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Trends in Competition among Digital Platforms for Shared Mobility: Insights from a Worldwide Census and Prospects for Research

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ABSTRACT

Mobility systems in metropolitan areas in both the Global North and the Global South have entered an era of rapid change since the early 2010s under the influence of mobile information and communication technologies (ICTs). Mobile ICT-based shared mobility platforms have been filling some of the gaps in transport supply left by historical modes of transport (i.e., private cars, public transit, and for-hire services). Shared mobility digital platforms are a subcategory of mobility applications that give individual customers direct and full access to one or several shared mobility services. Based on a worldwide systematic census, this paper documents the diversity of services provided by such platforms, then analyzes the trends in geographic distribution and competition among platforms across the world's metropolises. It proposes a new classification of shared mobility services. Since innovations in shared mobility are also taking a leading place in the Global South, future research avenues in this field are discussed in an effort to break away from the prior focus of the scientific literature on the Global North. The census brings out four original findings. First, the rise of shared mobility digital platforms is a worldwide metropolitan phenomenon transcending the traditional distinction between the Global North and the Global South. Second, emerging countries have become clusters for innovation and competition among platforms. Third, three types of shared mobility digital platforms are identified based on geographic reach (local, regional, or global). Fourth, shared mobility digital platforms providing for-hire services are the most widespread in the world.

Keywords: Shared Mobility, Digital Platforms, Geographic Distribution, Competition, Classification

INTRODUCTION

A Boom in Shared Mobility through Digital Platforms

Since the 2000s, shared mobility has been growing steadily in the countries of both the Global North and the Global South, filling the gaps left by historical modes of transport -traditionally divided into private cars (or individual transport), public transit, and for-hire services (i.e., taxi, limousine transport, car rental)- through service diversification (1–5). From 2007 to 2010 the number of cities with car-sharing services increased from 600 to 1,100 worldwide (6, 7). “Shared mobility” is commonly accepted to refer to the shared use of vehicles (i.e., cars, vans, scooters, bicycles, airplanes, or boats), for the same trip or not, over a short or a medium period of time, on an “as needed” basis (3, 5, 8, 9). Existing classifications for shared mobility cover different sets of services, and they sometimes use different taxons for the same travel mode (**Figure 1**). In 2018, the Society of Automotive Engineers (SAE International) released a standardized taxonomy based on a review of all existing classifications at the time (9). Twelve types of shared mobility travel modes were identified and their definitions clarified (**Appendix 2**): alternative transportation services (ATS), bike-sharing, car-sharing, courier network services (CNS), microtransit, pedicabs, personal vehicle-sharing, ride-sharing, ride-sourcing, scooter-sharing, shuttles, and taxis.

The growth in shared mobility has been fostered by the digital boom in mobile information and communication technologies (ICTs) (5). As of 2019 there were 5.2 billion unique mobile phone subscribers in the world, meaning that 68% of the world’s population used a mobile phone (10–11). Mobile ICTs have played a role in the restructuring of transport systems through the (re)emergence of shared mobility services better designed to meet the diversity of user needs (5, 12–15). Over the past decade in the field of transport and mobility, the rapid diffusion of mobile ICTs has led to the development of new service features (e.g., real-time location or navigation aid using Global Positioning Systems), new mobility services (e.g., free-floating car-sharing), and new business models (e.g., multi-sided market platforms for user-operator matchmaking) (12, 14, 16). Shared mobility digital platforms are central to these developments.

Shared mobility digital platforms are a subcategory of mobility applications that give individual customers direct and full access to one or several shared mobility services. Digital platforms are market interfaces that ‘connect demand and supply’ (17). They have been documented to foster growth in many economic sectors by reducing the costs of creation, reproduction and distribution of goods or services through economies of scale, and raising returns on marketing expenditures and unit revenues through better customer knowledge and product personalization (17–21). Their introduction in the field of mobility has been one of the major changes of the past decade both in the Global North and the Global South.

Shared Mobility in the Global South and the Global North: The Challenges of Taxonomy

Post-colonial scientific literature has used the notion of the Global South –defined in the 1980s so as to overcome prior, purely economic classifications that presented some countries as lagging behind others – to put emphasis on the need to build research on, and by, this side of the world, rather than copying theories and analytical frameworks of the Global North onto the Global South (22–23).

Shared mobility takes on specific forms in the Global South. Whenever the scientific literature discusses ‘informal transport’ (4, 24), what is at stake is in fact shared mobility, mainly in the form of motorcycle-taxis, minibuses-taxis, motorized 3-wheelers, or pedicabs (also known as ‘rickshaws’). Having been widely overlooked by the scientific literature on shared mobility, some of these services are not referenced in existing classifications, including the aforementioned SAE classification.

Shared mobility is a rather recent focus of the scientific literature (3, 5, 12, 15), and some blind spots remain to be addressed. Indeed, the scientific literature on shared mobility has mainly focused on the Global North, notably the United States, and/or on some specific services, notably ride-sourcing (1, 3, 25). Few scientific studies have taken a closer look at shared mobility in countries or cities of the Global South (4, 24, 26–27). The failure to embrace the diversity of shared mobility in the countries and cities of the Global South puts the scientific community at risk of developing biased visions of, and partial

taxonomies for, shared mobility worldwide. Besides, little research has endeavored to provide an overview of shared mobility services and even less for shared mobility digital platforms at a global level through systematic comparison across cities or countries, with a few notable exceptions for specific services, e.g., car-sharing (6–7) or bike-sharing (26).

Research Objectives

This paper pursues five scientific purposes:

- Initiate a documentation of shared mobility digital platforms in the cities of the Global South;
- Document the diversity of shared mobility services listed on digital platforms and complement existing classifications;
- Provide an overview of the presence of shared mobility digital platforms in cities around the world to reduce geographic bias;
- Analyze the trends in competition among shared mobility digital platforms;
- Map out future research avenues in the field of shared mobility.

This paper is organized into four sections. The first section introduces the data collection method and the extended shared mobility classification. The second section provides an overview of the census outcome and analyzes the rise in competition among shared mobility digital platforms worldwide. The third section further analyzes the geography of shared mobility digital platforms, and the competition between local, regional and global platforms. A final section highlights key research findings and discusses future directions for research.

METHODS

Data Collection

Platform Census

The authors conducted a worldwide systematic census of shared mobility digital platforms every year in April-May over three consecutive years (2018-2020). An exploratory round of data collection was undertaken in 2018, whereby the authors inventoried the localities where the shared mobility digital platforms with more than 10,000,000 downloads on *Google Play* had operations. From 2019 onwards, the census was moved to a more extensive approach, whereby all shared mobility digital platforms with more than 100,000 downloads were inventoried together with their networks of localities.

For the purposes of this research, mobility applications available for download from *Google Play* are considered as shared mobility digital platforms if they give individual customers direct and full access to one or several shared mobility services. Mobility applications that only provide services to, or for, mobility, such as navigation applications (e.g., *Waze*) or trip-planning applications (e.g., *Citymapper*), are not included in the scope of shared mobility digital platforms. Besides, mobility applications that only provide integration/brokerage functions for other services (with no original shared mobility services added) were also excluded to avoid double counting of services.

Platforms were identified using *Google Play* and other internet search engines for a large set of shared mobility keywords –including cab, car-pooling, van-pooling, car-sharing, for-hire, motorbike, on-demand transport, paratransit, ride-hailing, ride-sharing, ride-sourcing, scooter-sharing, taxi, transportation network companies–, as well as their spelling and colloquial variants (e.g., ride-sharing, ride sharing, ridesharing). Those keywords were checked for in English, French, Spanish, German, Swedish and Russian. *De facto*, not having searched for applications in other languages such as Chinese is a potential gap in the research and a limitation of its findings. Geographic designations like the names of countries, regional or continental areas, were also used in the keyword search to circumvent possible geographic or linguistic biases in the search algorithm. Platforms present on the app distribution service of other mobile operating systems than Android were not integrated for two reasons: either the operating

systems were not available in France (e.g., COS in China), or the number of downloads of the shared mobility digital platforms was not indicated (e.g., *App Store*, *Huawei App Gallery*). In March 2021, Android had a worldwide market share of 71.8%, compared to 27.4% for IOS and 0.8% for other mobile operating systems (source: <https://gs.statcounter.com/os-market-share/mobile/worldwide>). Despite the potentially uneven geographic distribution of mobile operating systems, Android's substantial global market share ensures limited bias in data collection.

Following this first step of platform identification, a table was created for each platform to collect further data on: the number of downloads for the application (retrieved from *Google Play*), the location of the company headquarters (retrieved from the company's official website, the commercial information platform *Crunchbase*, or *LinkedIn*), and the localities where the platform operated services. Most platforms release the list of localities where they operate services on their official websites. However, some platforms release incomplete or outdated lists, or no list at all. To complete the lists of localities, the authors e-mailed formal requests to the platforms and/or used press reviews and the platforms' pages on social networks (e.g., *Facebook*, *Twitter*, *Instagram*).

