initiative and risk of developing new service locations and responding to passenger demand. This is done through a complex, gradual process that includes temporary subsidies to drivers and operators, testing and measuring potential demand, and advertising the new route. The key mechanism is in competition not between individual drivers, who manage internal competition carefully with a variety of mechanisms to distribute income opportunities fairly, but between firms and associations over territorial coverage. This not only opens potential for engaging transport associations in planning and policymaking, but also reveals limitations to the coverage and equity of access offered by existing networks and incentive structures.

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1 Introduction

Informal transport, or paratransit, provides crucial transport services in cities worldwide, but remains poorly understood and marginalized in academic and policy discourse (Behrens et al., 2015; Cervero & Golub, 2007). When considered in terms of accessibility and transport justice, the geography and locations of operation of transport systems which are not subject to central planning, nor receive any subsidy or protections for their operations, has had little empirical or theoretical investigation. The impact of these questions on the mobility options and access to opportunities of a majority of the urban population of the world is critical as cities continue to grow and seek to become both more sustainable, and more equitable.

Based on based on mixed-methods data, including interviews, focus groups and route mapping and analysis, collected on planning and route setting practices by informal transport operators in four African cities, this paper interrogates the idea of "flexibility" as a mechanism for explaining the geography of informal transport. It proposes a concrete delineation of forms of flexible operation, by engaging with the role of both economic competition and social and labor structures, and theorizes market failures in the equity and efficiency of mass transit provision by private-sector operators and highlights

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the role of associations in overcoming these, holding the role of network planners.

Analysis of informal transport in Africa is disproportionately centered on a handful of major national and international cities. These cities are exceptional not only for their size, but for their role as political, economic and cultural centers, national capitals and regional and international megacities (Pojani & Stead, 2015). Research on such transport systems is often dominated by questions of political process, global financial flows and complex infrastructure investments. These include frequent efforts to ban, reform or integrate informal modes, the introduction of BRT or rail services, and questions of national and global visibility and city branding, modernity, development and planning ideology (Goodfellow, 2015; Mũngai, 2013; Paget-Seekins, 2015; Rizzo, 2017).

However, informal transport systems dominate motorized public transport in almost all cities in Africa, medium and small as well as large. Reforms and investments into public transport from governments or international organizations in many are limited and the central role of informal transport is uncontested. This study makes a contribution through by centering and theorizing "secondary" cities: Lubumbashi, Djibouti and Lilongwe, and with Nairobi as an illustrative contrast, working to center the analysis informal transport operations in their own right, rather than as a perceived deficit or site of political contestation. I argue that this oversite of secondary cities is not merely a quantitative problem, but has created a bias in the understanding of processes that organize informal transport operations, and consequently the services they are able to offer their passengers.

Flexibility, reactivity, and demand-responsiveness are often used to explain the spatial distribution of informal transport with little specificity for local conditions, practices or histories in a given city. Key ideas remain poorly theorized and defined in the literature, and the process by which routes are formed is unclear. Operating in competition for passengers across the city, individual vehicles are assumed to be motivated to pick up and deliver as many people as possible, and thus collectively form a varied and evolving route network through competition for different passenger segments with different mobility needs. In practice, rather than competition and individual laissez-faire market response, it is organization and coordination among transport workers and operators that facilitate flexibility and route changes and the creation of new services and destinations.

Over the past half-century, there has been a regular pendulum of approaches to regulation of informal transport. Currently, calls are increasingly being made for integration and support or drivers, operators and organizations in the sector. These center, or at least aim to maintain, the informal transport sector while working at ameliorating negative externalities, increasing the professionalism and capacity of firms, and improving working conditions and incomes for crews (Klopp & Cavoli, 2019; Stucki, 2015). This, however, raises the question of how this mode, if centered and regulated, and accepted as a major—and often only—mode of public transport, will be planned, and by whom?

The central importance of informal transport services is inarguable, as there are often no alternatives. In this regard, the great advantage of informal transport is that it exists. There is no dispute that informal transport modes are crucial to the mobility of almost all population groups in African cities (Behrens & Ferro, 2015; Kumar et al., 2021). Formal, state-managed or state-planned transport systems have increasingly ceased operating, and in many cities were always planned to exclude and limit the mobility of all but elites (Mutongi, 2017).

From a policy perspective, reforms and the integration of formal and informal modes are pressing. Transport plans and programs often call for informal operators to operate in complement to higher-capacity systems, taking on a feeder role or providing coverage in peripheral areas (Behrens et al., 2012; Gauthier & Weinstock, 2010; Paget-Seekins & Munoz, 2016), which operators frequently resist (Asimeng & Heinrichs, 2020; Schalekamp, 2017; Spooner et al., 2020). Understanding where informal operators choose to drive, and why, is a key issue in their active inclusion in transport planning, and whether they will act as competitors or partners to high(er)-capacity formal services is critical for inclu-

sive and effective reform efforts.

The paper is structured as follows: "Case Studies" describes the research cities and the backgrounds of the studies carried out in each. "Background" encompasses a review of relevant literature, defining what is meant by informal transport in this paper and examining the existing theoretical and empirical literature on flexibility, network geography and operator incentives and decision-making processes. Based on the four case studies, "Defining the Operations of Flexibility" develops and explains the importance of a distinction between two types of flexibility—Daily Experiences and Long Terms Network Change. "Explaining Network Planning" then presents an argument for the role of organization, over competition, in the creation of route networks. "Conclusion" summarizes and raises some policy and theoretical considerations.

2 Case study cities and methodology

This paper is based on mixed-methods research conducted in Lubumbashi, DRC, Djibouti-ville, Djibouti, and Lilongwe, Malawi, and Nairobi, Kenya. In the four cities studied, as in many African cities, informal transport is the dominant, and often only, motorized mode of public transport available (Kumar & Barrett, 2008).

Research in Lubumbashi was carried out in 2015-16 as part of an effort to develop a transport master plan for the city with ROM Transportation and the University of Lubumbashi. It included digital mapping of the city's transport routes and surveys of 278 minibus drivers and 3,000 passengers (see Kerzhner & Martens, 2018). Work in Djibouti, in May and October 2019, was likewise a transport sector analysis and reform proposal carried out with the World Bank, the University of Djibouti, and the Ministry of Equipment and Transport (2019).

