

Assessing social and spatial access equity in regulatory frameworks for moped-style scooter sharing services

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ABSTRACT

Moped-style scooter sharing services (MSS) offer short-period renting for daily urban mobility and are gaining popularity in cities worldwide. MSS provide substantial promise in reducing car-dependency and helping sustainability goals, but also significant risks in terms of spatial access equity and social justice. In recent years, European cities have been testing different regulation strategies for MSS but not always succeeding regarding social equity and spatial accessibility criteria.

In this context, this study employs a semi-structured interviewing approach to discuss the main existing MSS regulation models. The aim is to understand how experts, policymakers, and private operators assess the strengths and weaknesses of each model to guarantee spatial and social equity regarding accessibility to the service, while preserving the long-term economic interests of private operators.

Our results show a diversity of opinions, with solid consensus on proposing an alternative to the Barcelona regulatory model (capped vehicle licenses, uncapped number of operators), ranging from a *numerus clausus* model (Paris or Amsterdam) to a *laissez-faire* model (Madrid or Berlin), based on an open dialogue between administrations and the private sector. However, most respondents noted that the natural path of the regulation (as has happened in the past with other transport innovations) is towards a close public-private partnership model, with greater management and control capacity by the public sector. This option generates the greatest consensus of favouring a more spatial and socially equitable service while preserving its economic viability, although it would involve significant commitment and investment of the public sector. These findings provide valuable feedback for policymakers and transport regulators on how to approach micromobility and MSS regulation.

1. Introduction

In recent years, moped-style scooter sharing services (MSS) (Fig. 1) are gaining popularity and are already present in more than 100 cities worldwide (Howe and Jakobsen, 2020). This new form of shared micromobility was first introduced in European cities in the late 2010s, and currently, they are being viewed as both an opportunity and a challenge for achieving urban mobility sustainable goals. While some authors note the potential in MSS, regarding their use as lighter and more sustainable forms of individual motorised transport (Gómez, 2020), others criticise their unequal spatial accessibility (Bach et al., 2023), and their occupation of public space (Pérez-Fernández and

García-Palomares, 2021), among other issues. Although this debate is far from over, some consensus exists on the importance of regulation to maximise their potential and minimise the externalities caused by the introduction of these new forms of transport.

There is currently a lack of scientific evidence on how to better regulate these services. Consequently, cities have started planning the implementation of these services through their own regulation, and using a trial-and-error approach. One of the first cities to start planning the implementation of these services through regulation was Barcelona (northeast Spain) (Fig. 2), which already has a long-standing tradition of using mopeds and motorcycles for urban transport (Marquet and Miralles-Guasch, 2016). As a result, Barcelona has become a pioneer in

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proposing a new regulatory framework of public-private collaboration (PPC), with the purpose of developing the service appropriately. The Barcelona regulation model, together with others that have emerged in similar cities, however, has not incorporated specific equity and spatial access justice criteria. Similarly, to our knowledge, academic research to date has not studied how MSS could be planned using an underlying substrate of equity and social justice principles.

In this article, we employ a semi-structured interviewing approach to discuss the Barcelona model, and to evaluate regulatory alternatives that have been most frequently applied to MSS in European cities, such as Paris, Madrid, Berlin, or Amsterdam. The aim is to better understand how experts, planners, policymakers, and private operators assess each model's strengths and weaknesses to guarantee spatial and social equity regarding accessibility to the service, while preserving the long-term economic interests of private operators.

Following this introduction, we first review the existing literature on equity and social justice in shared micromobility regulation, and explain the three main MSS PPC models that are employed in European cities. Secondly, we describe the context in which the interviews were undertaken, and overview the methods that were employed in this research. Thirdly, we structure and discuss the findings. Finally, we conclude with implications for transport policy.

2. Background

2.1. Equity and social justice in shared micromobility regulation

In recent years, most cities have seen micromobility modes of transport appear and gain popularity in the form of shared e-scooters, bikes, or mopeds. Research interest in these vehicles is growing substantially, in particular, regarding their implications in terms of sustainability of the transport system (Abduljabbar et al., 2021; Felipe-Falgas et al., 2022; Moreau et al., 2020) or their health impacts (Kobayashi et al., 2019; OECD/ITF, 2020; Otero et al., 2018). Significant research has recently been established, analysing the new forms of travel behaviour that these new modes are creating (Bieliński and Ważna, 2020; Christoforou et al., 2021; Lazarus et al., 2020; Ma et al., 2020). Most of the research and debates are focused on the extent to which these shared micromobility modes might eventually be used as a first/last mile stage in intermodal trips with public transport and the bicycle in everyday mobility (Litman, 2021).

According to some authors, shared micromobility could potentially help cities accomplish sustainability and equity goals, in terms of spatial coverage (Meng and Brown, 2021; Palm et al., 2021; Shaheen and Cohen, 2019), solve their desire to reduce private car-dependency (Nieuwenhuijsen and Khreis, 2016), increase accessibility levels (Abduljabbar et al., 2021; Horner, 2020), or support more multimodal planning (Boarnet, 2013). However, in their current form, most shared micromobility services are operated by private providers, with no

participation of the public authorities. These private businesses tend to prioritise the maximising of profit, which can often enter into contradiction with guaranteeing equal access opportunities or equal spatial coverage within the city limits. To date, most cities have allowed operators to provide a service at their own discretion, without taking into account whether these services ensure equity and homogeneous access to the service.