Data Harmonization and Processing

The authors proceeded to harmonize collected data for comparison and aggregation purposes. Indeed, platforms tend to list the localities in which they operate in heterogeneous ways, especially when it comes to large metropolitan areas or yet state-wide areas. Some tend to list cities in an exhaustive way, including for example, several suburban cities of a particular metropolitan area. Others tend to only mention the main city of a metropolitan area even though they operate beyond its administrative and urban borders. It was therefore decided: *i*) to focus on cities exclusively (and exclude rural localities), *ii*) to group the cities of a same metropolitan area under the name of the major political city in the area.

For the sake of comparison and aggregation, the authors restricted the analysis to the metropolitan areas of 500,000 inhabitants or more, using the UN database for metropolitan area populations and the census of the Chinese government for Chinese metropolitan areas (as UN database was not exhaustive for China) (sources: <https://data.un.org/Data.aspx?d=POP&f=tableCode%3A240>; <http://www.stats.gov.cn/english/Statisticaldata/CensusData/>). The lack of recent updates of demographic censuses by some countries may have led to the exclusion of metropolitan areas that only recently exceeded this threshold. Similar processing was applied to platforms that list vast operating areas (e.g., Uber's "Croatian Coast" operating area), or platforms that only listed countries rather than cities. In such cases, the census only accounts for metropolitan areas of 500,000 inhabitants or more in the operating area, if any.

After processing the lists of cities for aggregation at metropolitan level and filtering by population, individual platform tables were aggregated into a final cross table listing all the metropolitan areas in which a particular platform operates and all the platforms with operations in a particular metropolitan area.

Further processing was needed for the sake of data analysis and visualization. Metropolitan areas were geo-referenced and underwent a cartographic processing on *QGIS* and *Adobe Illustrator* with a view to illustrating the geographic footprint of the shared mobility digital platforms.

Classification of Shared Mobility Services

The scientific literature on shared mobility has seen many attempts at classification yet it has not reached a consensus on the exact definition of shared mobility and its related travel modes (1–5, 9, 12, 15, 24–25, 28–29). **Figure 1** illustrates how shared mobility services included in each individual classification match with the types listed and defined in the SAE taxonomy (9). Based on all these existing classifications, the authors propose a new classification of shared mobility services (**Figure 1**). With a view to building broad categories (i.e., groups of service types), three criteria were used, based on the seating capacity of the vehicle, the need for the user to drive the vehicle, and the remuneration of the driver's service. Following this approach, five main service categories could be established (**Figure 1**): vehicle-sharing services (e.g., bike-sharing, car-sharing), ride-sharing services (e.g., car-pooling, van-pooling), alternative

1 transportation services (ATS) (e.g., microtransit, shuttles), for-hire services (e.g., ride-sourcing, taxis),
2 and courier network services (CNS).

3 The following shared mobility services listed in prior classifications found no match in the types
4 listed by SAE: ‘jitney’, ‘dollar vans’, ‘flexible route-based services’, and ‘paratransit’ (when considered
5 as a service type). Indeed, these modes did not match SAE’s definition for microtransit, which is
6 restricted to ‘*technology-enabled*’ transit services (**Appendix 1**). These services were therefore grouped
7 under a special type: ‘conventional paratransit services’.

8 Other shared mobility travel modes identified in the 2019 and 2020 censuses did not match any of
9 the types listed in existing classifications: motorcycle- and minibus-taxis were assimilated to the taxi type,
10 motorcycle-pooling was included in the ride-sharing type, and e-scooter sharing was added as a new type
11 within the vehicle-sharing service category (30–31).
12

Proposed Categories	Vehicle-sharing					Ride-sharing	ATS			For-hire services						Not included
Proposed Service Types	Bike-sharing	Car-sharing	Personal vehicle-sharing P2P carsharing	Scooter (moped)-sharing	E-Scooter (standing)- sharing (SAE, 2019)	Car-pooling Van-pooling Motorcycle-pooling	Microtransit DRT*	Conventional para-transit services	Shuttles	Pedicabs	Ride-sourcing	Taxis hail Taxis e-hail Taxis in advance Limousines Motorcycle-taxi Shared-taxi Minibus-taxi	CNS			
High-capacity vehicle?			No			No	Yes	No	Yes		No		Yes / No			
User driver?			Yes			Yes / No		No			No		No			
Driver paid?			No			No		Yes			Yes		Yes			
SAE (2018)	Bikesharing	Carsharing	Personal vehicle sharing P2P* carsharing	Scooter sharing	-	Carpooling Vanpooling	Microtransit Shuttles	ATS Demand responsive transport Paratransit Microtransit Shuttles	Shuttles	Pedicabs	Ridesourcing	Taxis hail Taxis e-hail Taxis in advance Limousines Pedicabs	CNS			
Cervero (1997)						Carpool Vanpools	Dial-a-Ride & Hybrid Services DRT	Jitney	Commuter vans Buspool Shuttles			Taxis		Intercity buses		
Vuchic (2007)		Carsharing				Carpool Vanpools	Dial-a-Ride & Hybrid Services	Jitney	Subscription bus			Taxis				
Shaheen et al. (2015)	Bikesharing	Carsharing		Scooter sharing		Ridesharing Carpool Vanpools	Microtransit	Paratransit Jitney	Shuttles		Ridesourcing TNCs* On-demand ride services Ridesplitting	E-hail On-demand ride services	CNS			
Enoch (2015)		Standard car club	P2P* car club Rental car Lease car			Vanpools Casual liftsharing Organised liftsharing	DRT*	Jitney	Shuttles		TNCs Private-hire vehicle	Taxis Shared-ride taxi Private-hire vehicle		Bus Private car Voluntary car schemes Community transport		
Committee for Review of Innovative Urban Mobility Services (2016)	Bikesharing						Microtransit		Employee Bus		TNCs	E-hail				
R. Behrens et al. (2016)							DRT									
TCRP (2018)							Microtransit Prearranged route- or zone-based services	Jitney Dollar vans Flexible route-based services	Employer-based commuter services Property-based services		TNCs On-demand pooled services	Shared taxis On-demand pooled services				
ITF (2019)	Bikeshare					Ridesharing	Microtransit DRT				Ridesourcing	Taxis				
Aguiléra and Boutueil (2019)	Bike-sharing	Car-sharing				Traditional ride-sharing	Microtransit		Employee Bus		TNCs	E-hail				
C2 Smart (2020)							On-demand microtransit DRT		Shuttles		TNCs					

*Alternative Transportation Service (ATS), Courier network services (CNS), Demand Responsive Transport (DRT), peer-to-peer (P2P), Transportation Network Companies (TNCs)

Figure 1 Proposed Shared Mobility Classification: Bring Existing Classifications into A General Taxonomy

Classification of Shared Mobility Digital Platforms According to Services Provided

Each shared mobility digital platform in the census was then classified along these broad categories according to the services it provided as of May 2020 on the application available for download from *Google Play*. Services provided by different applications related to the same mother brand were processed separately (e.g., *Careem* application provides a ride-sourcing service, whereas *Careem Now* and *Careem Bike* applications provide respectively a CNS service and a bike-sharing service).

Information on the services provided by each shared mobility digital platform was retrieved from the application, the official website, or through a review of media sources when the information was not available on the website (e.g., social networks of the shared mobility digital platforms; online newspapers, both mainstream and specialized). The classification of services is provided at platform level; it does not document possible differences in the portfolios of services provided by the same platform in different metropolitan areas.

Platforms fall in one of the following two categories:

- If the shared mobility digital platform provides services from a single category (e.g., *Karwa Taxi* only provides a taxi service, i.e., from the ‘for-hire’ category only), it is referred to as a specialist platform;
- If the shared mobility digital platform provides services from two or more service categories (e.g., *Little* provides ride-sourcing, shuttles and CNS services, i.e., from the ‘ATS’, ‘for-hire’ and ‘CNS’ categories), it is referred to as a multi-service platform.

Geographic Classification of Platforms

Platforms were classified according to their geographic reach, whether local, regional or global. A local platform operates in only one country, whereas a regional platform operates in several countries in a given sub-continental area, and a global platform operates in several countries and at least two sub-continental areas (**Figure 2**).

The metropolitan areas listed in the harmonized cross table were then classified into five categories depending on whether they hosted only local platforms, only regional platforms, only global platforms, a combination of local and regional platforms, or a combination of local/regional platforms and at least one global platform.