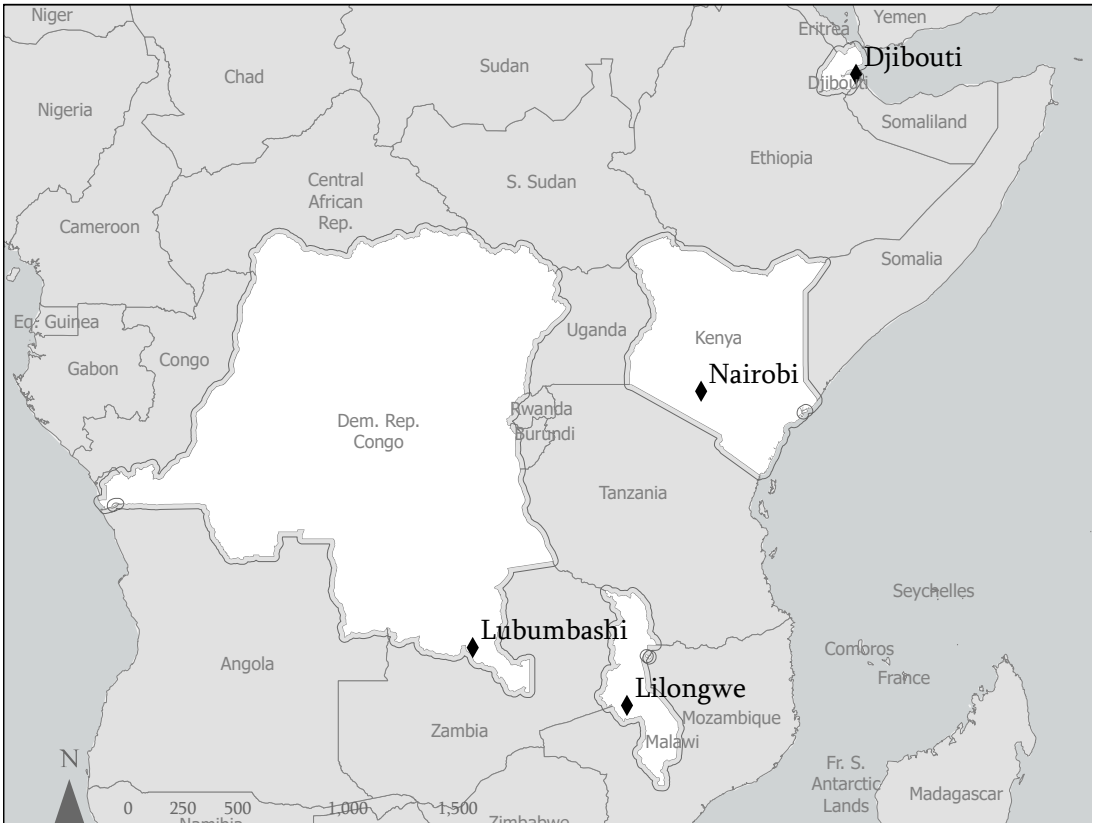

Figure 1. Case study cities in Africa

Alongside mapping of the bus routes and an on-street survey of 1,500 people carried out with trained enumerators, this study also included on-site interviews with minibus drivers (conducted in French and Somali with the assistance of a translator), a focus group held with drivers and conductors, and a separate focus group with vehicle owners.

Qualitative research was carried out in Lilongwe in June 2019 and May-August 2021, and in Nairobi in July-August 2019 and February-April 2021. This included interviews with drivers, vehicle owners or terminal managers, and regulators across multiple institutions in both cities. Two focus groups with bus drivers and bus owners, and a total of 30 interviews in Lilongwe were conducted, transcribed and translated by trained research assistants in Chichewa. Drivers were approached at bus terminals, while focus groups were organized through the Malawi Driver's Association and the Malawi Minibus Owners Association. 18 interviews were carried out in Nairobi, in English, by the author. These were primarily SACCO management personnel and vehicle owners, and government and planning professionals in the transport sector, recruited through a snowball method, as well as via referral from the Kenya Transport Research Network (KTRN).

Nairobi, a metropolitan area of approximately 5 million people, is one of the best studied urban informal transport systems in the world, but in some ways atypical. In 2010, regulation required independent matatus to join SACCOs—Savings and Credit Cooperatives. Each vehicle must be part of a SACCO of at least 30 vehicles and each SACCO limited to a set of pre-defined routes. It is vehicle owners, not drivers, who join the SACCO, and drivers largely continue to be employed on a one-to-one basis on informal contracts (Kelley et al., 2021; McCormick et al., 2013).

This study of Lubumbashi (pop. approx. 1.5-2 million), Lilongwe (1.1 million) and Djibouti (650,000) found that these cities follow a different pattern of operations, and hew closely to a model of independently owned and operated vehicles, with drivers leasing vehicles and competing to collect passengers across the city, with little further regulation. There are no route-based associations or cartels, and vehicles are licensed to operate in any locations within the city. Authorities and terminal managers maintain a degree of oversight over major departure terminals, including efforts to enforce departure queues. However, the choice of which route to operate on, whether to go off-route, or even to act as a "pirate," poaching passengers along the route without queuing, is largely at the driver's discretion.

3 Background: Informal transport

The definition of "informal transport" and the choice of vocabulary has been widely debated and contested. This paper, following Behrens' et al definition (Behrens et al., 2015), focuses on vehicles traveling with multiple passengers and operating on largely fixed routes, with destinations chosen by the drivers or operators, though they may be influenced by passengers' demands. Secondly, services are provided by the private sector with no subsidy, and there is limited or no "top down" planning. That is—locations of routes, schedules and prices are not, or very weakly, influenced by the state (though they may be enforced, to some degree, by the state once they have been arrived at, or maintained in a given status-quo.) Thirdly, the finances of operation—even where multiple vehicles are owned by a single person or amalgamated into associations or cooperatives—are primarily carried at the individual vehicle level and costs and revenues are not pooled across multiple vehicles. This leaves out the majority of bicycle, motorcycle and most rickshaw operations in which passengers request a specific destination, while leaving in some four-door sedans and most jeep, van, minibus and, in some cities, midi- and large-bus services.

Transport workers in African cities have been widely documented to have precarious incomes, extremely long working hours, physically and mentally difficult working conditions, lack of social and economic mobility, and often a fatalistic, devil-may-care attitude embedded in work culture (Agbiboa,

2016; Barrett, 2003; Ference, 2016; Mũngai, 2013; Rizzo, 2017; Spooner et al., 2020). Drivers in many cities operate on a daily "target" lease, in which a daily fee—the target—is paid to a vehicle owner, regardless of the days' earnings. Drivers therefore carry almost all the risk of operations, and their income can be unpredictable, with the targets often difficult or impossible to meet without extremely long working hours, speeding, and dangerous driving (Kumar et al., 2021; Kumar & Barrett, 2008; Rizzo, 2017; Spooner et al., 2020).

In practice, the target can be shifting, with under-payment common, but never risk free. In Santiago, some 20% of vehicle crews' income comes from under-reporting ticket sales (Estache & GóMez-Lobo, 2005) and in Nairobi, systemic under-payment of the daily contract fees appears common (Kelley et al., 2021). This is both tolerated and policed by vehicle owners, leaving even the informal contracts dubious and in a constant state of negotiation. Ference (2021) sheds light on this financial complexity in Nairobi and Mombasa. Relations between different drivers and owners, drivers and conductors and other temporary workers associated with the transport industry are marked by constant conflict, mistrust, surveillance and negotiation. The flows of money, and who is owed what, are both constantly changeable and never fully known. At the same time, there is a strong redistributive element, with constant flows of cash into the community through payment for various small and temporary jobs on the vehicle.

As each vehicle operates as a separate business, they must compete for passengers, and there is rarely protection against entry of more competitors on in a given route or area. Such a system is described in what may be the earliest analysis of urban mass transport regulation, with the effects of "competition for the field" and "competition within the field" laid out by Edwin Chadwick in 1859, comparing the independent, free-entry, system of omnibuses in London, to that of Paris, which had introduced route franchising:

> Instead of, as in London, streets encumbered and disturbed by nearly empty, or only partially filled inferior vehicles, sometimes crawling with a few passengers, annoyed by detentions for a full load, at other times racing, and dangerously overladen, the circulation throughout Paris was made regular from regularly appointed stations, at fixed charges, which precluded extortionate variations. (Chadwick, 1859)

> Such a binary conceptualization of competition in-the-market and competition for-the-market has been used to differentiate formal and informal operators up to the present. (Cervero & Golub, 2007; Gwilliam, 2008; Gwilliam, 2001; Klein et al., 1997)

Despite this seeming-binary, different forms of association are described as a critical organizational backbone of informal transport services, with several writers making the case that they help to prevent duplication of services, balance supply and demand and avoid "all out anarchy" (Cervero, 2000). Others are more skeptical, noting that route cartels are not universal and that they vary widely in the types of regulation and enforcement they carry out (Gomez-Lobo, 2007). Even where associations exist, their reach and importance can be variable. Associations may manage queuing for a given route, but individual vehicles can choose to circumvent this system to different extents by cruising around, trading off the waiting time with the uncertainty of picking up a full complement of passengers for the same trip length. As fine-grained recent financial analyses from Kampala (Ndibatya & Booysen, 2020b; Spooner et al., 2020), and the prevalence of both practices in many cities show, neither tactic is obviously financially advantageous.