But, for Pereira and Karner (2021), achieving high levels of universal accessibility is a requirement that enables equal participation in society and, thus, it is perceived as a key feature for urban policies and transport management decisions (Gallez and Motte-Baumvol, 2017). While equity and social justice are increasingly being integrated into the planning of public transport services (di Ciommo and Shiftan, 2017; Shaheen, 2017; M. Zhang and Zhao, 2021), there are a few examples of shared micromobility services that are planned on these principles. Policy decisions regarding new transport forms, such as micromobility, should take accessibility into account if they aim to contribute to equity and social justice. As suggested by Shaheen and Cohen (2019), concerns such as low-income affordability, neighbourhood availability, access for people with disabilities, underbanked households, or digital impoverishment should be addressed in equitable public policies initiatives. One such example is the Electric scooter sharing pilot programme implemented in Portland, Oregon, USA (Shaheen and Cohen, 2019), which included as a key goal, a driver of expanding access to underserved communities. A similar project was the Better Bike Share Partnership (Fishman and Allan, 2019) in Philadelphia, USA, which was set up to directly address barriers to access these services for low-income groups and communities of colour. All of these examples have in common a high degree of government involvement. These cases demonstrate that public-private collaboration (PPC) can play a positive role in achieving common ground between the needs of the public administration and the private sector.

The term public-private collaboration can broadly be defined as a collaboration between public and private organisations, in which partners share information, resources, or capabilities to achieve an outcome that could not be achieved by organisations that only operate either in the public or private sector alone (Crispeels et al., 2018). PPC is not necessarily a static agreement, but is rather a process that reinvents itself during policy diffusion (Wang et al., 2020). PPCs are not new in the transportation sector and have been performing well in urban bus services (Willoughby, 2012) or light rail transit (Salvador et al., 2020). More recently, they have also been discussed in the context of shared micromobility operations, such as bike-sharing systems (Li et al., 2021). However, to our knowledge, they have not yet been evaluated in the case of MSS, even if they offer unique possibilities for urban mobility. Unlike other micromobility services, MSS, have specific ergonomic characteristics, such as seat, operable pedals, floorboard, etc. (SAE International, 2019), and their use is characterised by a different set of temporal and spatial dimensions (Arias-Molinares et al., 2021; McKenzie, 2018, 2019,



Fig. 1. Two MSS vehicles in Barcelona. (a) Cooltra. (b) Yego. Photographer: Xavier Bach.

2020). Moreover, MSS have specific associated operative needs, such as curb space management specificities (Shaheen and Cohen, 2019), and operators with fewer years of experience in cities (Shaheen et al., 2020). As a result, not only do they have different uses and requirements, but also their environmental (de Bortoli, 2021; Felipe-Falgas et al., 2022) and health impacts (OECD/ITF, 2020), injuries in particular, have different dimensions. Because of their characteristics (Aguilera-García et al., 2020), the lessons learned from other transport services might not directly be translatable to MSS management. Consequently, there is a glaring need for more research into MSS.

It must be borne in mind that, to date, the scarce academic literature on MSS has mainly been focused on characterising the sociodemographic profile of their users (Aguilera-García et al., 2020, 2021), assessing their spatio-temporal dimension (Arias-Molinare et al., 2021; Bach et al., 2023; Pérez-Fernández and García-Palomares, 2021), or determining the motivations for using these services (Eccarius and Lu, 2020; Gilibert and Weymar, 2022). According to these articles, MSS are more frequently used by young high-income men and tourists, and more often for personal reasons with sporadic frequency, rather than for commuting to work or college. MSS are generally offered with a pay-per-minute fare (about 18 cents/minute) and can provide door-to-door service, thus gaining comfort and speed, compared to public transport, but with a maximum speed of 45 km/h.

To date, to our knowledge, no studies exist on how to regulate MSS services, as the bulk of literature on the subject of micromobility regulation has only focused on other means of transport with similar characteristics, such as bike-sharing (Laa and Emberger, 2020; Nikitas, 2019; Wang et al., 2020; Winslow and Mont, 2019; Wood and Hamidi, 2019), carsharing (Akyelken et al., 2018; Dowling and Kent, 2015), or e-scooter sharing (Anderson-Hall et al., 2019; Moran et al., 2020; Sareen et al., 2021). However, in those studies, even if the roles of the private and public sectors are generally explained, there is a lack of clarification about how regulation can generate a shared micromobility that would ensure service equity, notwithstanding understanding how PPC schemes can help to achieve that goal.

2.2. MSS PPC models in European cities

Despite the lack of scientific evidence on the subject, some European cities have started to regulate these services using different approaches to PPC with private MSS operators. Summarised below are the three more common PPC models, which mainly differ in their approach to MSS regulation, in terms of the number of operators and the number of vehicles permitted within city limits.

