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Digital platforms for mobility services: Analyzing the current market landscape and European regulatory efforts

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Abstract

This paper analyses multimodal mobility platforms which enable the matching of supply and demand for transportation services, including new forms such as ride-hailing, ride-pooling, or vehicle sharing. Typically, such platforms appear as mobile applications (apps), sometimes evolving into "super apps" that even include non-transport services. This paper aims at answering the following research questions: (1) Which digital mobility platforms dominate the global market and how can they be characterized?; (2) What economic impacts can be expected for mobility companies from a possible EU regulation to facilitate platform-based bookings and multimodal travel (e.g., the EU Multimodal Digital Mobility Services (MDMS) initiative)?; and (3) Which overarching recommendations can be derived for policymakers concerning such a possible regulation? To investigate these questions, we first identify and characterize the most important mobility platforms based on data from an analytics firm for the mobile app market. The characteristics considered include platform usage, the number of integrated mobility services, and the countries in which they are operated. We then analyse statements from stakeholders collected during a public consultation on the EU MDMS initiative to identify significant SWOTs (strengths, weaknesses, opportunities, threats) for individual stakeholder groups in connection with such a possible future EU regulation. Based on this, we derive regulatory recommendations for policymakers.

1 Introduction

In the transport sector, digital business models for mobility services, such as ride-hailing (e.g., Uber, Freenow), carpooling (e.g., BlablaCar), or car-, e-scooter, or bike sharing (e.g., Lime, Tier), have become indispensable. After the year 2010, the majority of such business models started operations due to the rapid development of mobile applications and the spread of smartphones (Mitropoulos et al., 2021). Many of them increased their user numbers significantly, and some operate internationally and now have millions of users worldwide. For example, in 2022, Uber had 131 million active platform users, BlaBlaCar had 26 million active members, of which 6.5 million were drivers, and Lime had 4 million active riders (Lime, 2023; Uber, 2023; VNV Global, 2023).

Among other advantages, these applications enable the sharing of rides with other, mostly unknown people at the same time (e.g., ride-sharing, carpooling) or the sharing of vehicles on a short-term basis by using them one after the other (e.g., carsharing, e-scooter sharing). By employing intelligent algorithms which, among other things, pool ride requests from passengers and match them with drivers, attractive offers with high service quality can be built up in real time and "on demand". This enables a greater mobility individualization compared to today's still mostly rigid public transport system. Often, such applications can be referred to as platforms offering different means of transport (e.g., bus, e-scooter, bike, car) provided by different stakeholders (e.g., Freenow), and possibly even different modes of transport (e.g., Omio, Trainline). However, the emergence of multimodal mobility platforms is a more recent phenomenon. While digital apps for the use of individual means of transport, such as cabs, dominated in the beginning of the 2010s, apps enabling the use and combination of different means and modes of transport have been growing in relevance over the last years. In some world regions, this development is currently continuing up to so-called super apps, which can link mobility platforms with services of non-transport industries such as food delivery (Hasselwander, 2024a; Hasselwander, 2024b).

Mobility platforms can be understood as digital market places for mobility services. In this paper, digital platforms in general and platforms for mobility services in particular are defined by the following main characteristics, predominantly based on Täuscher and Laudien (2018):

1. Digital platforms connect independent actors from a demand and supply side (Bakos, 1998). Independence requires, for example, that suppliers have considerable freedom in the design of the goods and services they offer and are not mere subcontractors.
2. The actors enter into direct interactions to initiate and realize commercial transactions, facilitated by the platform which may, for example, fulfil the payment process.
3. The platform provides an institutional and regulatory framework for transactions. This criterion excludes, for example, flight comparison websites and other meta search applications that only provide links to the actual booking opportunity.

In contrast to Täuscher and Laudien (2018), however, we adopt a broader definition of platforms in this paper and also consider service providers that produce a significant part of the goods or services themselves. An example are public transport operators that also integrate third-party transport services (e.g., e-scooter sharing) into their mobility apps (e.g., Jelbi and hvv switch in Germany). Furthermore, our platform definition includes not only B2C but also C2C platforms that follow the “sharing economy” concept, such as peer-to-peer car sharing platforms (e.g., Snappcar).