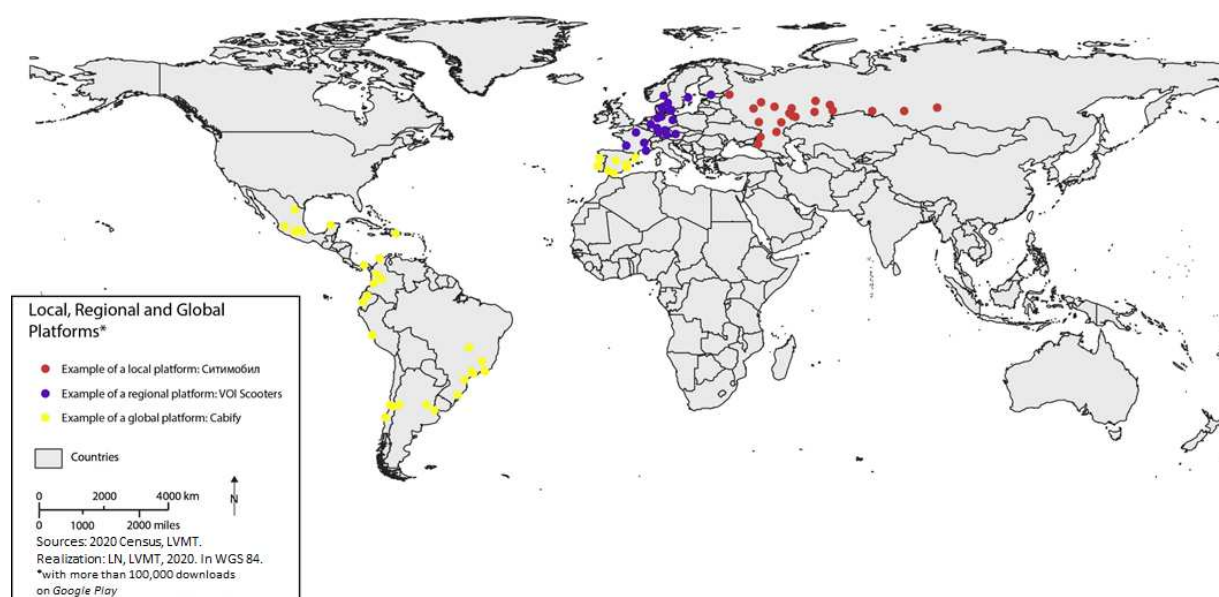


Figure 2 The Geographic Classification of Platforms Illustrated according to their Geographic Distribution

THE RISE OF SHARED MOBILITY DIGITAL PLATFORMS: A SNAPSHOT

The Rise of Shared Mobility Digital Platforms: An Overview of Trends in Downloads

Shared mobility digital platforms are growing fast. The number of platforms with more than 100,000 downloads on *Google Play* grew from 146 in May 2019 to 236 in May 2020. As of May 2020, 141 platforms had their headquarters in countries of the Global North and 94 platforms in countries of the Global South.

The rise of platforms also translates into an overall growth in downloads, as illustrated in **Table 1** for platforms with more than 5,000,000 downloads on *Google Play*.

TABLE 1 Shared Mobility Digital Platforms with more than 5,000,000 Downloads in 2019 and 2020

Download category	2019	2020
500,000,000+	-	Uber
100,000,000+	Grab Uber	Grab Ola
50,000,000+	Go-Jek Ola	99 Go-Jek Blablacar Yandex.Taxi
		Beat Bolt Cabify Careem Easy A Cabify App FreeNow Gett inDriver Lime Lyft maxim Rapido Snapp! Ситимобил 카카오 T
10,000,000+	99 Blablacar Bolt Cabify Careem Gett Lyft Yandex.Taxi 카카오 T	
5,000,000+	Beat Didi maxim mytaxi Zoomcar	GoViet Jugnoo Pathao Swvl Zoomcar

*Bold characters point to shared mobility digital platforms that have exceeded a threshold in downloads from 2019 to 2020 on *Google Play*.

Source: Authors, 2019 and 2020 censuses of shared mobility digital platforms (open dataset to be released soon).

The list of platforms with more than 5,000,000 downloads grew from 18 in 2019 to 27 in 2020, with new platforms crossing every download threshold set by *Google Play*. Most remarkably, *Uber*

inaugurated the 500,000,000+ category in 2020 and platforms like *Rapido*, *Snapp!* or *Ситимобил* entered the ranking directly in the 10,000,000+ category.

Out of 27 platforms with more than 5,000,000 downloads on *Google Play*, 14 are from the Global North (9 from Europe, 4 from the USA and 1 from South Korea), and 13 are from the Global South (5 from South Asia, 3 from Southeast Asia, 3 from the Middle East, 1 from Brazil and 1 from Egypt).

It should be noted that *Didi Chuxing* (in the 1,000,000+ category) is not listed in **Table 1** because the platform does not rely on *Google Play* as their main downloading platform. The users of *Didi Chuxing* services appear to access services through social network *WeChat*, without downloading an extra application (source: <https://www.saporedicina.com/english/how-to-use-didi-china/>).

Classifying Platforms by Service Category: For-Hire and Vehicle-Sharing Services in the Lead

For-hire and vehicle-sharing services are the service categories most developed among platforms around the world (**Table 2**). As of May 2020, out of 236 shared mobility digital platforms, 121 provided for-hire services (51% of all shared mobility digital platforms), 111 platforms provided vehicle-sharing services (47%), 24 platforms provided CNS (10%), 18 platforms provided ride-sharing services (8%) and 12 platforms provided ATS (5%). From May 2019 to May 2020, the number of platforms increased for each service category, but the relative shares of each service category remained nearly unchanged.

In the 2020 census, 89% of shared mobility digital platforms were ranked in the 1,000,000+ download category or below, and 58% were ranked in the 500,000+ download category or below. Platforms with vehicle-sharing services and platforms with for-hire services were overall the most represented in all downloads categories up to 10,000,000+ (**Figure 3**). *De facto*, they were the most represented platforms in the world in 2020. Within the 10,000,000+ download category, 14 platforms provided for-hire services, 4 platforms provided vehicle-sharing services, 3 platforms provided CNS and 1 platform provided ATS. Out of 18 platforms providing ride-sharing services, 10 platforms ranked in the 100,000+ download category, suggesting more local customer bases.

The number of metropolitan areas of shared mobility digital platforms also appears to be sensitive to the categories of services provided. As of May 2020, shared mobility digital platforms providing ride-sharing services operated in 34 metropolitan areas on average, whereas those providing vehicle-sharing services operated in 14 metropolitan areas on average. Platforms providing for-hire services operated in 18 metropolitan areas on average. Of the 12 platforms providing ATS, 58% were from the Global South (e.g., *Grab*, *Jugnoo*) and one third were African platforms (e.g., *Little*, *Swvl*).

TABLE 2 Distribution of Shared Mobility Digital Platforms by Service Categories*

	Vehicle-sharing	Ride-sharing	ATS	For-hire	CNS	Total
2019						
Platforms - Unit	72	11	6	75	16	146
Platforms - %	49	7	4	51	11	100
Average (median) number of metropolitan areas* per platform	20 (8)	51 (13)	18 (6)	22 (6)	9 (4)	19 (7)
2020						
Platforms - Unit	111	18	12	121	24	236
Platforms - %	47	8	5	51	10	100
Average (median) number of metropolitan areas** per platform	14 (4)	34 (10)	26 (6)	18 (4)	8 (4)	15 (4)

*Multi-service platforms are counted once in each column for which they offer the corresponding service category, but only once in the “total” column.

**Metropolitan areas with more than 500,000 inhabitants.

Source: Authors, 2019 and 2020 censuses of shared mobility digital platforms.