Another key issue that emerges in the analyses of the work practices and labor conditions of the transport sector is in identifying not an easily delimited set of professions with specific responsibilities, but as "ecosystems of labor," with a wide assortment of jobs and services (Ference, 2016; Mũngai, 2013;

Rink, 2018; Rizzo, 2017). Drivers do not only lease buses and hire conductors, but rely on a variety of terminal personnel, with sub-leases of the bus over the course of the day. This is an important entry mechanism into the sector, and aspiring drivers may take this role until they develop relationships with owners and get a permanent driving position. Entry into the sector can be time consuming and elaborate, moving up through ranks of terminal gigs, conductor, and driver. Turnover is high, and drivers cycle in and out of employment, often being relegated to "the bench" until a full-time driving opportunity arrives again.

4 What is flexibility?

The term flexibility is used almost axiomatically in writing on informal transport. Services are "nimble" and "flexible" in their its ability to connect passengers to their desired destinations, and this responsiveness is furthermore key to profitable operations (Cervero, 2000; Cervero & Golub, 2007). It is often described as a direct contrast to the ineffectiveness of formal, protected, or centrally planned services, with informal operators "more likely to craft new, tailor–made services in response to increases in suburb–to–suburb commutes, trip–chaining, and off–peak travel" (Cervero, 2000).

As early as 1978, writers note "the key concepts appear to be flexibility and responsiveness" and "they exploit quickly all demand situations. The operators are immediately aware of new patterns, and they can step in at a moment's notice" (Grava, 1978). Others describe "the advantages of minibuses are their agility…flexibility of fares and schedules…ability to rapidly respond to changes in demand" (Kumar & Barrett, 2008), and "adaptability, flexibility, important territorial coverage and demand responsiveness." (Stucki, 2015). Studies using similar terminology can be found for Lagos (Alcorn & Karner, 2021) and Ibadan (Moyo & Olowosegun, 2021), Kinshasa and Nairobi (Heinze, 2018), Cape Town, (Clark & Crous, 2002) and Kampala (Spooner et al., 2020).

A vein of research further positions informal transport in its social context, rejecting a purely market-based understanding. Operations may be shaped by "non-market norms and institutions, involving reciprocity, mutuality and sharing" (Rekhviashvili & Sgibnev, 2020). In Quito, informal transit is argued to be oriented to accessibility and safety in marginalized neighborhoods (Gamble & Dávalos, 2019), and in Indonesia, to be responsive to specifically indigenous transportation needs (Mateo-Babiano, 2016). Brooklyn's primarily Caribbean immigrant-serving Dollar Vans are "practices of movement defined as flexible, vernacular, and specific to postcolonial subjects" (Best, 2016). Routes are assumed to change over time without intervention from a central planner, in response to the needs of the passengers and the city, often with a special and specific suitability to local conditions.

There are also long-standing critiques of romanticization and exotification of informal transport. A 1980's study of five Asian cities identifies strands of tension between sympathetic (primarily Western) observers praising "responsiveness" and "flexibility," compared to local skepticism over the tendency to utilize the same flexibility to raise prices at will (Ocampo, 1982). Another early paper critiques the preoccupation of writers on informal transport in developing countries for their excessive fascination with cataloguing and classifying vehicle types with "exotic names," to the detriment of studying labor, operations and practical service provision (Rimmer, 1980). More recently, Rizzo, in positioning transport workers in Dar es Salaam within a broader discourse on the African urban informal economy, takes task with "the steady flow of romantic and unsubstantiated celebrations of the choices and repertoires of "people at the grassroots" …[that] crowds out an understanding of the concrete realities they face" (Rizzo, 2017, pg 7).

In analyzing the fit of services to needs, an obvious limitation is that an unsubsidized service can only operate where it is profitable to do so (Cervero, 2000; Grava, 1978; Gwilliam, 2001). Ticket prices

are often high across Africa, and many people and locations are simply priced out (Olvera et al., 2008). For example, attempts to assign *daladalas* to specific, underserved, routes in Dar es Salaam failed, because they were deemed unprofitable by operators (Rizzo, 2017). Otunola et al, on Lagos, observe that less-profitable routes are underserviced, "leaving many citizens behind" (Otunola et al., 2019). In urban West Africa, state regulation is argued to be necessary to counter the private sector focus on "market segments where it is most relevant" (Godard, 2013) and the informal operators of Kampala and Nairobi criticized for "operate a basic route structure" (Pirie, 2013).

Several studies have measured the accessibility provided by informal transport networks by mapping routes and calculating travel times to jobs, hospitals or other amenities. A study of Nairobi looking at access to workplaces found a large gap between wealthy and poor areas, and an even greater one between formal and informal residential areas, with *matatus* having relatively limited penetration into informal, low-income areas (Nakamura & Avner, 2021). Also in Nairobi, an analysis of access to hospitals found substantial gaps in the distribution of the transport system (Campbell et al., 2019). A comparisons of access to employment by informal transport in major Sub-Saharan African cities find a great deal of variation, and both low overall accessibility and substantial inequality within many cities (Quiros et al., 2019). Outside Africa, in Santiago, Chile, the liberalization of bus transport in 1979 did see expansion of geographic coverage and reduced distance to bus routes. At the same time, bus fares increased by 100%, and despite expansion, 80% of bus routes post-liberalization passed through just six corridors (Estache & GóMez-Lobo, 2005).

As well as spatial distribution, travel times, convenience and connections also appear to be poor, though the passenger experience of low and middle-income urban residents remains understudied. A small survey of commuters in Lagos, Nigeria, found that over 65% had at least three transfers, including multiple payments (Ibitayo, 2012). A majority of Kingston, Jamaica passengers in 1987 reported that outlying routes services were insufficient and low-frequency (Anderson, 1987, in Cervero & Golub, 2007). Minibus services in Cape Town, which act as feeders for a BRT system (Plano et al., 2018) were found to have long off-peak headways and early end of operations, failing to match the BRT's operations and passenger travel needs.

Research into how operators decide where to operate are limited, particularly for urban Africa. A recent theoretical contribution by Ndibatya and Booysen (2020a), tracked minibuses in Kampala and show that routes evolve substantially over just eight months, with local residents calling drivers to locations they have organized as impromptu terminals. However, the daily searches for passengers lead to long wait times, stops and deviations. Combined with an analysis of driver's changing profit margins, they show in a companion paper that such searches offer little in the way of greater profits or productivity for the vehicle crew (Ndibatya & Booysen, 2020b).

In contrast, a study of a single Dollar Van in New York City reveals the analysis of changing demographics carried out when introducing a new route, as the Caribbean immigrant population that was the basis of ridership was being displaced by gentrification (Goldwyn, 2020). Gamble and Puga's study of routes developed by informal transport firms in Quito, Ecuador, finds a complex, evolving process of route apportioning between firms, often socially-driven and carefully considered. Firms in this instance are highly organized, often with fixed schedules, (Gamble & Puga, 2019).