Model 1, which can be summarised as “capped vehicle licenses, uncapped number of operators”, is the one being implemented in Barcelona (Barcelona City Council, 2019) and has no similar reference in Europe. This model restricts the number of vehicle licenses, in order to ensure controlled occupancy of public space, but it does not limit the number of operators, as it considers that the freedom for private companies to carry out an economic activity cannot be deprived. To avoid monopolistic situations, the model distributes the licenses to a minimum of three operators. As a result, the more companies there are that opt for licenses, the fewer vehicles each operator will be able to deploy.

Model 2, which is a “regulation based on *numerus clausus*” model, is implemented in some French cities, such as Paris (Mairie de Paris, 2021), under a national law “*d’orientations des mobilités*” (Parlement français, 2019), as well as in Amsterdam, with a two-year pilot test (Gemeente Amsterdam, 2022). This regulation is also based on limiting the occupancy of public space, with a maximum number of licenses. However, in this case, a limited number of operators (*numerus clausus*) is selected according to technical criteria. The aim is to provide a higher quality service to the users and to guarantee the economic viability of operators.

Finally, Model 3, which can be labelled as a “*laissez faire* policy”, is found in both Madrid and Berlin. It is characterised by the absence of any specific regulation (Stadt Berlin, 2022), but there is an open dialogue between operators and the local administration in order to address the most relevant issues, such as parking regulations or road safety policy. In the case of Madrid, only a slight modification of the mobility ordinance was carried out, to minimally safeguard public space (Ayuntamiento de Madrid, 2021).

Although these three models of regulation are the most prominent in European cities, the reality is that there is no scientific evidence to back

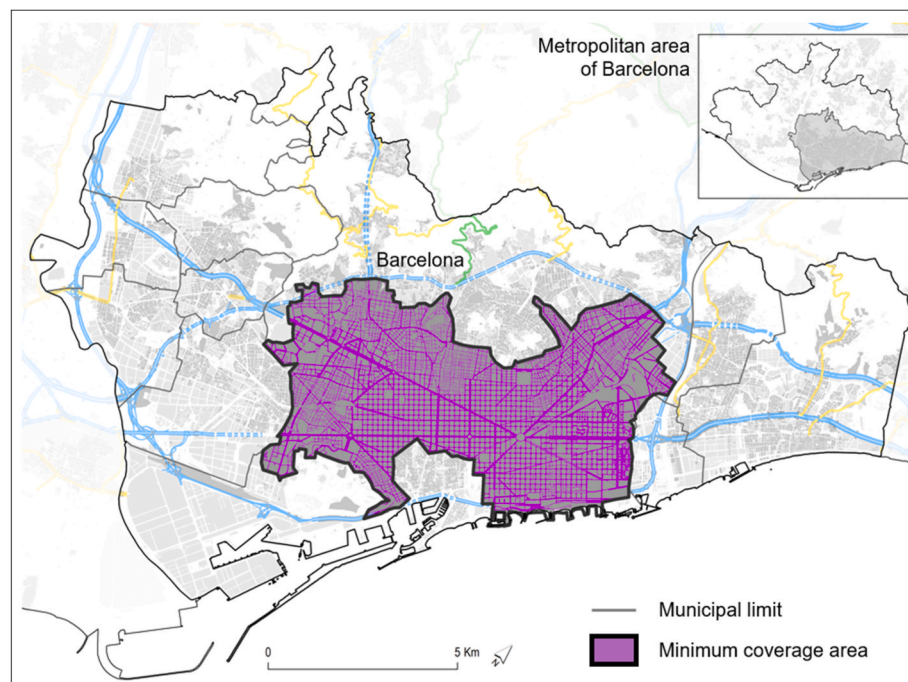


Fig. 2. Minimum coverage area defined by Barcelona City Council regulation.

up the suitability of any of them, which leaves cities to experiment and come up with the more efficient models through a costly trial and error process.

3. Methodology

3.1. Context: Barcelona's MSS regulation

The study area of this research focuses on the City of Barcelona, which has approximately 1.6 million inhabitants (IDESCAT, 2021) and the highest two-wheeled motorisation rate of all European cities (Marquet and Miralles-Guasch, 2016); in that, in 2020 there were 403 motorcycles per 1000 inhabitants (IDESCAT, 2020). The moped and motorcycle modal share in one working day is about 6.2% (EMEF, 2019, Working Day Mobility Survey). In Spanish urban areas, motorcycles and mopeds are used interchangeably for similar uses, and for this reason, in this article the Spanish term “moto-sharing” will often be used when referring to MSS.

In this context, in 2016, Yego and Cooltra were the first MSS companies to settle in Barcelona, where their start-ups were founded, while taking advantage of the synergies offered by the largest technological and digital ecosystem from the South of Europe (Galtés, 2020). They began offering the service without a municipal licence. Barcelona City Council only imposed a minimum road safety standard and requested that the companies obey parking regulations. Three years later, in 2019, two new operators, Actiona and Movo, started offering their services in the city. During these years, other companies such as Scoot, Motit, Muving, and Outo also tried to introduce services in the Barcelona area, but they ended up leaving the city, or even running out of business.