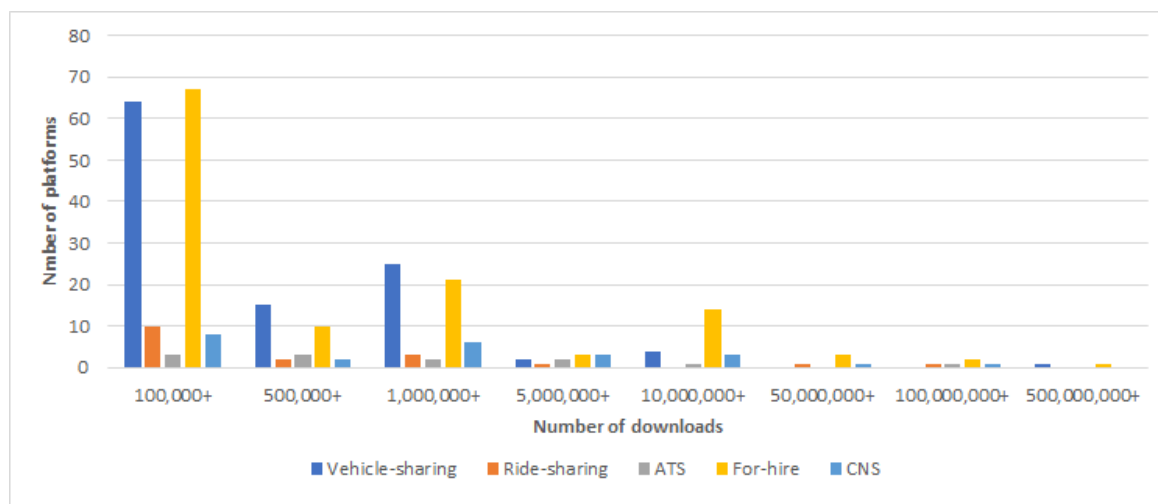


Figure 3 Distribution of Shared Mobility Digital Platforms by Number of Downloads and Service Categories as of May 2020 (Source: Authors, 2020 census of shared mobility digital platforms)

Shared mobility digital platforms can, in some cases, diversify their offer through providing services from multiple service categories. As of May 2020, 197 platforms provided services from only one service category, 32 platforms provided from two different service categories (e.g., *Go-Jek*, *Uber*, *Snapp!*), four platforms provided services from three different service categories (*13Cabs*, *Didi Chuxing*, *Little* and *OHI CABS*), two platforms provided services from four service categories (*Grab* and *Vaya Africa*) and one platform provided services from five service categories (*Jugnoo*). The classification of the 39 multi-service platforms is provided in **Appendix 2**. Shared mobility digital platforms that provided for-hire services were most likely to be multi-service platforms.

Out of 39 multi-service platforms, 23 had their headquarter and operated in metropolitan areas of the Global South. Thus, countries of the Global South appear to be fertile ground for certain innovations in shared mobility digital platforms, including the diffusion of ATS (which may not be so ‘alternative’ after all) and the provision of services from multiple categories.

The Drivers of Growth for Shared Mobility Digital Platforms: Geographic Distribution and Service Diversification

The size of shared mobility digital platforms (analyzed here through the proxy of download counts) appears to be correlated with the extent of their geographic footprint. As illustrated in **Figure 4**, platforms with more downloads tend to operate in a larger number of metropolitan areas, and *vice versa*.

Platforms in each of the 100,000+ and 1,000,000+ download categories operated in 6.6 and 18.7 metropolitan areas on average as of 2020, whereas platforms in the 100,000,000+ download category operated in 159 metropolitan areas on average.

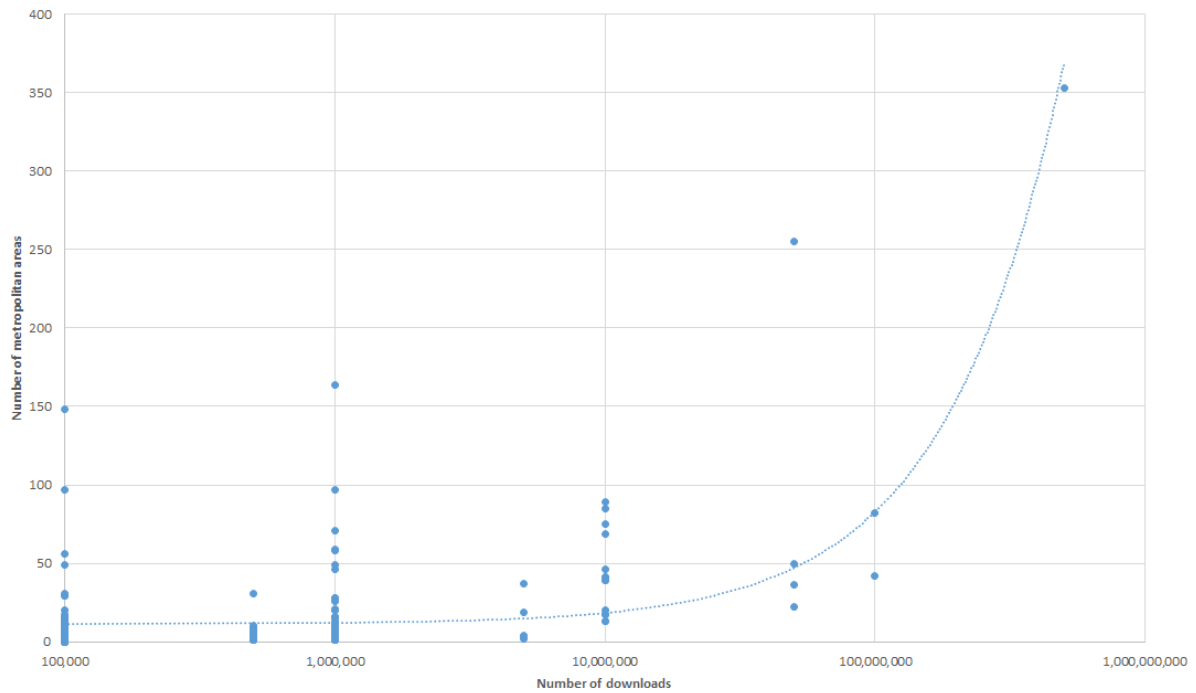


Figure 4 Distribution of Platforms with more than 100,000 Downloads on *Google Play* by Number of Metropolitan Areas with more than 500,000 Inhabitants and Number of Downloads as of May 2020 (Source: Authors, 2020 census of shared mobility digital platforms)

The size of platforms also appears to be correlated with the diversity of services they provide. As illustrated in **Figure 5**, platforms with more downloads tend to offer more diverse services and *vice versa*. Platforms in the 100,000+ download categories offered 1.3 different services on average as of 2020, whereas platforms in the 100,000,000+ downloads category offer 3.4 different services on average.

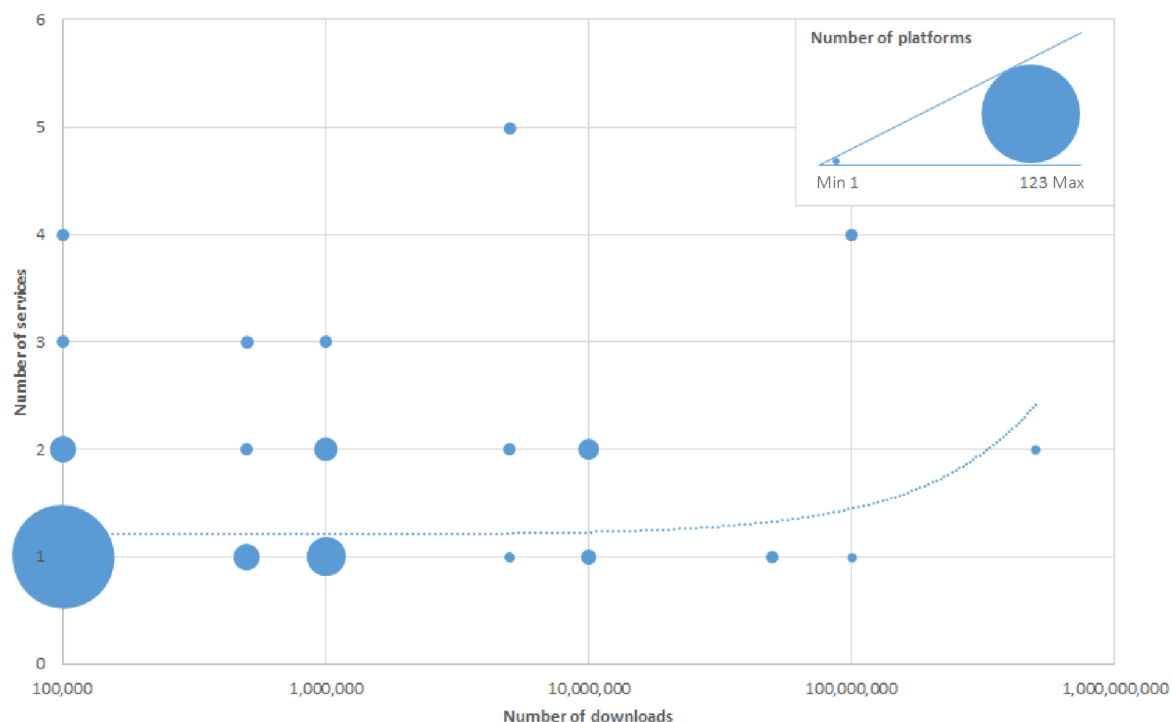


Figure 5 Distribution of Platforms with more than 100,000 Downloads on *Google Play* by Number of Services Provided and Number of Downloads as of May 2020 (Source: Authors, 2020 census of shared mobility digital platforms)

Geographic distribution and service diversification may be intertwined, as a correlation also exists between the number of metropolitan areas where a platform operates and the number of different services it offers. Two possible interpretations could be that the conquest of new markets brings up the need to adapt to diverse local needs through a diversified portfolio of services, or that large platforms with a wide market foothold and abundant resources operate a diversification of services they provide to users for greater market reach.