Rural informal operators in South Africa (Venter et al., 2014) are also highly organized into associations, which make routing decisions based on determination of exclusive, violently-enforced geographic service areas. Coupled with a lack of information by operators as to passenger demand and low densities, means that routes are not "determined with user convenience in mind, leading to sometimes fragmented routes, unnecessary transfers, circuitous routings, and even complete withdrawal of service from conflicted areas." Informal services are found to function alongside formal, cheaper, subsidized

and scheduled buses on the same routes, rather than filling spatial gaps where the latter do not operate (Venter et al., 2014).

This matches another unusually detailed study, this one from Lima, Peru, in the 1980s (Uzzell, 1987). Lima's system was organized into associations (comités), each controlling defined zones, which constantly grew and changed in competition with one another. Incumbent associations would carefully scout potential new services, surveying passengers and testing out the route. Changes and expansions to route networks in Lima appear to have been driven substantially by competition between associations for the same passengers, rather than by providing new services to new passengers. The ability of competing operators to change their service networks, moreover, was buttressed as much by political party backing and police cooperation as by passenger demand—which itself was garnered by campaigns and petitions organized by the associations, which could be used to show a form of squatters right in Peruvian law, justifying the new routes (Uzzell, 1987).

A number of models of informal transport operations have also been developed. Many of these identify market failures, where de-regulation leads to negative effects on the quality, quantity or location of services (Ardila, 2008; Chavis & Daganzo, 2013; Evans, 1990; Gomez-Lobo, 2007). One study of the UK bus deregulation experience in the 1980s argues that informal operators use the anchor of a high-capacity formal route to compete at greater frequencies, lower prices, or a more direct or transfer-less route. This damages the passenger base of the core route and it goes out of business, but the informal sector is not able to provide enough service to meet the full demand, the passenger base dwindles, and the service area is then lost altogether (Klein et al., 1997), echoing Venter's findings in South Africa.

5 Defining the operations of flexibility

Based on findings from the four city case studies, a more complex delineation of the ways routing decisions are made in informal systems is required, particularly in distinguishing immediate, daily service decisions and long- and mid-term network growth. This distinction requires not just recognition of different temporal scales, but finds that a greater attention to local specificities, histories, forms of organization and power relations within each local transport sector reveals a variety of responses, and consequently of transport networks—with critical differences in providing accessibility for a variety of needs across the urban landscape.

The idea of flexibility often elides different practical aspects of transport operations, and drivers' and organizers' decisions and constraints. Table 1 summarizes the distinction, and the following section consider how these patterns of operation take place in practice, and the effects for access and equity,

Table 1. Distinguishing daily and long-term flexibility of informal transport operations

	Daily Operations	***Long-Term Network Change***
Operations	• Choosing routes over the course of the day • Changing route alignment on-the-go • Changing destination • Dropping people mid-way • Dropping passengers at requested locations • Alignment of supply with demand over the course of the day • Changing prices over course of the day	• Development or extension of new routes • Establishment of new stops, terminals, locations of service • Changes in expected operating hours • Changes in overall prices long-term
Incentives and motivations	• Avoidance of traffic • Avoidance of police checkpoints • Minimizing fuel expenditure, • Searching out new passengers, • Alignment to passenger requests, • Avoidance of excessive competition • familiarity	• Avoidance of vehicle-damaging or unpaved roads • Competition with other associations • Perception of captive transit riders
Equity and access for passengers	• Increased safety/convenience with closer drop-off • Unpredictability, long travel times/waits, fluctuating prices • Hostile behaviours from vehicle crews • Unequal treatment of passengers—gender, class, ethnic/social group	• Changing distance from residence to transport route • Changing distance of activity location to transport route • Travel times • Number of transfers required • Overall price of travel
Main actors in decision-making process	• Drivers and crews • Individual or small groups of passengers • Terminal managers • Route-based associations	• Route/Area-based association management • Associations of vehicle owners • Planners or regulators • Passenger or resident groups or organizations

Overall assumptions on the competitive provision of services, based on the idea of vehicle-by-vehicle competition, which is frequently regulated and ameliorated by route-level organization in major capital cities, nevertheless tend to describe a "dispersing" tendency, with each vehicle attempting to "distance" itself from competitors, identifying new locations and routes of service. However, when considering the on-the-ground practices evinced in secondary cities where such competition is not internally or externally regulated, as in Lubumbashi, Lilongwe and Djibouti, they instead show a centralizing tendency, as passengers gravitate to reliable, and therefore, without set schedules, high-frequency routes, and in turn draw more vehicles.

Hotelling's Law (Hotelling, 1929) may be a useful conceptual frame, stating that competing businesses, rather than distributing themselves evenly throughout space in order to each capture a unique share, instead tend to cluster together in order to compete for the densest section of the market. This is usually applied to static businesses, and has occasionally been considered with the temporal clustering of bus services on a single corridor (Cowie, 2009; Foster & Golay, 1986). Another approach to the practice of "researching" new routes and service locations may be in terms of coordination failure, a market failure where multiple equilibriums—higher and lower productivity ones—are possible, and a given sector, industry or economy has settled in the lower one. This can be due to disinvestment in knowledge production due to spillovers: if any new approach or know-how adopted developed by a given firm is non-excludable—there here are no barriers for any other firm in the local environment to immediately take it up as well—there is no gain to the firm in putting resources into developing it in the first place, as it will not gain any competitive advantage (Rodriguez-Clare, 2005).

6 Daily experiences

Informal transport vehicles often deviate from the routes on which they are assumed to be operating. The definition of a route itself can be vague, with multiple parallel routes or different end points, but generally vehicles have relatively set origin and destination points, whether formally sanctioned or collectively recognized. Increasingly widespread mapping of informal transport systems is only possible because some route stability is evident (Digital Transport 4 Africa, 2019; Klopp et al., 2015).

Despite these generally-agreed-upon routes, drivers usually have substantial de-facto freedom to make changes. This can be to avoid bad traffic, search out new passengers, or follow the requests of existing passengers. For example, minibus drivers in Queen in New York City, and in Tbilisi, Georgia, have been found to frequently deviate from their route to drop off passengers in need at their door, such as those with children or heavy shopping (Musili & Salon, 2019; Rekhviashvili & Sgibnev, 2020). In Kampala, there are extensive search behaviors, with drivers zigzagging, stopping to wait along the route, and going off-route in search of potential new passengers when the taxi is underfilled (Ndibatya & Booysen, 2020a, 2020b). In some cities both minibuses (12-20 passengers) and sedan cars (4-6) passengers operate, with minibuses usually having stronger route adherence and sedans having more capacity to deviate according to passenger requests, such as in Iran, in Kano, Nigeria or in Cape Town (Askari et al., 2020; Madugu, 2018; Rink, 2020).

While providing potential benefits to new passengers being picked up, this can come at the detriment of existing ones. Interviews with Djibouti drivers found that they may shift their route based directly on passenger requests, but primarily if these were a sizeable group, and were vocally in making the demand. There is considerable frustration with this arrangement—some groups of passengers were able to be vocal—indeed, rude—and bludgeon the driver into route changes. Others were not. In Djibouti, drivers were also frustrated with a norm of very frequent stops, at intervals of just tens of meters, demanded by both boarding and alighting passengers (interviews).

This substantially slows the trip, cutting into drivers' earnings and lengthening other passengers' travel times—but drivers perceived themselves as powerless against the demands of middle-class passengers expecting to dropped at a precise spot along the street, and called for the imposition of regular stop locations by regulators (interviews). GPS tracking of Kampala minibuses also shows very high waiting and hold-back times (as drivers stop along the trip with a partly filled vehicle to wait for more passengers) and very low operating speeds. In fact "a large portion of minibus taxi commuters' travel time consists not of actual travel but of sitting in a stationary vehicle waiting" (Ndibatya & Booysen, 2020a).