Shortly after, the MSS, which put some pressure on the question of public space, began to raise concerns among administrations. Consequently, in 2018, Barcelona City Council started to conceive a regulation for the sector, based on the use that these vehicles make of the public space. The main goal of this regulation was not only to avoid over-occupation of public space, but also to ensure satisfactory road safety levels for both the users and the citizens (Barcelona City Council, 2019). The regulation was concluded in 2020, with a system based on non-transferable licenses, thus setting a precedent, and often a path for other European cities to follow. This regulation made Barcelona a pioneer in proposing a new regulatory framework of public-private collaboration (PPC) with the purpose of developing the service in an appropriate way. Following that regulation, Barcelona City Council restricts the operation of shared mopeds to a total of 6958 licences, and to avoid a monopoly role, it imposes a maximum of 2319 licences per operator. As a result, the eleven private operators were given 632 licenses each, with permission to provide services for a period of three years (plus one optional year of extension) (Barcelona City Council, 2019). The license is conditional on the payment of a tax. Operators are obliged to provide the service over a minimum coverage area (70.3 km²) and they are not allowed to concentrate more than 50% of the fleet in the more centric area of the city.

This regulation has led to some criticism from the moto-sharing sector (Howe, 2020). On the one hand, companies that were already operating in the city had to reduce their fleet size. On the other hand, licences were also given to companies with little experience and without proprietary technology. Consequently, the market has become fragmented, the economic viability of companies is uncertain, and services to customers have suffered as users need to be subscribed to multiple services.

3.2. Methods

The research approach consisted of semi-structured interviews, which is similar to studies by Butrina et al. (2020), Geffroy et al. (2021), and Wang et al. (2020), of senior experts with experience in Barcelona's MSS regulation. Beginning with a target to achieve 15 fully completed

interviews, we contacted 20 individuals to solicit their participation, with 15 of these requests resulting in an interview.

The stakeholders who were contacted were carefully chosen for their wide knowledge of MSS under Barcelona's regulation. Stakeholder diversity was a crucial selection criterion. Selected interviewees included managers from five private MSS operators, five public officials who are directly involved in MSS or responsible for transportation policies, and five individuals with expertise in both transport management and the micromobility innovation start-up ecosystem (Table 1).

The set of participating stakeholders encompassed 5 out of the 11 MSS private operators in Barcelona (and 3 of them with additional experience in other European cities) and all of the public administrations involved in mobility issues in the metropolitan area of Barcelona.

During the planning phase, we made a design decision to maintain

Table 1
Characteristics of the interviewed sample.

Stakeholder ID	Type stakeholder	Organisation	Position title of interviewee	Date of interview
EX1	Expert	Mobility advisor	Senior Consultant	October 26, 2020
EX2	Expert	European Institute of Innovation and Technology of Urban Mobility	Director	June 2, 2021
EX3	Expert	Innovation and Mobility Consultancy	Senior Consultant	July 20, 2021
EX4	Expert	Centre for Innovation in Cities. Business School	Coordinator	June 3, 2021
EX5	Expert	Digital and tech ecosystem Hub	Corporate Development Director	August 3, 2021
PO1	Private operator	Operator with experience in Barcelona and other European cities.	Co-Founder and Chairman (and writer)	July 13, 2021
PO2	Private operator	Operator with experience in Barcelona and other European cities.	General Manager	July 28, 2021
PO3	Private operator	Operator with experience in Barcelona and other European cities.	City Manager	October 27, 2020
PO4	Private operator	Operator with experience in Barcelona.	Project Manager	November 20, 2020
PO5	Private operator	Former operator with experience in Barcelona.	Founder and CEO	November 10, 2020
PS1	Public sector	AMB (Metropolitan Area of Barcelona)	Mobility Department Project Manager	July 22, 2021
PS2	Public sector	Barcelona City Council	Mobility Department Manager	August 10, 2021
PS3	Public sector	ATM (The Metropolitan Transport Authority)	Mobility Service Manager	July 12, 2021
PS4	Public sector	L'Hospitalet de Llobregat City Council	Mobility Department Manager	July 20, 2021
PS5	Public sector	ACCIO (Catalonia Trade and Investment)	I + D Department Project Manager	July 21, 2021

the anonymity of respondents, in the interests of encouraging free and open discussion (Butrina et al., 2020). Stakeholders ID codes in Table 1 are maintained in the Findings section.

Interviews were conducted remotely between October 2020 and August 2021 and ranged from 30 to 90 min in duration. They were recorded after the interviewees' acceptance. Only one member of the study team participated in each interview. Following the semi-structured interview approach, which is the most used qualitative methodology in Human Geography (Kitchin and Tate, 2000), the interviewer aimed to be knowledgeable, structuring, clear, gentle, sensitive, open, conductive, critical, memorising, and interpreting (Valles, 2007). An effort was made to not judge, and to offer a space of comfort within which the interviewees could openly speak (Clifford et al., 2003). The perspective of the interviewees was collected without influencing them with its point of view, and without specifying whether it was for or against what they were saying (Bryman, 2012).

No pre-set questionnaire was followed. Questions revolved around what the most appropriate regulatory model would ensure in terms of social and spatial equity, and at the same time would guarantee the economic viability of companies. In particular, questions on the effectiveness of Barcelona's regulation in meeting these objectives were asked.