A GEOGRAPHY OF SHARED MOBILITY DIGITAL PLATFORMS

The Development of Shared Mobility Digital Platforms: A Global Phenomenon Transcending the North-South Divide

Shared mobility digital platforms have a very broad geographic footprint, covering all sub-continental areas in the world except Central Africa: 814 metropolitan areas from 116 countries (that is 60% of the 193 UN-recognized countries) have at least one platform operating services (Table 3).

TABLE 3 Geographic Footprint of Shared Mobility Digital Platforms with more than 100,000 Downloads on *Google Play* as of May 2020, by Sub-Continental Area*

	Countries**	Metropolitan Areas**
Africa	21	61
◦ <i>Central</i>	0	0
◦ <i>East</i>	7	11

◦ North	4	14
◦ South	3	10
◦ West	7	26
Americas	18	202
◦ North	3	124
◦ Central	5	6
◦ South	8	69
◦ Caribbean	2	3
Asia & Oceania	25	331
◦ Central Asia	6	7
◦ East Asia	4	160
◦ South Asia	5	112
◦ Southeast Asia	8	45
◦ Oceania	2	7
Europe	32	157
◦ Eastern Europe	10	28
◦ Mediterranean Sea	1	1
◦ Northern Europe	9	27
◦ Southern Europe	9	31
◦ Western Europe	5	35
Middle East & Caucasus	19	63

*According to the UN geographic classification.

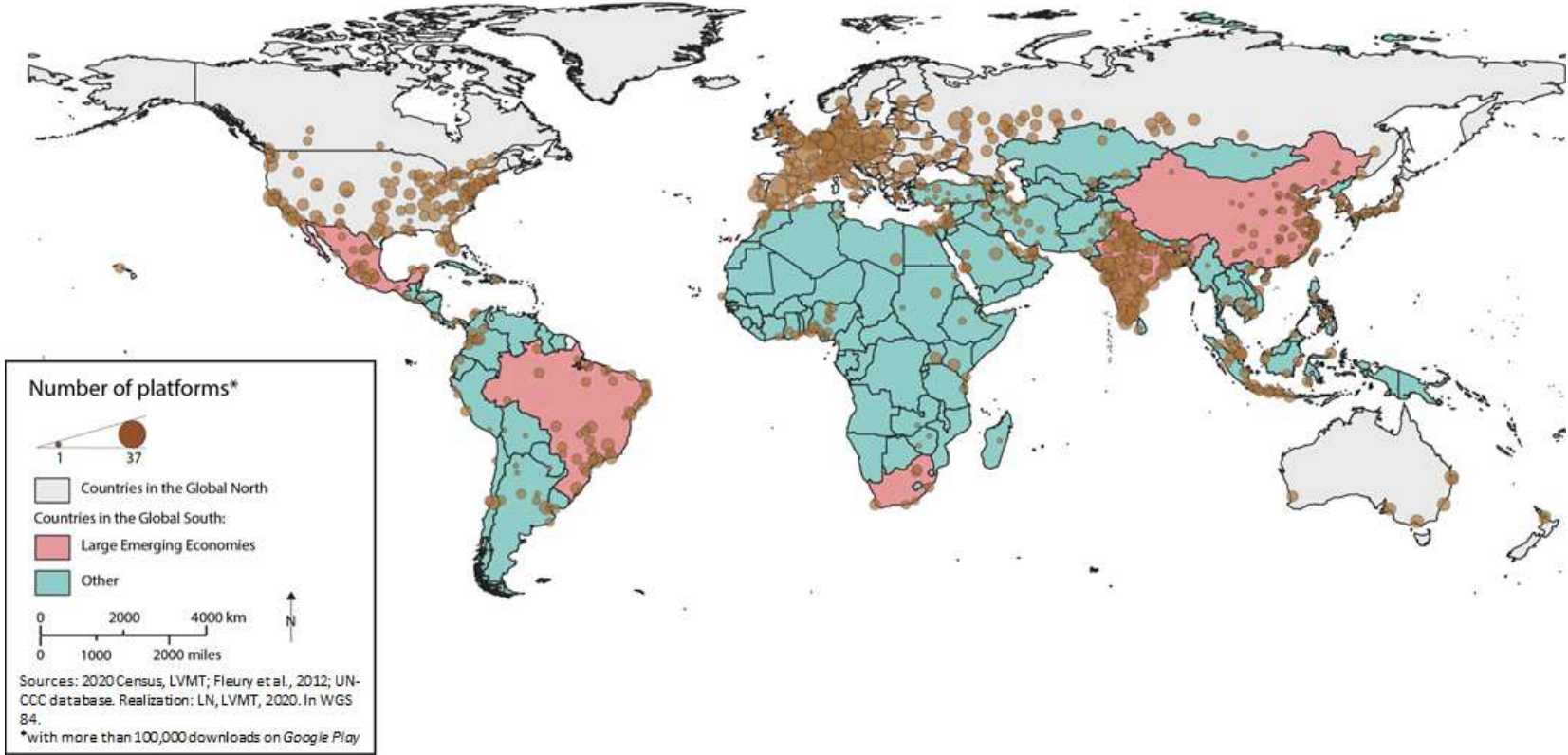
**Number of countries and metropolitan areas where at least one shared mobility digital platform operates services.

Source: Authors, 2020 census of shared mobility digital platforms.

At a global level, 530 metropolitan areas of more than 500,000 inhabitants in the Global South have at least one platform operating services, as compared to 284 metropolitan areas in the Global North. Platforms operate more extensively in some areas. Europe (161 metropolitan areas covered), East Asia (160), North America (124) and South Asia (112) are extensively covered. Other areas, including the Middle East and Africa, may appear to lag behind, but platforms have very strong momentum there. Africa, for instance, went from 22 metropolitan areas with at least one platform operating services in 2019 to 61 in 2020, following significant development in West Africa.

Despite an uneven distribution around the globe, shared mobility digital platforms now have a global reach (**Figure 6**) and they have definitely transcended the traditional divide between countries from the Global North and from the Global South. Besides significant clusters in Europe and North America, large emerging countries, like Brazil, China, India or Mexico (22), also stand out as fertile ground for shared mobility digital platforms. They could even fight for leadership with Northern countries in the upcoming years, as new local platforms are constantly emerging in those countries, including *Grab* and *Ola* which have a number of downloads close to that of *Uber* (**Table 1**).

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Figure 6 Worldwide Distribution of Platforms in Metropolitan Areas with more than 500,000 Inhabitants as of May 2020 (Source: Authors, 2020 census of shared mobility digital platforms)

Europe stands out as a hot spot for shared mobility digital platform competition, with 25 metropolitan areas having 15 platforms or more in 2020. Cities with 20 platforms or more included: Paris with 37, Berlin and Lyon with 27, Hamburg, Munich and Madrid with 25, Bordeaux with 21, Frankfurt and Düsseldorf with 20. The use of *Google Play*'s search engine from computers with a French IP address may have played a role in the over representation of Paris and Lyon in this census.

India is another hotspot, with 19 metropolitan areas having 10 platforms or more in 2020 (Hyderabad ranks first with 21 platforms), as compared to 13 in 2019. Five more countries display a rather extensive and intensive coverage by shared mobility digital platforms: United States of America (USA), Russia and Australia in the Global North, but also Brazil and Indonesia in the Global South, had five platforms or more in almost all metropolitan areas of more than 500,000 inhabitants as of 2020.

At the other end of the spectrum, no metropolitan area in China had more than 4 platforms as of 2020. Altogether six shared mobility digital platforms operated in China in May 2020. These were: *BlackLane*, a specialist platform from Germany operating in 6 Chinese metropolitan areas; *ComfortDelGro*, a specialist service platform from Singapore operating in 9 Chinese metropolitan areas; *Didi Chuxing*, a multi-service platform from China operating in 97 Chinese metropolitan areas; *FlyTaxi*, a specialist platform from Hong-Kong operating in 3 Chinese metropolitan areas in Hong-Kong, where *Didi Chuxing* did not operate; *GetTransfer*, a multi-service platform from Cyprus operating in 5 Chinese metropolitan areas; and *Uber*, a multi-service platform from the USA operating in 2 metropolitan areas in Macau and Hong-Kong, where *Didi Chuxing* did not operate. The low platform counts could relate to the existence of mobile operating systems other than Android that are more popular, and/or the quasi-monopoly of *Didi Chuxing*, and/or to the closure of the Chinese market to foreign shared mobility digital platforms.