Mobility platforms have the potential to lower transaction and search costs (e.g., in bundling all transport options in one app), to increase comfort and reliability, and to generate time savings through increased connectivity. In addition, platforms can increase competition between mobility providers by offering users a clear comparison of the various mobility alternatives and providers. As a result, (locally) dominant mobility providers, in particular, may have no interest in having their products integrated into third-party platforms. Policy regulation that requires mobility providers to allow their products to be integrated into third-party platforms under defined conditions could therefore generate benefits for consumers. In the EU, the ongoing Multimodal

Digital Mobility Services (MDMS) initiative aims to materialize in a proposal for a regulation to integrate various modes of transportation (such as rail, road, air, and sea). This is to be achieved through digital technologies, as "planning and buying tickets for journeys that combine different modes of transport can be cumbersome" (European Commission, n.d.). The initiative shall foster the development of digital platforms or systems for seamless coordination, booking, and tracking of transportation across different modes. This is planned to enhance the efficiency, accessibility, and sustainability of transportation by providing users with easier access to information, smoother connections between modes, and optimized routes. Overall, the MDMS initiative seeks to improve the overall experience and effectiveness of multimodal transportation networks. A public consultation ran from December 2021 to February 2022, and adoption by the Commission was planned for Q1/2023, but has still not happened at the time of writing (July 2024). While the introduction of such a regulation may indeed increase transparency and improve the booking process for customers, it could be seen as a strong market intervention in case providers have to make their services available on third-party platforms.

Against the backdrop of these ongoing regulatory efforts and the dynamic developments in the platform market, this paper aims to answer the following research questions:

1. How can the current global market for digital mobility platforms be described? Which are the most relevant platforms, how many mobility services do they integrate, and in how many countries do they operate?
2. What economic impacts can be expected for mobility companies from a possible EU regulation to facilitate platform-based bookings and multimodal travel (e.g., the EU MDMS initiative)? What opportunities and threats arise given the stakeholders' strengths and weaknesses?
3. Which overarching recommendations can be derived for policymakers concerning a possible regulation to facilitate multimodal travel?

Recent studies on digital mobility platforms include, for example, Mitropoulos et al. (2021), Montero (2019), Nourinejad & Ramezani (2019), Stopka et al. (2018), Hasselwander et al. (2022), and Cruz & Sarmento (2020). Thus far, the existing literature has mainly focused on the analysis of individual platforms, the definition of such business models, the network effects triggered by them, and the opportunities and risks of the respective analyzed platforms in the transport sector. In addition, there is a large number of papers on the "sharing economy" concept – which is also key to many mobility platforms. Jiang et al. (2021) provide an overview of definitions in relation to the sharing economy. Gerwe & Silva (2020), for example, define "sharing economy" as "a socioeconomic system that allows peers to grant temporary access to their underutilized physical and human assets through online platforms".

The contribution of our paper to the existing literature is, firstly, an up-to-date overview of the globally prevalent mobility platforms and their key characteristics. Secondly, we contribute to the limited academic literature on the EU's MDMS initiative. To the best of our knowledge, no study has yet conducted a structured SWOT analysis for the affected stakeholders, neither for the EU MDMS initiative nor for comparable regulatory efforts. The results show decision-makers in business and politics what developments can be expected in national transport markets as a result of globally operating mobility platforms. In addition, the identified opportunities and risks of a possible regulation provide a basis for decision making for potentially affected mobility companies and policymakers considering regulation.

This paper is structured as follows: First, Section 2 provides an overview of the currently frequently used mobility platforms and their characteristics. Section 3 discusses the theoretical background of mobility platforms with a focus on their opportunities and risks from a societal perspective. Section 4 analyzes the consequences of a potential regulation for mobility providers and platforms by using the SWOT approach. Recommendations for policymakers and conclusions finalize this paper.