Another common, though rarely measured, practice is the in-completion of routes. Passengers are dropped short of the destination and must walk or wait for another bus to come by. In Nairobi, drivers may coordinate with another vehicle to transfer passengers over at no cost. In Lubumbashi and Lilongwe there is no recourse, logistical or financial—the vehicle simply turns around (interviews, observations). A study from Kingston, Jamaica similarly found that 74% of passengers had experienced an incomplete route (Anderson, 1987, in Cervero & Golub, 2007).

7 Long-term network change

The more complex issue to pinpoint is the nature of the long-term evolution of informal transport networks. In many cities, bus drivers and owners have the legal authority to set their own routes. In Lilongwe, Djibouti and Lubumbashi, operating licenses for public transport vehicles are issued at a city-wide level, and there are no statutory restrictions on which locations buses may stop or wait at (interviews). On the other hand, in Nairobi, vehicles are required to join route-specific cooperatives (interviews), as is

the case some other major cities, such as Lagos (Alcorn & Karner, 2021). They may drive only on routes the association has claim to, and any deviation from the set route are illegal and can be enforced by both the cooperative and the traffic police, though in fact the practice remains common (Kelley et al., 2021).

How much do operators take advantage of such freedoms? Firstly, informal services are often praised for their ability to go where formal, or at least large, buses cannot, particularly narrow and unpaved roads (Kumar & Barrett, 2008). There is no evidence that operators see the issue the same way. Based on interviews, operators strongly prefer to avoid unpaved roads to avoid wear and tear on vehicles, in all four cities in the study. Mapping of routes in Djibouti and Lubumbashi, as well as studies from rural South Africa (Venter et al., 2014) and Nairobi (Kelley et al., 2021), corroborate this, finding most services strongly concentrated on paved routes. In Lilongwe, two routes were identified which operated partially on unpaved routes, and both of these were dominated by especially poor-quality vehicles which could not pass inspections to receive operating licenses or required insurance. Vehicles chose these routes because they avoided police checkpoints (interviews, route mapping).

8 Explaining network planning

Driver: If we could find passengers—for new destinations—at a higher price, we would do that, [but] we never experiment.

Author: When was the last time you tried a new area?

Driver: Never. We have to be very careful, if we experiment, we will lose a lot of money.

(Focus group notes, Djibouti, 2019)

In the three secondary cities in this paper, as in many cities around the world—but unlike systems such as Nairobi, Kampala or Lagos—drivers and operators have the ability to freely choose their routes, stops and locations of operation. How is this freedom exercised, and by whom? Do the "target" contracts, and the resulting precarity, social positioning and economic incentives, lead to effective in-the-market competition? This assumes operators are strongly incentivized to pro-actively search out profitable locations to operate, in turn producing adaptive and responsive routes, which change or expand "in tune" with the diversity of passenger needs?

In the research carried out in Djibouti, Lilongwe and Lubumbashi, drivers stated that they prefer to stick to the network of familiar pre-existing routes, and do not search out new ones. At the same time, drivers recognize that this is a right they have, and could theoretically do so. This is the case both legally—in all three cities, licenses are issued city-wide, permitting any vehicle to operate any route, stop, or road segment—and de facto, in terms of formal and informal practices of associations and terminals. But, despite this freedom, quite stable route networks persist in all three cities. Individual drivers make decisions as to where to operate primarily along the existing network, balancing a variety of factors in their route choice, but very rarely "exploring" for unserved locations. As the quote above from a Djibouti focus group shows, drivers *consider* the possibility, but in practice, avoid it. Further, as well as little tendency to explore off-network, the Lubumbashi survey of drivers found that 46% preferred a single, regular route, and a further 27% drove only on two routes weekly. Driving on multiple routes in Lubumbashi was highly uncommon and only a small percentage of drivers choose this kind of changeable work pattern (survey, n=287).

How to explain this? Searching out new market niches and geographical areas of operation requires investment and overhead of time and fuel. In an atomized transport system—one where each vehicle's

operations are a closed financial unit—this means taking time off operations on established, profitable routes and, given the nature of daily target contracts, an associated loss of earnings if a given "route-making" attempt is does not immediately prove productive.

The process of starting new routes of operations cannot be considered a uni-directional one, where passenger demand is discovered like an uninhabited island. The introduction of services to relevant locations may draw passengers over time, but this process cannot be carried out with a single vehicle, which would not generate the density of service that would make new locations fully and easily accessible, and lead to changes in travel habits, and eventually, in residential, employment and other activity location decisions. These are months- and years-long processes that informal operators cannot invest in individually.

This is illustrated by the process in Nairobi, a highly organized, route-based system, where—unlike in the other three cities—SACCOs have a license to operate only on specific, designated routes. The interviews carried out with SACCO managers show that SACCOs take the initiative to develop new routes, petitioning the authorities to approve them. This is driven by a complex process on the part of the SACCO, which may try out a new route with a small number of vehicles, and subsidize their operations—paying drivers' incomes and owners leases from collective funds—for several months. Before and during this experimental phase, the SACCO will measure demand—including, in some cases, by sending out surveyors and calculating traffic flows along a corridor—assess potential market share vis a vis competing SACCOS, and advertise new routes by handing out leaflets and hanging posters. Rather than an intuitive process by individual drivers, in Nairobi it is the emergent, professionalized middle management of the SACCO which carries out route planning.

In contrast, in Lilongwe, Lubumbashi and Djibouti, while there are cooperatives of drivers, and in Djibouti and Lilongwe, association of minibus owners, none of these are geographic in nature, belonging to a particular terminal, route or neighborhood. The drivers' groups are primarily emergency funds for medical, legal or funeral expenses. The Djibouti and Lilongwe owners' associations play a political lobbying role vis a vis the government. Interviews with drivers, owners and regulators in all three cities found no evidence that these groups played any role in developing routes or controlling entry and behavior along them.

Explaining the resistance on the part of individual drivers is complex. Firstly, it appears drivers often do not fully know their revenues, expenses, profits, or have a strong big picture view of their business. In the surveys conducted in Lubumbashi and Djibouti, drivers yielded highly uncertain assessments of basic facets of operations, such as number of daily trips, numbers of passengers, and estimations of daily income. Interviews in Lilongwe found some drivers did not keep track of the number of trips made per day. The "target" based daily lease system is also often more fluid and complex than a simple daily payment. In Djibouti, where minibus owners were interviewed, found a frequent state of clashes, hostility and contract-breaking between owners and drivers, with targets and debts going unpaid, and drivers cyclically moving from vehicle to vehicle as relationships sour. Vehicle owners, meanwhile, are often dissatisfied with drivers, frequently firing and hiring new ones. This means the ability and resources to analyze the preferability of any given route within the financial constraints of the target arrangement is difficult and risky and risk-aversion understandably high.

As well as fraught relationships with vehicle owners, drivers' often cite difficult relationships with *passengers*. In Djibouti, interviews found drivers feeling bullied by middle class passengers into irritating and unprofitable behavior, such as short intervals, non-payment, and pressure by groups of passengers to change routes. (Disrespect and non-payment from passengers are also found to be one of the major problems recounted by minibus crews in Kampala, and, for female conductors, misogyny and harassment (Spooner et al., 2020)). In Lubumbashi and Lilongwe, surveys and interviews with passengers found hostility and frustration with drivers behaviors, personal conduct, and driving deci-

sions, such as delaying, deviating or cutting short trips, over-filling buses, and changing the expected payment mid-trip.