Geographic Footprint of Multi-Service Platforms: The Emergence of Major Players

As already mentioned, service diversification appears to go hand in hand with geographic distribution. **Figure 7** illustrates the geographic footprint of the major multi-service platforms (more than 10,000,000 downloads on *Google Play* as of May 2020).

Out of these nine platforms, four operated in at least two continents as of 2020. Only *Uber* had a geographic footprint that covered all continents (354 metropolitan areas with more than 500,000 inhabitants). Russia and China were the only two major economies where *Uber* did not operate because local competitors *Yandex.Taxi* and *Didi Chuxing* enjoyed protectionist market conditions (and commercial agreements were reached among platforms accordingly). The geographic footprint of *Taxify-Bolt* was more limited, yet with 69 metropolitan areas spread across in Europe, North America, Central Asia, the Middle East and Africa. Both *Uber* and *Taxify-Bolt* operated in countries of both the Global North and the Global South. In contrast, *inDriver* (headquarters in Russia) only operated in countries of the Global South (44 metropolitan areas in South America, Africa and Southeast Asia). *Easy Taxi* A *Cabify App* was available in 39 metropolitan areas in South America and Central America, apparently following a classical pattern of linguistic and cultural influence rooted in the Spanish and Portuguese colonization. The same footprint was observed for *Beat* being available in 17 metropolitan areas across Central America and South America. Finally, *Grab*, *Kakao Taxi*, *Lyft* and *Snapp!* were concentrated in specific geographic areas: *Grab* in Southeast Asia (with 42 metropolitan areas), *Kakao Taxi* in South Korea and Vietnam (13 metropolitan areas), *Lyft* in the United States of America (89 metropolitan areas), and *Snapp!* in Iran (17 metropolitan areas).

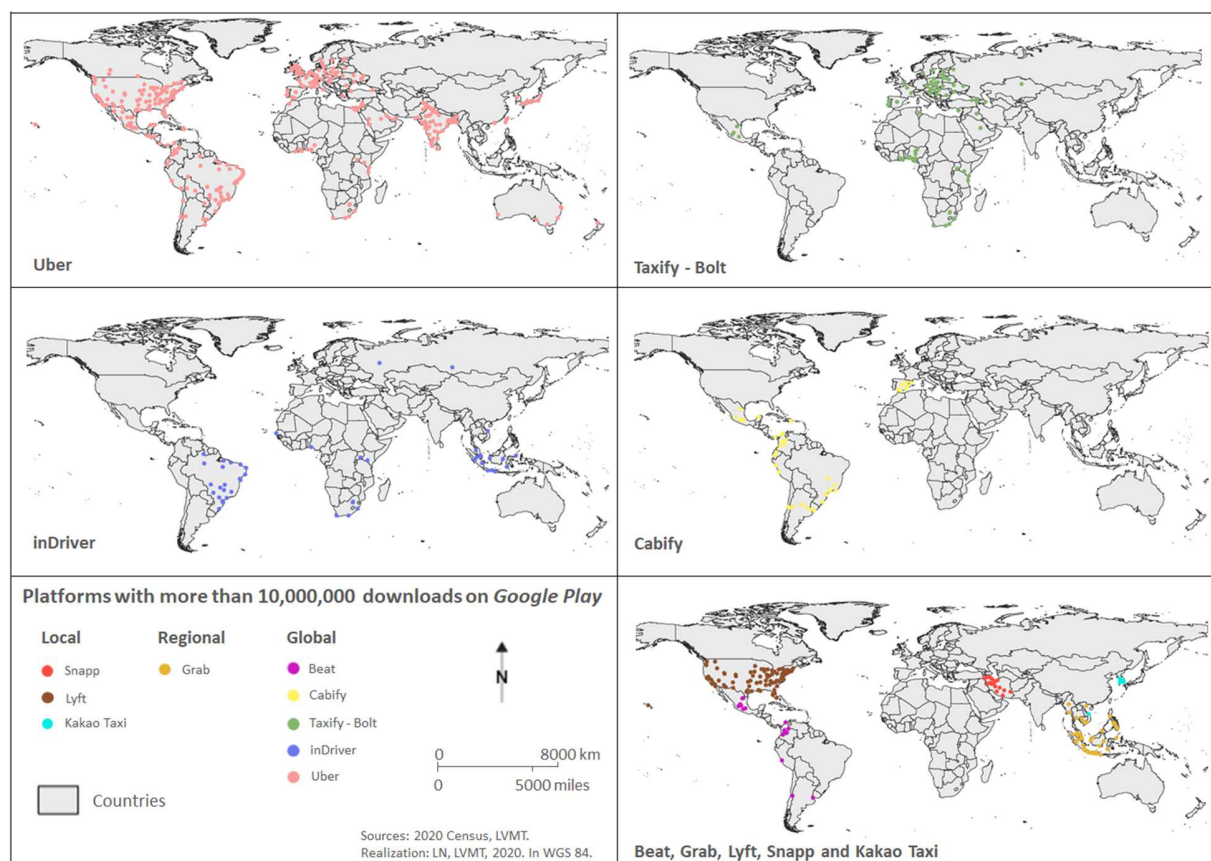


Figure 7 Worldwide Presence of Major Multi-Service Platforms in Metropolitan Areas with more than 500,000 Inhabitants as of May 2020 (Source: Authors, 2020 census of shared mobility digital platforms)

Emergence and Strengthening of Local, Regional and Global Platforms

Three types of shared mobility digital platforms can be distinguished based on the extent of their geographic footprint: local, regional and global platforms. Out of the 236 platforms inventoried in the 2020 census, 150 could be classified as local platforms, 50 as regional platforms, and 36 as global platforms. Looking into possible differences among service categories, the authors found that platforms providing ride-sharing services altogether had the most limited coverage of worldwide metropolitan areas, whereas platforms providing for-hire services had the most widespread coverage (18 platforms in 274 metropolitan areas in 27 countries, as compared to 122 platforms in 772 metropolitan areas in 115 countries) (**Figures 8 and 9**).

Platforms with more than 100,000 downloads on *Google Play* providing ride-sharing services were noticeably absent from the United States of America and Canada, but also from the Middle East (except for Turkey) and from Africa (except for Zimbabwe). Besides, a clear-cut division could be observed among countries where ride-sharing services are operated, with some countries having only one local platform present (Argentina, China, Zimbabwe), other countries having only one regional platform present (countries in Scandinavia and Southeast Asia), and yet others having only one global platform present (most European countries, as well as Turkey, Australia, Mexico, and Brazil). Three countries displayed a more hybrid profile: India, Spain and France.

Shared mobility digital platforms providing for-hire services were present in 115 countries in the world (out of 193 countries), although noticeably absent from 30 of the 54 UN-recognized African

1 countries. The ubiquity of for-hire services mostly resulted from a combination of global and
2 local/regional platforms in most metropolitan areas in the world, from both the Global North (the United
3 States of America, most of Europe) and the Global South (55 countries including emerging countries such
4 as Brazil, India, Indonesia, and countries from all sub-continental areas). Global platforms were the only
5 providers of for-hire services in a limited number of countries, for example, Bolivia, Canada, Finland,
6 Mongolia, South Africa. Few countries relied on regional platforms only for for-hire services, e.g., Benin,
7 Iraq, Kuwait, Myanmar, Pakistan, Togo, Zambia. On top of these, few countries relied on local platforms
8 only for for-hire services, namely China, Iran and Zimbabwe. The exclusive reliance on a local platform
9 in such large markets as China or Iran may point to political or economic protectionism.

10 The differences in geographic coverage and competition patterns between platforms providing
11 for-hire services and platforms providing ride-sharing services may point to, for example, a stronger
12 influence of local regulation or stronger cultural barriers in ride-sharing services compared with for-hire
13 services.