In accordance with the work of Winslow and Mont (2019), two pilot interviews were conducted to provide prior training, to check the reliability and validity of the questions, and to outline the issues to be addressed.

Interview data were transcribed mainly in Catalan or Spanish and then translated into English, except for one interview that was conducted directly in English. All interviews were manually transcribed except for the English example, which was automatically transcribed using *Amberscript* software, and supervised by the authors afterwards. To make transcription easier, voice speed was reduced by 50% using the free online *AudioTrimmer* software.

Data were then cross-analysed with the help of *Atlas.Ti*, a computer-assisted qualitative data analysis software, coding the texts into different topics, contrasting the opinions among interviewers, prioritising ideas, and selecting the main contributions for the article.

Our findings gather the experience of a variety of stakeholders who are dealing with MSS, and the results will be valuable to other cities which are considering regulating these services.

4. Findings

The section synthesises findings from the interviews, and discusses the strengths and weaknesses of each of the regulatory models that were considered during the conversations with the experts.

Firstly, the Barcelona regulatory model is examined. The discussion then moves on, to pose questions regarding two more regulation models that have been suggested by some private stakeholders which operate in this way in other European cities, but have also been questioned by other interviewees. Finally, the pool of interviewees reflects on the value of a service based on a close public-private partnership, a regulation model that has not yet been implemented in a MSS, but is very common in the case of bike-sharing services (BSS).

4.1. Model 1: capped vehicle licences, uncapped number of operators

The Barcelona model, based on offering a limited number of vehicle licenses, but with no limit to the number of operators, is a highly contested model. Policymakers who are responsible for generating this model, have defended it under the premise that it was the only model that could enable neutral competition between private operators, while also safeguarding the use of public space by not overcrowding it with an unlimited number of vehicles. The municipality saw a preeminent need to regulate an emergent activity that could affect the conditions of the urban public space: *“regulation, in essence, administrates the use of public*

space to carry out a particular economic activity” (PS2). However, the city council did not believe it had the power to intervene in limiting the economic activity of certain companies, as it would violate the principle of freedom of competition. They thus chose to focus on a mechanism that could keep the number of vehicles under control: *“we wanted to limit the number of licenses because we did not want any backlash for citizens if there was an overcrowding of public space. That would have led to the service never succeeding”* (PS2). The Barcelona model is the easiest path towards MSS regulation, by effectively capping the number of vehicles in circulation but not the operator market. The municipality effectively regulates the end result of the service, based on the estimated load capacity of the public space: *“we calculated the parking capacity of the motorcycle, and what percentage of these spaces were occupied. A fragile area of the city, the most central area, was delimited, and the excess capacity that could be occupied by moto-sharing was calculated. We also estimated the number of mopeds that the city could absorb without saturating the public space”* (PS2). While this model is not without challenges (i.e., how to set the exact number of vehicles, and how to manage the license acquisition processes), it does save public regulators from having to delve into defining the specific conditions, that companies need to meet to be allowed to operate in the city. Most importantly, it also avoids future free-competition complaints and legal challenges from the side of the operators, and offers an end-result oriented process that is often beneficially viewed from the public opinion perspective.

The model, that in the specific case of Barcelona has led to 6958 licenses being distributed among 11 operators, causes, however, inconveniences on the operation-side of the service, as demonstrated by the negative issues that were raised by other interviewed stakeholders and experts (PS1, PS2, PS4, PS5, PO1, PO2, PO5, EX1, EX5). These issues can be grouped into three main topics: the excessive number of operators, the appearance of opportunistic operators, and the non-compliance of regulation.

The matter of the exact number of vehicles allowed in the city, together with the involuntary incentives posed by the model in order to spawn irregular practices, was central to the discussion with stakeholders. In retrospect, some public sector interviewees (PS1, PS4, PS5) conceded that the regulation had created a situation with too many operators: *“It is evident that in Barcelona, there are too many operators”* (PS1), or *“I don't think there is a market for so many companies”* (PS4). Having up to 11 service providers operating in a capped vehicle-licence regulation environment often means excessive fragmentation, and can thus jeopardise business viability. While some operators acknowledge the motivations and factors behind the city council decisions, in understanding the need to not limit competition and to not disturb regional and national competition authorities (PO1), there is some consensus (PO1, PO2, EX1) on the fact that the uncapped number of operators generates a negative incentive towards the creation of opportunistic operators. These members are those that apply for several licences with only speculative intentions, and with no real interest or capacity of providing an actual service. A model based on managing only the number of licences does not consider technical criteria (such as data management, users' safety, or logistics capacity), and tends to not screen for operators' conditions. It thus promotes the appearance of such operators having no technology or infrastructure, as well as no previous experience. One expert added that *“the criteria for selecting the operators should have been stricter and more rigorous and should have granted a right to operate only to those operators that could guarantee a minimum level of quality and experience”* (EX1). In the same way, but in the railway sector, Montero (2019) found that asymmetric regulation for competition in European railways could also attract opportunistic operators and create inefficiencies against the interests of consumers and low levels of investment in innovation.