Vehicle owners' preferences and incentives also need to be understood—they may be little involved in daily operations (McCormick et al., 2013), but it is their investments regulate the number of vehicles in operation and contribute to managing competition across routes. Informal transport networks remain highly atomized in many cities, with little organization into firms. In Lubumbashi, the survey of drivers found that 36% of bus owners had one bus only, and 40% between two and four (for a fuller description of the Lubumbashi findings, see Kerzhner & Martens, 2018). In interviews with Lilongwe bus owners and drivers, owners are not involved, and do not keep track, of where the vehicle operates.

As with drivers, it is unclear how this form of ownership contributes to flexibility, except that it appears to offer few constraints. However, the inability, in many cities, to build up businesses and expand ownership to multiple vehicles means vehicle fleets may remain smaller than demand, and competition between vehicles is limited due to undersupply. This appears to be the case in Lubumbashi, where the total vehicle capacity in 2016 was only a fraction of the city's population and violence was frequently reported in attempts to gain a seat on a bus during morning peak time.

Further, in contrast to the free-roving, vehicle-level-autonomy suggested by a demand responsive system, it also appears that the labor force—even when unorganized—might be highly localized. Once organized routes and terminals are established, drivers have strong incentives against operating away from them or branching out. This is not just a question of profitability of daily operation, but also of entry to the sector. The economic and social mechanisms that provide entry into driving and conductor jobs are tied to specific locales and webs of familiarity and reciprocity, that, for many drivers, further bring them back to the same small set of terminals and routes. It is at these that their labor ecosystem is rooted, rather than stretching across the whole space of the city.

What kind of impact do these complex and shifting spatial, social and monetary relationships have on assumptions about response to demand? A few points can be made: firstly, it is not clear that drivers and crews have an especially accurate or conscious mechanism for assessing passenger demand via ticket sales. The management of incoming cash from passengers, outgoing cash for expanses (fuel, taxes, bribes) and into the labor-ecosystems (handovers of the vehicle to replacement drivers, payment to terminal personnel) and what is paid, and unpaid, to the vehicle owner is fluid and unrecorded. Calculating or intuiting from such flows whether a given service is better compared to another, appears questionable. Relationships with passengers, rather than organically delivering an understanding of mobility needs across the city, can be confrontational and frustrating for vehicle crews. A variety of other considerations play an important, and it appears from interviews, possibly more important role in guiding route choices, including familiarity and a need to meet other social or economic obligations (such as handing over the vehicle to a substitute driver at a particular location).

Comparing the atomized structure of operations in Lubumbashi, Djibouti and Lilongwe to the strong geographically-distinct SACCOs of Nairobi, as well as evidence in the literature, illustrates collective, organized nature of demand-response. Driver's and other on-the-ground transport workers, caught in exploitative contracts and with precarious incomes, hew to cautious, conservative choices to guarantee a return for a day's work. The creative, flexible responsiveness which may theoretically be able to pick up varied passengers needs is not evidenced. The investment needed to develop new destinations and routes, and test their profitability, can be carried out only at a higher level of organization, such as route associations, who are able to pool the resources needed to carry a loss, protect their members investment (time, for drivers; capital, for owners) as well as having the wider perspective to direct and manage the expansion of the network.

9 Conclusions

When returning to the model of "competition-for-the-market" and "competition-in-the market," a different perspective can be considered: individual vehicles compete for passengers along *already established routes,* while organizations compete for space in expanding their route network to new locations, or capturing passenger shares from one another. Cartels, terminal managers, route associations or government franchising, provide a degree of control of entry and enforcement ticket prices and orderly departures, guaranteeing a full vehicle in return for a long wait to all route-members. However, only geographically bounded associations, such as Kenya's SACCOs, work to develop their networks spatially, with an interest in expansion as a collective, rather than vehicle-by-vehicle.

Cruising, searching behavior by drivers does not easily translate into new routes—passenger bases cannot be consistently established. However, when vehicles are organized beyond the individual level, spatially-responsive, exploratory and competitive behavior can emerge. By pooling together multiple vehicles, pre-advertising routes and stops, and, crucially, creating a management cadre who are responsible for the operations multiple vehicles, the market failures that affect the competitiveness of individual drivers are partially circumvented. Firms or association can carry a few weeks' or months' loss on the operation on a number of vehicles, coordinate multiple vehicles, and invest resources into studying and testing new destinations and routes.

Importantly, this does not resolve accessibility issues. In Nairobi, and from available literature, it appears that associations are motivated strongly by competition over existing passenger bases, and less in establishing new services. They compete to capture a fraction of traffic on popular routes from competing associations, rather than being primarily interested in extending the network. Secondly, SACCOs view their services as differentiated on vehicle quality, style (with or without music, for example), and maximum price caps, not on serving specific routes or niche destinations.

It is important to make explicit—informal transport is not equitably flexible and responsive. Operation patterns do not purely follow profitability, but must also reliably serve the complex internal financial flows of exploitative employment, mutual obligation and collective organization within the sector. This does not "fill the gaps" left by formal planning and formal services—it exacerbates them. Informal transport tends to build on corridors established by formal transport, where it existed in the past, and doubles down on existing high-frequency, high-traffic routes, providing services that primarily serve profitable, direct patterns of mobility. More research is required to understand the equity and justice concerns, but existing literature on the mobility of women, informal workers and low-income populations suggest it is these groups who are least well served by the trunk, radial routes often developed by such systems.

The dire working conditions, poor knowledge base and limited reliability and margins of the labor structure of informal transport underly this. Where efforts at expansion, niche-finding and creativity are taking place, they are being driven at a level of greater organization, sophistication, managerial capacity and stability than that of the romanticized figure of the "ear to the ground," preternaturally demand-aware driver of a bus or taxi. Exploitative labor conditions mean less, not more, variety of transport services.

The role of worker-based organization in the sector, such as in Kampala or Accra, also plays an important role in setting different patterns of operation and can overcome some of the limitations of owner-based operations, though it may also create new ones (See Kerzhner, forthcoming). These topics, however, remain altogether under-explored, and this paper finds there is a significant gap in the literature

in connecting research on informal transport workers and operations, with informal transport service and passengers.

Informal transport networks are actively organized and developed by their workforce and operators in response to a variety of economic and social incentives and positions, which can result in market failures and externalities. These can be substantially at odds with some passenger needs, particularly when considering questions of equity across different population groups with different mobilities and destinations of interest. The planning work carried out by informal operators to identify and measure demand and operate profitably is often de-professionalized and de-skilled, instead becoming a product of instinct, reflex, and responsiveness based on fuzzy "local knowledge."

The possibility of flexibility is no guarantee that this will be used benefit the most marginalized and underserved locations and groups, contribute to mobility justice and equity, or be aligned to best contribute to urban transport measures like poverty reduction, GDP growth, employment and amenity access, or agglomeration. While informal-sector actors can be proactive planners, this planning is limited precisely by its responsiveness. Without intervention and longer-range planning, a marginalized and impoverished workforce, responding to the in-built inequalities of post-colonial cities, has little choice but to perpetuate them.