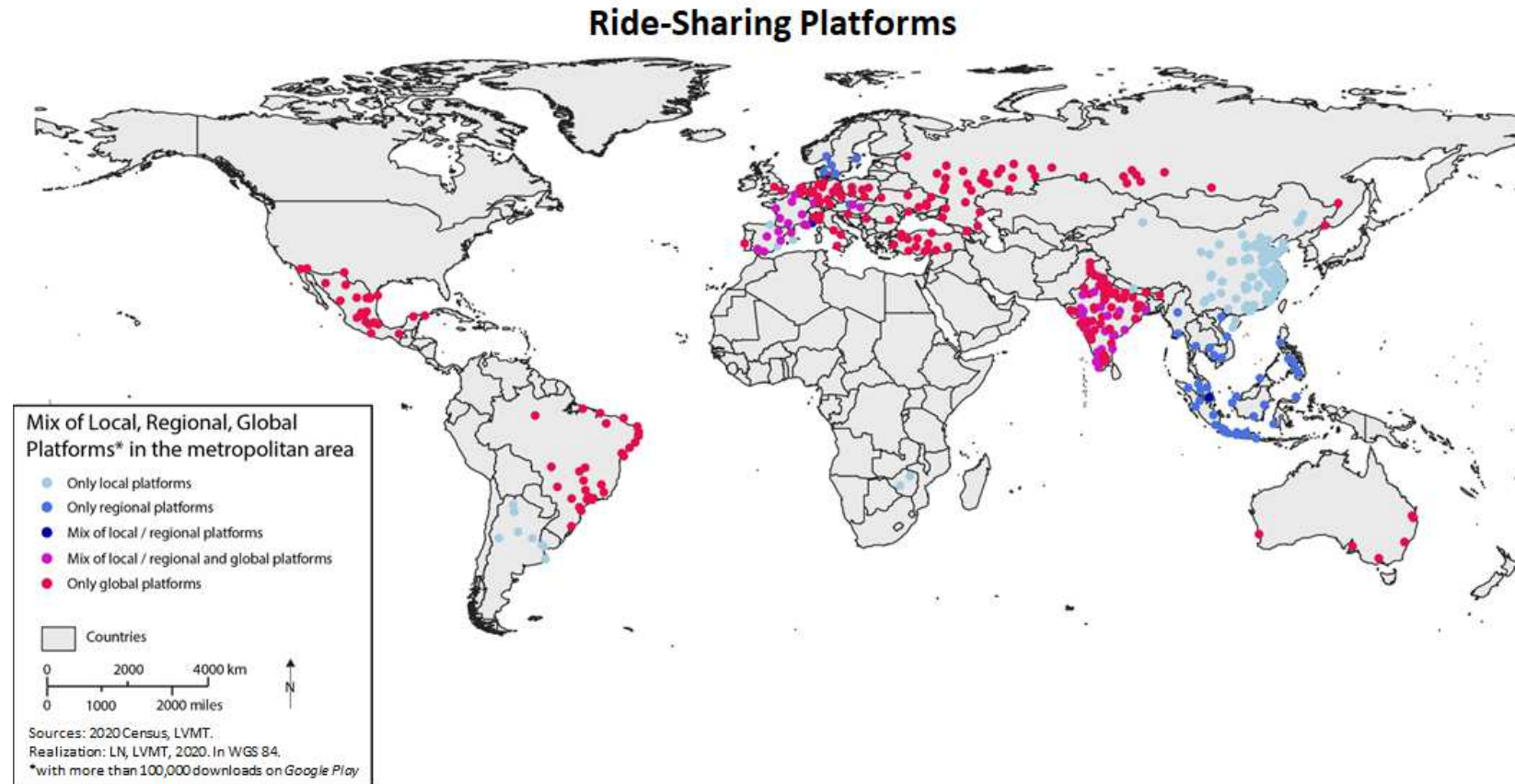


Figure 8 Worldwide Presence of Local, Regional, Global Ride-sharing Platforms in Metropolitan Areas with more than 500,000 Inhabitants as of May 2020 (Source: Authors, 2020 census of shared mobility digital platforms)

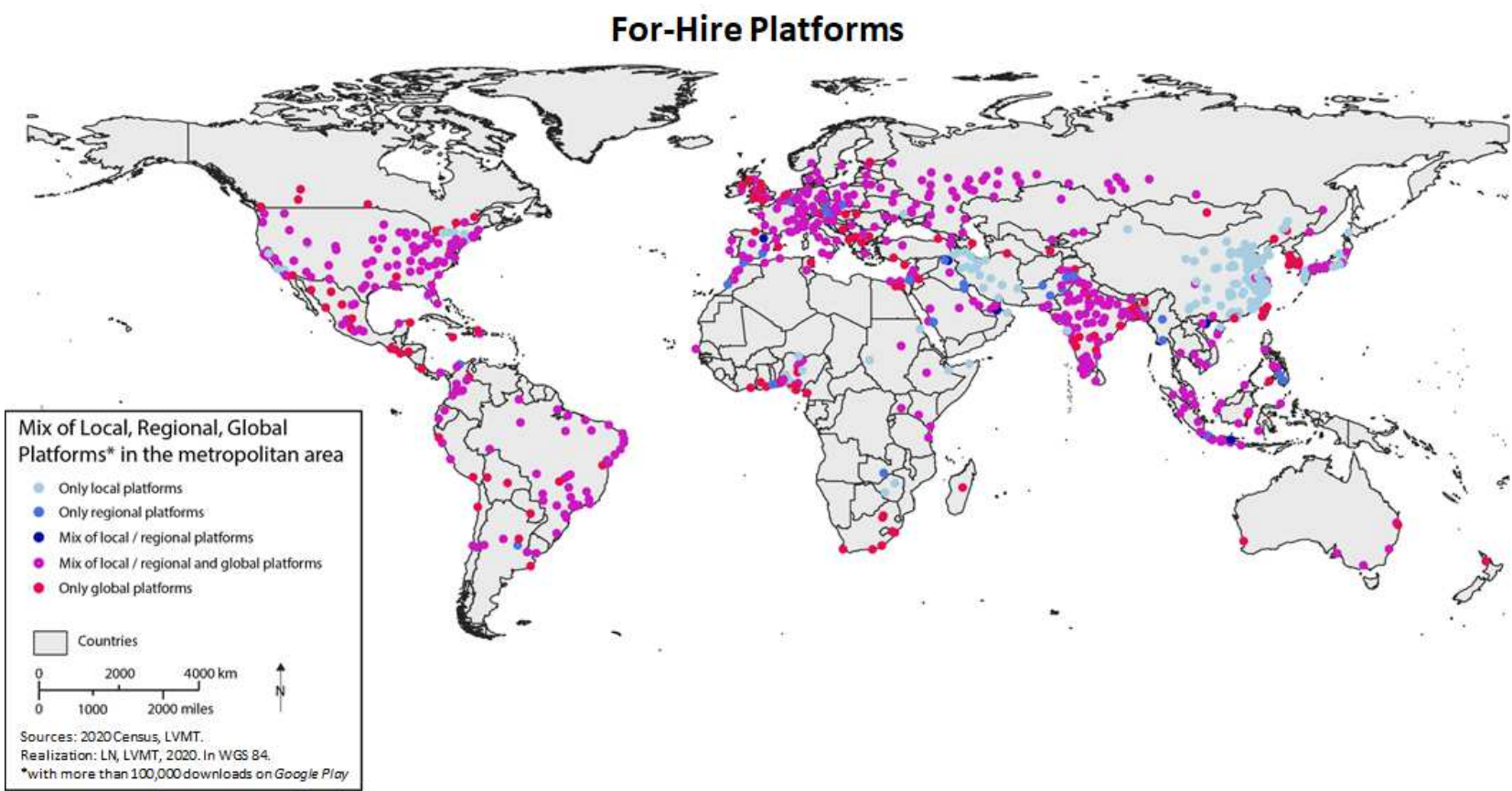


Figure 9 Worldwide Presence of Local, Regional, Global For-Hire Platforms in Metropolitan Areas with more than 500,000 Inhabitants as of May 2020 (Source: Authors, 2020 census of shared mobility digital platforms)

CONCLUSION AND RESEARCH PROSPECTS

Shared mobility digital platforms are growing at an accelerating pace around the world, with marked increases in the number of platforms (which is indicative of business attractiveness), in the number of downloads (which is indicative of success with users), and in the diversity of services (which is indicative of adaptation to the diverse needs of users). Further annual censuses will be needed to assess whether the upward momentum of shared mobility digital platforms will continue, or whether the number of shared mobility digital platforms will stabilize as a result of, for example, market saturation, market consolidation or tighter regulation. The basic principles of platform economy tend to favor consolidation –i.e., positive network externalities can lead to “winner-takes-all” situations in the digital economy (32)–, yet some local contexts may lead to consolidation or even monopolistic situations on other grounds, for example, political or economic protectionism.

The rise of shared mobility digital platforms takes place on all continents, in the metropolitan areas of both the Global North and the Global South. Nevertheless, the operations of shared mobility digital platforms are unevenly distributed around the world. The metropolitan areas of the Global North are experiencing a strong presence and intensive development of shared mobility digital platforms. They are clusters for shared mobility, which has already been documented in the scientific literature. Emerging countries (i.e., Brazil, China, India, Mexico and South Africa) and certain sub-continental regions (i.e., the Middle East, Southeast Asia and West Africa) have also become clusters and places of innovation for shared mobility digital platforms. The divide between countries of the Global North and the Global South has come to be transcended, if not completely overcome. Further research would be needed to analyze the drivers of growth for shared mobility in these geographic areas, as well as possible peculiarities in demand, supply or regulation of shared mobility services locally. As shared mobility has long taken the form of “informal” services in cities of the Global South, the rise of digital platforms calls for further investigation into their role in the formalization (e.g., regulation, planning, industrialization of operations) of said services. Besides, as shared mobility has a long history of “filling the gaps” (24) in transport supply in countries of the Global South, the rise of digital platforms calls for further research into the compared (social) costs and benefits of these services, conventional public transit services, and private car use.