The result of the appearance of opportunistic operators, that competed on an equal opportunities basis with more established operators, was that some companies with a significant background in the city ended up having fewer licences. This meant that some of them had to

even reduce their vehicle fleet size (EX5). On the other hand, the goal of these opportunistic operators was to solely obtain a licence, and then take advantage of another operator that would provide the service. One opportunistic operator revealed: *“I saw the business opportunity with licences, which have a value, just like the licences of my tourist apartments”* (PO5). Another operator, in discussing their competitors, stated that *“the purpose of some companies was to obtain a licence and to then put themselves under an operator, since they do not have the know-how or experience regarding moto-sharing service operations”* (PO2).

Both, the appearance of opportunistic operators and the pressure of maintaining levels of service with a reduced fleet, have led to some non-compliance issues. As reported by the City Council Mobility Management: *“Private operators have ended up in breach of the regulations, putting in the street more vehicles than allowed. There were geolocated vehicles only in the private apps and not in the public MAAS. The operators were even using algorithms to falsify data and send us only one part of the necessary data, setting aside the data from other vehicles only for use on their private app”* (PS2). Primarily, these dynamics result in harming free competition, and may end up invalidating the municipality goal of controlling the number of vehicles in the public space, as operators are pressured to break the regulations and increase their fleets in order to be economically viable.

4.2. Model 2: A regulation based on *numerus clausus*

In several discussions, the *numerus clausus* model (that is implemented in Paris and Amsterdam) emerged as a true alternative to Barcelona's regulation model (PO1, EX2). As the interviewees stated, the local administration should put technical prescription of the vehicles into regulation, as it enables to increase the overall quality of service: *“Shared micromobility services only make sense, both for the user and the operator, when they have enough market share, and this is only achieved by limiting the supply. The service should be offered by the operators that are able to provide the best service, maintain the best technology, or can guarantee the best security to users”* (PO1). This opinion aligns with the idea of Cohen and Kietzmann (2014), that a merit-based business model may offer a more optimal alignment between service provider and local government goals.

Participants, however, also recognised two main issues with this model, mainly revolving around its lack of efficiency. EX4 and PO1, for instance, warned about potential monopoly or oligopoly situations, that could lead to price setting practices (or to distortions in prices), and the associated negative effects, such as poor level of service and social exclusion (Moscholidou and Pangbourne, 2019). Handing the control of the market to a selected group of companies could also disincentive further competition and technical innovation, as operators would have fewer incentives to introduce novelties and service-upgrades: *“A monopolistic or oligopolistic market generates price setting and a decrease in the quality of the services, and users are the most affected”* (EX4). This is evident in the case of e-scooters in Paris, where price setting is outside the sphere of influence of local authorities (Latinopoulos et al., 2021).

Public intervention on price has long been regarded as a solution for price setting and anti-competition tendencies, in particular, in urban public transport, in which prices are widely subsidised (van Goeverden et al., 2006). Such interventions, however, are highly contested by private operators (PO1) who consider that, for now, shared micromobility is still a commercial service and public authorities do not have the right to regulate prices. The decision on whether the public sector needs to intervene on micromobility prices is rooted in the debate on whether, or not, this transport service should be assumed as public transport. The contribution of micromobility innovation to making transport sustainable is unclear (Sareen et al., 2021). Research is still quite fragmented in relation to the role micro-mobility, as a transformative solution for meeting sustainable outcomes in urban environments (Abduljabbar et al., 2021). However, the decision to not intervene is contrary to social equity, as prices would be subjected to the free market. The public policy called “Shared Mobility as a Social and Environmental Benefit” (Cohen

and Shaheen, 2016) is a good illustration of maximum governmental support, with the condition that shared mobility operators provide social and environmental impact results.

The political decision to not intervene in price setting and management of these kinds of services, however, could have implications in terms of equity and social justice. If prices and service conditions (i.e., number of vehicles, geographic service areas, etc.) were left to be decided by the market, these services would tend to not promote social equity and equal access opportunities. These conditions would limit the use of services among users with less purchasing power.

In terms of the risk of irregular practices, the same expert argued why this model would not be ideal: *“A market system where innovation criteria are required from companies to obtain a concession leads to cheating of the system. If the legislator or the administration must verify that the conditions pass, operators will try, by means of irregular practices or lobbying, to instruct the legislator so that what those operators want, will occur”* (EX4).

4.3. Model 3: A *laissez faire* policy

For some private operators, the most positively viewed model would be one with no regulation on either the number of vehicles or the number of actual operators (as is the case for Madrid or Berlin). That model, which we can label as a *laissez faire* model, is based on a framework of collaboration, and open dialogue between the public and the private sector. Two private operators (PO2, PO3) defended it as the best model for a MSS, noting that: *“the public administration sometimes forgets that MSS operators are private companies which do not receive subsidies and, therefore, they have to make profits from their economic activities. The more freedom they have, the better service they can offer, because they will try to make the motorcycles move as much as possible, so it would definitively mean that citizens will be receiving a better service”*. Furthermore, the same operator (PO3) cites the case of Madrid (a well-known case of *laissez faire* approach by MSS operators) as evidence that MSS does not cause problems of saturation of the public space, even in a context of the absence of regulation. MSS is highly successful in the Madrid scenario since 2018 (Arias-Molinares and Carlos García-Palomares, 2020), but the service area changes depending on the operator (Aguilera-García et al., 2020). In this sense, an expert (EX2) supported the idea that these businesses are only profitable if vehicles are moved for a minimum of 3–5 trips a day. The other private operator (PO2) is convinced that, without the regulation process, opportunistic operators would not have appeared, and the market would end up being self-regulating, giving rise to a market with 3 or 4 companies.