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References

Agbiboa, D. E. (2016). No condition is permanent: Informal transport workers and labor precarity in Africa's largest city. *International Journal of Urban and Regional Research, 40*(5), 936–957. https://doi.org/10.1111/1468-2427.12440

Alcorn, L. G., & Karner, A. (2021). Integrating formal and informal transit into one hybrid passenger transport system in Lagos, Nigeria. *Transportation, 48*(3), 1361–1377. https://doi.org/10.1007/s11116-020-10099-8

Ardila, A. (2008). Limitation of competition in and for the public transportation market in developing countries: Lessons from Latin American cities. *Transportation Research Record: Journal of the Transportation Research Board, 2048,* 8–15. https://doi.org/10.3141/2048-02

Asimeng, E. T., & Heinrichs, D. (2020). Why do paratransit operators resist participation in bus rapid transit? Case evidence from Bogota, Mexico City, Johannesburg and Lagos. *Transport Reviews, 41*(1), 1–21. https://doi.org/10.1080/01441647.2020.1818872

Askari, S., Peiravian, F., Tilahun, N., & Yousefi Baseri, M. (2020). Determinants of users' perceived taxi service quality in the context of a developing country. *Transportation Letters, 13*(2)125–137.

Barrett, J. (2003). *Organizing in the informal economy: A case study of the minibus taxi industry in South Africa.* Geneva: International Labor Organization.

Behrens, R., & Ferro, P. S. (2015). *Barriers to comprehensive paratransit replacement. Paratransit in African cities* (pp. 215–236). Abingdon-on-Thames, UK: Routledge.

Behrens, R., McCormick, D., & Mfinanga, D. (2015). *Paratransit in African Cities: Operations, regulation and reform.* Abingdon-on-Thames, UK: Routledge.

Behrens, R., McCormick, D., & Mfinanga, D. A. (2012). *An evaluation of policy approaches to upgrading and integrating paratransit in African urban public transport systems: Results of the first round of a Delphi survey.* Retrieved from https://trid.trb.org/view/1250431

Best, A. (2016). The way they blow the horn: Caribbean dollar cabs and subaltern mobilities. *Annals of the American Association of Geographers, 106*(2), 442–449.

Campbell, K. B., Rising, J. A., Klopp, J. M., & Mbilo, J. M. (2019). Accessibility across transport modes and residential developments in Nairobi. *Journal of Transport Geography, 74,* 77–90. https://doi.org/10.1016/j.jtrangeo.2018.08.002

Cervero, R. (2000). *Informal transport in the developing world.* Nairobi, Kenya: UN-HABITAT. https://www.google.com/books?hl=en&lr=&id=_4z7AI6XuH8C&oi=fnd&pg=PA3&dq=africa+informal+transport&ots=V9hMH33Wgn&sig=hvmRBBocpbwmZLjhoLytdyTj4vs

Cervero, R., & Golub, A. (2007). Informal transport: A global perspective. *Transport Policy, 14*(6), 445–457.

Chadwick, E. (1859). Results of different principles of legislation and administration in Europe: Of competition for the field, as compared with competition within the field, of service. *Journal of the Statistical Society of London, 22*(3), 381–420.

Chavis, C., & Daganzo, C. F. (2013). Analyzing the structure of informal transit: The evening commute problem. *Research in Transportation Economics, 39*(1), 277–284.

Clark, P., & Crous, W. (2002). Public transport in metropolitan Cape Town: Past, present and future. *Transport Reviews, 22*(1), 77–101.

Cowie, J. (2009). *The economics of transport: A theoretical and applied perspective.* Abingdon-on-Thames, UK: Routledge.

Digital Transport 4 Africa. (2019). *Digital Transport Resource Center (Beta) – An open & collaborative platform to improve urban public transport.* Retrieved from https://digitaltransport4africa.org/

Estache, A., & GóMez-Lobo, A. (2005). Limits to competition in urban bus services in developing countries. *Transport Reviews, 25*(2), 139–158. https://doi.org/10.1080/0144164042000289654

Evans, A. (1990). Competition and the structure of local bus markets. *Journal of Transport Economics and Policy, 24*(3), 255–281.

Ference, M. (2016). Together we can: Redefining work in Nairobi's urban transportation sector. *Anthropology of Work Review, 37*(2), 101–112. https://doi.org/10.1111/awr.12098

Ference, M. (2021). You will build me: Fiscal disobedience, reciprocity and the dangerous negotiations of redistribution on Nairobi's matatu. *Africa, 91*(1), 16–34. https://doi.org/10.1017/S0001972020000820

Foster, C., & Golay, J. (1986). Some curious old practices and their relevance to equilibrium in bus competition. *Journal of Transport Economics and Policy, 20*(2), 217–244.

Gamble, J., & Dávalos, C. (2019). Moving with masculine care in the city: Informal transit in Quito, Ecuador. *City, 23*(2), 189–204.

Gamble, J., & Puga, E. (2019). *Is informal transit land-oriented? Investigating the links between informal transit and land-use planning in Quito, Ecuador* (Working Papers) [WP19JG1]. Cambridge, MA: Lincoln Institute of Land Policy. https://www.lincolninst.edu/sites/default/files/pubfiles/gamble_wp19jg1_0.pdf

Gauthier, A., & Weinstock, A. (2010). Africa transforming paratransit into BRT. *Built Environment, 36*(3), 317–327.

Godard, X. (2013). Comparisons of urban transport sustainability: Lessons from West and North Africa. *Research in Transportation Economics, 40*(1), 96–103.

Goldwyn, E. (2020). Anatomy of a new dollar van route: Informal transport and planning in New York City. *Journal of Transport Geography, 88,* 102309. https://doi.org/10.1016/j.jtrangeo.2018.08.019

Gomez-Lobo, A. (2007). Why competition does not work in urban bus markets: Some new wheels for some old ideas. *Journal of Transport Economics and Policy, 41*, 26.

Goodfellow, T. (2015). Taming the rogue sector: Studying state effectiveness in Africa through informal transport politics. *Comparative Politics, 47*(2), 127–147.

Grava, S. (1978). *Locally generated transportation modes of the developing world* (TRB special report, 181). Washington, DC: Transportation Research Board.

Gwilliam, K. (2008). Bus transport: Is there a regulatory cycle? *Transportation Research Part A: Policy and Practice, 42*(9), 1183–1194. https://doi.org/10.1016/j.tra.2008.05.001

Gwilliam, K. M. (2001). Competition in urban passenger transport in the developing world. *Journal of Transport Economics and Policy, 35*(1), 99–118.

Heinze, R. (2018). Taxi pirates: A comparative history of informal transport in Nairobi and Kinshasa, 1960s –2000s. In D. Agbiboa (Ed.), *Transport, transgression and politics in African cities: The rhythm of chaos* (pp. 19–41). Abingdon-on-Thames, UK: Routledge. https://doi.org/10.4324/9781351234221

Hotelling, H. (1929). *Stability in competition. The collected economics articles of Harold Hotelling* (pp. 50–63). New York: Springer.

Ibitayo, O. O. (2012). Towards effective urban transportation system in Lagos, Nigeria: Commuters' opinions and experiences. *Transport Policy, 24,* 141–147. https://doi.org/10.1016/j.tranpol.2012.07.009

Kelley, E. M., Lane, G., & Schönholzer, D. (2021). *Monitoring in target contracts: Theory and experiment in Kenyan public transit.* Berkeley, CA: Center for Effective Global Action, University of California.

Kerzhner, T., & Martens, K. (2018). *The role of labor informality in paratransit services: Case study of*

Lubumbashi, Democratic Republic of the Congo. Paper presented at the Transportation Resarch Board 97th Annual Meeting, Washington, DC, January 7–11.

Klein, D. B., Moore, A. T., & Reja, B. (1997). Curb rights: Eliciting competition and entrepreneurship in urban transit. *The Independent Review, 2*(1), 29–54.