At a global level, the geographic distribution of shared mobility digital platforms highlights the importance of local contexts of the metropolitan areas and countries in which they are embedded (e.g., mobile penetration rate, regulation and public policies, pricing of competing services, platforms users). In-depth case studies (comparative case studies where necessary) would therefore be useful to achieve a better understanding of the dynamics of competition and complementarity between platform-supported shared mobility services and other, preexisting services.

Through sorting platforms by their geographic reach (local, regional or global), the analysis revealed a diversity of competitive environments for local, regional and global platforms, most probably depending on public policies and strategic options taken by stakeholders. This would be the case if the combined presence of local/regional and global platforms providing the same service in a given area could be interpreted as a sign of open and fair competition (according to WTO standards). Further investigation would still be needed to better understand the competitive dynamics among local and global platforms, both in a given metropolitan area (i.e., agility, adaptation to local regulation and local mobility needs), and at global scale (i.e., economies of scale, learning curves, brand effect).

Shared mobility digital platforms providing for-hire and vehicle-sharing services displayed strongest growth momentum in terms of platform volume and metropolitan areas covered. Other service categories –ride-sharing, ATS and CNS– also grew steadily though at a slower pace, especially in the Global South for ATS. The relative paces of spreading of shared mobility services may result from different combinations of drivers of, and barriers to, digitalization relative to said service categories (including network effects, ownership structure, market concentration, stakeholder interplay).

The strategy of some shared mobility digital platforms to provide users with a growing number of services from different categories hints at the hypothesis that such platforms are on their way to becoming MaaS (Mobility-as-a-Service) platforms. As an illustration, *Lyft* in the U.S.A. offers for-hire and vehicle-

1 sharing services in addition to allowing users to access public transport schedules on the same application.
2 The trend towards service diversification appears to be conducive of further platform growth as broader
3 service portfolios allow to address a broader range of user needs.

4 Recent efforts to achieve a robust classification of shared mobility services have found an
5 extension in this research, as new types of services have been documented –namely motorcycle taxis,
6 motorcycle-pooling and e-scooter sharing– that call for the addition of new services to prior
7 classifications, including SAE’s (9). Interestingly, two of the suggested additions stem from shared
8 mobility services that first emerged in the Global South. Explicit inclusion of these services in
9 taxonomies can help foster dedicated research on their development and position in mobility systems. As
10 far as taxonomy is concerned, the authors also want to bring forth their view that the concept of
11 ‘intermediate transport modes’ may be preferable to that of ‘shared mobility’, as it is more explicit as to
12 the expected role (and conditions for sustainability) of these modes relative to public transit and private
13 car use (and other individual transport means).

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18 **AUTHOR CONTRIBUTIONS**

19 The authors confirm contribution to the paper as follows: study conception and design V. Boutueil, L.
20 Nemett, T. Quillerier; data collection: L. Nemett, T. Quillerier; analysis and interpretation of results: V.
21 Boutueil, L. Nemett, T. Quillerier; draft manuscript preparation: V. Boutueil, L. Nemett, T. Quillerier. All
22 authors reviewed the results and approved the final version of the manuscript.
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APPENDIX

Appendix 1 Definitions of Shared Mobility Travel Modes and Service Models from the SAE Taxonomy (2018) (9)

Travel Modes	Definition
Alternative Transportation Services (ATS)	“‘Alternative transportation services’ is a broad category that includes multi-occupant modes such as shuttles, vans, and small busses, as well as paratransit and microtransit services. Alternative transportation services are differentiated from public transit services by the lower volume of individuals moved on average per trip. In some contexts, alternative transportation services may also be referred to as ‘demand responsive transport’”
Bikesharing	“Bikesharing provides users with on-demand access to bicycles at a variety of pick-up and drop-off locations for one-way (point-to-point) or roundtrip travel. Bikesharing fleets are commonly deployed in a network within a metropolitan region, city, neighborhood, employment center, and/or university campus.”
Carsharing	“Carsharing offers members access to vehicles by joining an organization that provides and maintains a fleet of cars and/or light trucks. These vehicles may be located within neighborhoods, public transit stations, employment centers, universities, etc. The carsharing organization typically provides insurance, gasoline, parking, and maintenance. Members who join a carsharing organization typically pay a fee each time they use a vehicle.”
Courier Network Services (CNS)	“CNS provide for-hire delivery services for monetary compensation using an online application or platform (such as a website or smartphone app) to connect couriers using their personal vehicles, bicycles, or scooters with freight (e.g., packages, food, etc.). CNS are also referred to as flexible goods delivery.”
Microtransit	“Microtransit is defined as a privately or publicly operated, technology-enabled transit service that typically uses multi-passenger/pooled shuttles or vans to provide on-demand or fixed-schedule services with either dynamic or fixed routing.”
Pedicabs	“Pedicabs are for-hire services in which a cyclist (or “pedaler”) transports users on a cycle containing three or more wheels and a passenger compartment.”
Personal Vehicle Sharing	“Personal vehicle sharing is defined as the sharing of privately owned vehicles, where companies broker transactions between vehicle hosts and guests by providing the organizational resources needed to make the exchange possible (e.g., technology, customer support, driver and motor vehicle safety certification, auto insurance, etc.). This model also includes P2P carsharing, P2P marketplace, hybrid B2C and P2P models, and fractional ownership.”
Ridesharing	“Ridesharing (also known as carpooling and vanpooling) is defined as the formal or informal

	sharing of rides between drivers and passengers with similar origin-destination pairings. Ridesharing includes vanpooling, which consists of 7 to 15 passengers who share the cost of a van and operating expenses, and may share driving responsibility.”
Ridesourcing	“Ridesourcing services are prearranged and on-demand transportation services for compensation in which drivers and passengers connect via digital applications. Digital applications are typically used for booking, electronic payment, and ratings.”
Scooter Sharing	“Scooter sharing allows individuals access to scooters by joining an organization that maintains a fleet of scooters at various locations. Scooter sharing models can include a variety of motorized and non-motorized scooter types. The scooter service provider typically provides gasoline or charge (in the case of motorized scooters), maintenance, and may include parking as part of the service. Users typically pay a fee each time they use a scooter. Trips can be roundtrip or one way.”
Shuttles	“Shuttles are shared vehicles (typically vans or buses) that connect passengers from a common origin or destination to public transit, retail, hospitality, or employment centers. Shuttles are typically operated by professional drivers, and many provide complimentary services to the passengers.”
Taxis	“Taxi services provide prearranged and on-demand transportation services for compensation through a negotiated price, zone pricing, or taximeter (either traditional or GPS-based). Passengers can schedule trips in advance (booked through a phone dispatch, website, or smartphone app), street hail (by raising a hand on the street, standing at a taxi stand, or specified loading zone), or e-Hail (by dispatching a driver on-demand using a smartphone app).

Appendix 2 Multi-Service Platforms Classification as of May 2020 (Source: Authors, 2020 census of shared mobility digital platforms)

Platform	Vehicle-sharing	Ride-sharing	ATS	For-hire	CNS	Total
13cabs			✓	✓	✓	3
Amovens	✓	✓				2
Beat				✓	✓	2
My Blue Bird			✓	✓		2
Cabify	✓			✓		2
Clerver Shuttle			✓	✓		2
Didi Chuxing	✓	✓		✓		3
GET				✓	✓	2
GetTransfer			✓	✓		2
Go-Jek				✓	✓	2
GoMore	✓	✓				2
GoViet				✓	✓	2
Grab		✓	✓	✓	✓	4
inDriver			✓	✓		2
Jugnoo	✓	✓	✓	✓	✓	5
Lemon				✓	✓	2
Liftago Taxi				✓	✓	2
Little			✓	✓	✓	3
Lyft	✓			✓		2
Max Okada				✓	✓	2
Meru Cabs	✓			✓		2
Mobyzy Zyp				✓	✓	2
OHI CABS	✓	✓		✓		3
Oride				✓	✓	2
Pathao				✓	✓	2
Pick Me				✓	✓	2
Red Taxi	✓			✓		2
SafeBoda				✓	✓	2
Shohoz Drive				✓	✓	2
Sixt (Share)	✓			✓		2
Snapp				✓	✓	2
Taxify - Bolt	✓			✓		2
tem:tem				✓	✓	2
Uber	✓			✓		2
UKLON				✓	✓	2
Vaya Africa		✓	✓	✓	✓	4
VOGO	✓				✓	2
Такси Престиж Эконом				✓	✓	2
카카오 T (Kakao Taxi)				✓	✓	2