Despite some private operators being overwhelmingly in favour of these *laissez faire* approaches, other participants highlighted three negative aspects: problems of saturation of public space, citizens' negative perceptions of these services caused by this saturation, and failure to guarantee an equal spatial service level, which can lead to specific neighbourhoods being left out of the service due to insufficient demand. When confronted with the issue of public space occupation, private operators admitted the need for minimal regulation, in order to avoid the issue, but framed the problem as a simple matter of not coming into conflict with the rest of the means of transport (PO1, PS2). This need for minimal regulation would also help on the matter of public acceptance, as posed by one participant: *“if parking is not regulated, citizens could perceive shared vehicles as an enemy of the role they play in the transformation of public space in mobility. If pedestrians begin to perceive them as a hindrance or a nuisance, they will be in conflict with them”* (PS2). This perception is similar to those perspectives reported by Butrina et al. (2020), which explain the reason why municipalities are adapting to the new pressures of their kerbside caused by the growing demand of emerging micromobility services.

With respect to shared micromobility deserts, the term used by Zhang et al. (2021) which means “areas with limited mobility services that constrain people from accessing services and opportunities”, experts and public sector agreed (EX1, PS4) on the need for regulation to avoid

underserved areas and that they only offer services in the central or more populated areas: “When a private operator wants to offer a service, it should offer it to the entire territory. Serving all citizens should be above any private interest. The administration might have to contribute financially when the deficiency in an area is proved” (EX1). In the *laissez faire* model, access to these services would be left in the hands of private operators, that could define their service areas based on market preferences and would have no incentive to guarantee equal levels of access throughout the city. This model contrasts with that of Sherriff et al. (2020), who highlights the importance of private operators being sensitive to the social and physical geography of cities, and of engaging with existing bodies, including transport authorities and local authorities, in co-creating the service.

4.4. A close public-private partnership

After recognising the advantages and disadvantages of the Barcelona, Paris-Amsterdam, and Madrid-Berlin model, a number of participants (EX2, EX4, PS1, PO1, PO4) offered a solution involving compromise, based on a mixed model that could integrate the needs for the private operators with the demands of the public administration: “These services require public support, because even though they are run by private companies, citizens also benefit from them” (EX2). That solution would depend on a closer collaboration between the public and private sectors, and would involve a trade-off between the private sector guaranteeing service area minimums or price maximums, in exchange for the administration offering financial contribution and assistance in order to support these services: “Working hand in hand with the administration allows MSS to be considered as an additional transport service, and at the same time the operators do not lose money” (PO4). Two interviewees (PS1, PO1) defended a collaboration that is similar to those collaborations that already exist in public transport: “I imagine a future with few operators and a close relationship with the administration” (PS1) or regarding public bicycles services: “the public bicycle concession model should be replicated for a MSS” (PO1).

In a close public-private regulation model, the risks of creating a monopoly market (model 2) would disappear. According to an expert: “It is better to provide the service directly by the public sector than to create a monopoly market” (EX4). He also proffered the idea of creating a public actor with 10–15% of the supply, which would establish a minimum quality of the service, and influence the market, so that private operators would be motivated to improve their service quality (EX4). He suggested that, eventually, the public sector could offer the service in collaboration with a Spanish motor vehicle manufacturer, as a strategy to replace private vehicles with shared vehicles and, consequently, guarantee a reduction in the number of parked vehicles in the public space. This idea connects with the *Entrepreneurial State* concept of Marianna Mazzucato (2015), which underlines the strategic role of public investment in technological innovation processes, and the need to build public-private partnerships in which the safeguard of the collective interest is maintained.

Despite recognising the potential benefits of such an approach, two public sector interviewees (PS1, PS3) were reticent about this model. “It would be difficult to find a cost-benefit balance” (PS3), admitted one interviewee. “The costs of a MSS contract are enormous and no previous experiences are known” (PS1), stated another interviewee.

In summary, it remains to be seen how this model, which is the only model that can answer important questions regarding a public transport service (i.e., the economic viability of operators and social and spatial equity), justifies the high public sector spending. With BSS, equitable systems seem to be achieved only when funding alliances between the public and the private sectors have been generated (Tiznado-Aitken et al., 2021). However, to our knowledge, no similar experience exists regarding MSS, which would cast doubts in terms of its applicability in the case of MSS. Going beyond that, while a strong consensus exists among many municipalities on the fact that bike-sharing is a positive

step towards making the transportation system more environmentally sustainable, to date, no such consensus exists in the case of MSS. This makes it difficult for the public sector to justify entering into a hefty public-private agreement to promote and maintain these kinds of services. Finally, and as Laa and Emberger (2020) point out, should a municipality be interested in pursuing such a collaboration, then it would still have to forge and implement the proper regulation to ensure that the private operators are not externalising costs by demanding public resources to maximise private profits.