Klopp, J. M., & Cavoli, C. (2019). Mapping minibuses in Maputo and Nairobi: Engaging paratransit in transportation planning in African cities. *Transport Reviews, 39*(5), 657–676. https://doi.org/10.1080/01441647.2019.1598513

Klopp, J., Williams, S., Waiganjo, P., Orwa, D., & White, A. (2015). Leveraging cellphones for wayfinding and journey planning in semi-formal bus systems: Lessons from digital Matatus in Nairobi. In S. Geertman, J. Ferreira, R. Goodspeed, & J. Stillwell (Eds.), *Planning support systems and smart cities* (pp. 227–241). New York: Springer. http://link.springer.com/10.1007/978-3-319-18368-8_12

Kumar, A., & Barrett, F. (2008). *Stuck in traffic: Urban transport in Africa* (AICD Background Paper, 1). Retrieved from http://siteresources.worldbank.org/EXTAFRSUBSAHTRA/Resources/Stuck-in-Traffic.pdf

Kumar, A., Zimmerman, S., & Arroyo-Arroyo, F. (2021). *Myths and realities of informal public transport in developing countries: Approaches for improving the sector.* Washington, DC: World Bank, SSATP. https://www.ssatp.org/sites/ssatp/files/publication/SSATP_Informal_v_final_double_compressed.pdf

Madugu, Y. U. (2018). Filling the mobility gaps: The shared taxi industry in Kano, Nigeria. *The Journal of Transport History, 39*(1), 41–54. https://doi.org/10.1177/0022526618759530

Mateo-Babiano, I. (2016). Indigeneity of transport in developing cities. *International Planning Studies, 21*(2), 132–147. https://doi.org/10.1080/13563475.2015.1114453

McCormick, D., Mitullah, W., Chitere, P., Orero, R., & Ommeh, M. (2013). Paratransit business strategies: A bird's-eye view of matatus in Nairobi. *Journal of Public Transportation, 16*(2), 135–152. https://doi.org/10.5038/2375-0901.16.2.7

Moyo, D., & Olowosegun, A. (2021). Resilience of informal public transport and urban land governance in Ibadan, Nigeria. In R. Home (Ed.), *Land issues for urban governance in Sub-Saharan Africa* (pp. 281–297). New York: Springer. https://doi.org/10.1007/978-3-030-52504-0_18

Mũngai, M. (2013). *Nairobi's matatu men: Portrait of a subculture.* Nairobi, Kenya: Twaweza Communications.

Musili, C., & Salon, D. (2019). Do private transport services complement or compete against public transit? Evidence from the commuter vans in Eastern Queens, New York. *Urban Science, 3*(1), 24.

Mutongi, K. (2017). *Matatu: A history of popular transportation in Nairobi.* Chicago: University of Chicago Press.

Nakamura, S., & Avner, P. (2021). Spatial distributions of job accessibility, housing rents, and poverty: The case of Nairobi. *Journal of Housing Economics, 51,* 101743. https://doi.org/10.1016/j.jhe.2020.101743

Ndibatya, I., & Booysen, M. J. (2020a). Characterizing the movement patterns of minibus taxis in Kampala's paratransit system. *Journal of Transport Geography, 92*(C). https//:doi.10.1016/j.jtrangeo.2021.103001.

Ndibatya, I., & Booysen, M. J. (2020b). Minibus taxis in Kampala's paratransit system: Operations, economics and efficiency. *Journal of Transport Geography, 88,* 102853. https://doi.org/10.1016/j.jtrangeo.2020.102853

Ocampo, R. B. (1982). *Low-cost transport in Asia: A comparative report on five cities.* Ottawa: IDRC.

Olvera, L. D., Plat, D., & Pochet, P. (2008). Household transport expenditure in Sub-Saharan African cities: Measurement and analysis. *Journal of Transport Geography, 16*(1), 1–13.

Otunola, B., Harman, O., & Kriticos, S. (2019). *The BRT and the danfo: A case study of Lagos' transport reforms from 1999-2019.* London: International Growth Center.

Paget-Seekins, L. (2015). Bus rapid transit as a neoliberal contradiction. *Journal of Transport Geography, 48*, 115–120. https://doi.org/10.1016/j.jtrangeo.2015.08.015

Paget-Seekins, L., & Munoz, J. C. (2016). The promise of BRT. In J. C. Munoz & L. Paget-Seekins (Eds.), *Restructuring public transport through bus rapid transit: An international and interdisciplinary perspective.* Bristol, England: Policy Press.

Pirie, G. (2013). *Sustainable urban mobility in Anglophone sub-Saharan Africa: Global report on human settlements.* Nairobi, Kenya: Un-Habitat.

Plano, C., Behrens, R., & Zuidgeest, M. (2018). Towards a stated choice methodology to determine minibus-taxi driver willingness to provide off-peak feeder service. *Civil Engineering, 2018,* 19–27.

Pojani, D., & Stead, D. (2015). Sustainable urban transport in the developing world: Beyond megacities. *Sustainability, 7*(6), 7784–7805.

Quiros, T. P., Avner, P., & Kerzhner, T. (2019). *Exploring accessibility to employment opportunities in African cities—A first benchmark* (World Bank policy research working paper). Washington, DC: Work Bank.

Rekhviashvili, L., & Sgibnev, W. (2020). Theorizing informality and social embeddedness for the study of informal transport. Lessons from the marshrutka mobility phenomenon. *Journal of Transport Geography, 88,* 102386. https://doi.org/10.1016/j.jtrangeo.2019.01.006

Rimmer, P. J. (1980). Paratransit: A commentary. *Environment and Planning A, 12*(8), 937–944. https://doi.org/10.1068/a120937

Rink, B. (2018). Place ballet in a South African minibus taxi rank. In *Transport, transgression and politics in African cities.* Abingdon-on-Thames, UK: Taylor & Francis. https://doi.org/10.4324/9781351234221-5

Rink, B. (2020). Capturing amaphela: Negotiating township politics through shared mobility. *Geoforum.* https://doi.org/10.1016/j.geoforum.2020.06.010

Rizzo, M. (2017). *Taken for a ride: Grounding neoliberalism, precarious labor, and public transport in an African metropolis.* Oxford, UK: Oxford University Press.

Rodriguez-Clare, A. (2005). Coordination failure, clusters, and microeconomic interventions. *Economía Journal, 6*(Fall), 1–41.

Schalekamp, H. (2017). Lessons from building paratransit operators' capacity to be partners in Cape Town's public transport reform process. *Transportation Research Part A: Policy and Practice, 104*, 58–66.

Spooner, D., Mwanika, J. M., Natamba, S., & Manga, E. O. (2020). *Kampala bus rapid transit: Understanding Kampala's paratransit market structure.* Manchester, England: Global Labor Institute.

Stucki, M. (2015). *Policies for sustainable accessibility and mobility in urban areas of Africa.* Washington, DC: World Bank. http://documents.worldbank.org/curated/en/467541468191641974/pdf/95606-REVISED-PUBLIC-SSATPWP106-Urban-Mobility-IO.pdf

Uzzell, D. (1987). A homegrown mass transit system in Lima, Peru: A case of generative planning. *City and Society, 1*(1), 6–34. https://doi.org/10.1525/city.1987.1.1.6

Venter, C. J., Molomo, M., & Mashiri, M. (2014). Supply and pricing strategies of informal rural transport providers. *Journal of Transport Geography, 41,* 239–248. https://doi.org/10.1016/j.jtrangeo.2014.10.001

World Bank, University of Djibouti, and Ministry of Equipment and Transport. (2019). *Djibouti Digital Transport Resource Center.* Retrieved from https://git.digitaltransport4africa.org/data/africa/djibouti