4.5. MSS regulation complexity

The four regulatory models presented above are significantly different from each other, but they are a good example of the complexity involved when considering regulating shared micromobility services in terms of social and spatial equity. Diversity of opinions between the different actors has been very high and up to four different models of regulation have been defended. Surprisingly, not all of the opinions of private operators were common and completely contrary to those of the public sector, but within the group of private operators themselves there were completely opposite views.

All participants seemed to agree that the regulation process and settling on one specific regulation model would benefit from a longer period of discussion. Representatives from the public sector, private operators, and experts all (PS1, EX4, PS5, PO2, PO3) weighted on the need for more pilot tests in order to gauge the new innovations and regulations. For some private operators (PS5), the city should have engaged in a trial-and-error process before deciding on one particular model: “The ideal fit is a progressive work based on trial and error” (PS1). This view, however, contrasts with the public calls made by operators for the city to rush the planning process and allow them to start providing the service. It is a policy perfectionism perspective that is commonly found in other transport policy initiatives, and has been identified by Lamb et al. (2020) as one of the main sources of discourses of climate delay. There is a middle term, in which cities can even focus on a dynamic regulation, that is permanently repositioning, in order to focus on the end users of these emerging mobility options (Goldsmith and Leger, 2020).

5. Conclusions

This study examined the public-private collaboration in MSS in Barcelona from the perspectives of the actors involved in that regulation, and assessed the positive and negative aspects of regulatory alternatives implemented in other European cities. The discussions focused on analysing how the regulations can guarantee social and spatial equity, regarding accessibility to the service, while at the same time preserving the long-term economic interest of private operators.

Using semi-structured interviews, we analysed the three most popular models of MSS regulation in terms of equity, accessibility, affordability, and economic viability. The consensus among the consulted stakeholders seems to be a close public-private partnership model, with greater management and control capacity by the public sector. However, this model may imply the need for implementing considerable political will, as it involves significant public spending and commitment on the part of the administration. Because of that, this model is likely only a realistic option in those cities which are already convinced of the positive impacts of MSS, would wish to deploy it as an integral part of their transportation system.

To date, no such examples exist in the case of MSS since, there is insufficient evidence to claim that these services offer a net benefit in terms of social or environmental sustainability. Most importantly, there are certain barriers to accessing these services, which challenge the idea that MSS can improve accessibility and transport for more disadvantaged groups. Firstly, to use them, one must have a driving licence and be over 18 years of age. Secondly, MSS are more expensive than public

transport (Arias-Molinares and Carlos García-Palomares, 2020), which suggests that they are not affordable for everyone. Further, there are no tested ways to subsidise vulnerable people for using them, as occurs with social fares in urban public transport. In addition, motorbikes and mopeds are still very associated with high levels of severe casualties in traffic accidents (Albalade and Fernández-Villadangos, 2010).

Overall, more research is needed to justify economic public funding for implementing a regulation model that could guarantee equal service levels across all of the municipality area. An *ex-ante* Cost-Benefit Analysis (CBA) should be conducted in order to estimate the economic, environmental, and social return of the public investment. Converting a private service into a public sector is not a novel action in the transportation sector, as many transport innovations in the past started as private businesses to be later incorporated into the public sector, when it was clear that they provided a basic public interest. For example, at the end of the 19th century, in Barcelona, private tramway lines were nationalised to provide public service to the citizens and allow the government a larger role in management decisions (Castillo, 1960). Most recently, BiciMad, a public company in Madrid, started a free-floating BSS after some private operators had abandoned the city, because a similar service had failed. However, to date and to the best of our knowledge, no MSS service has been incorporated into any public transportation system. The subsidies dedicated to public MSS services would probably exceed at least the 22M€/year currently invested on docked BSS in the Metropolitan Area of Barcelona, since MSS have higher fleet redistribution expenses and higher vehicle manufacturing and maintenance costs than BSS. In the case that a public MSS is finally implemented, an *ex-post* CBA would also be a useful method to evaluate the degree of fulfilment of the initial predictions and goals.

Our results offer insight into how current public-private collaborations in MSS regulation design are still overly dedicated to avoiding over-occupation of public space or ensuring road safety levels for both users and non-users. While MSS are certainly gaining popularity, thanks in part to the COVID-19 pandemic effects (Gilibert and Weymar, 2022), cities are still debating whether to include them as part of the transportation system and as a true alternative to the private car.

6. Limitations

Despite the plurality and expertise of the people who were interviewed for this article, only experts based in Barcelona could be consulted. However, the regulation of Barcelona has been very controversial and well known within the sector, and the interest in it being disseminated was very high, both at the academic level and among policy-makers. Few cities have as much experience and long-term tradition in motorcycles as Barcelona, hence, the opinions of the stakeholders might be considered more valuable than in other cities.

CRedit authorship contribution statement

Author I: Conceptualisation, Formal analysis, Methodology, Investigation, and Writing - Original Draft. Author II: Conceptualisation, Writing - Reviewing and Editing, Supervision. Author III: Conceptualisation, Writing - Reviewing and Editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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