2 Emergence and characteristics of major (mobility) platforms

The Internet has facilitated the emergence of digital platforms with lower transaction costs, higher transaction speed, and larger network effects than non-digital platforms (for a comprehensive overview of these developments see Evans & Schmalensee, 2016). One of the most intuitive examples is the comparison of a traditional flea market (with limited geographic scope and hence a limited range of potential suppliers and customers, mandatory personal presence, and relatively long processing time for each sale) with Ebay or Amazon as C2C, B2C, or B2B online marketplaces. In addition, filtering and algorithm use allow for mass customization, enabling platforms to provide users with only those offers that may be of interest to them (Da Silveira et al., 2001).

Following the rise of Ebay and Amazon as marketplaces for – primarily – physical (consumer and/or non-consumer) goods, other platforms have emerged which – partly – deal with completely digital products such as music and videos (e.g., Deezer, Soundcloud, Spotify, YouTube) or social relations (e.g., Facebook, Instagram). The virtual distribution of travel trade and transportation services is another area which has grown strongly because of lower transaction costs for both sellers and buyers, be it on platforms as defined above (e.g., Airbnb, Booking.com) or not (e.g., direct sales on websites of hotels, airlines, tour operators, or train companies).

For mobility providers, the ongoing process of platformization presents the opportunity to diversify their offerings, both horizontally, by integrating additional mobility services in their platforms, and geographically, by expanding into more countries (Figure 1) (Guyader & Piscicelli, 2019; Hasselwander, 2024a; Hasselwander, 2024b). Mobility services, which a platform may integrate, can be categorized according to service type (transport service, vehicle rental), service flexibility (on-demand, scheduled), and means of transport (Figure 2). The horizontal diversification strategy prompts a critical decision for mobility providers: whether (or not) to develop dedicated apps for each service, each with distinct boundaries encompassing branding, customer base, and value proposition. For instance, the German railway and mobility company Deutsche Bahn offers separate apps for rail services (DB Navigator), carsharing (Flinkster), and bike sharing (Call a Bike).

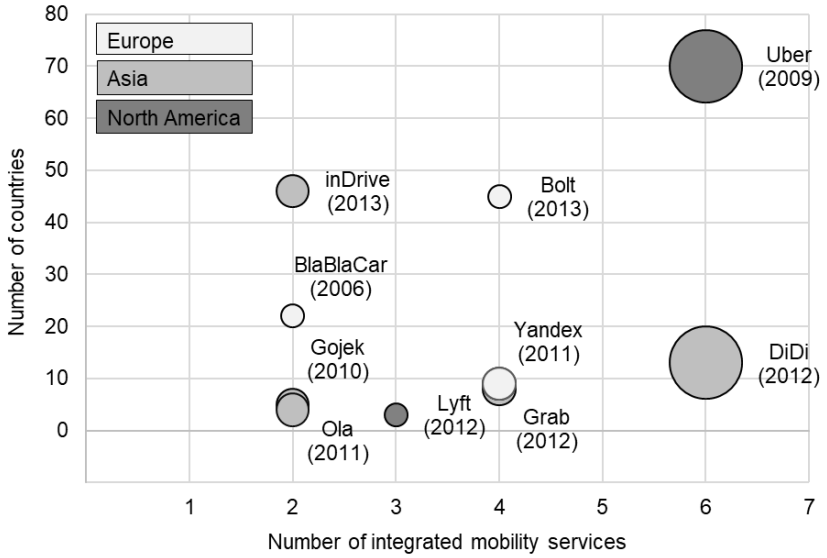

Figure 1. Most used digital mobility platforms
Note: Founding year in parentheses. Not all services might be available in all geographic markets. The size of the circles represents the no. of app downloads in the Google Play store (scale: 1=50M+; 2=100M+; 3=500M+), except for DiDi Chuxing where several sources indicate that it has more than 500M users. The color of the circles represents the geographic location of the platforms' headquarters. Source: Own illustration.

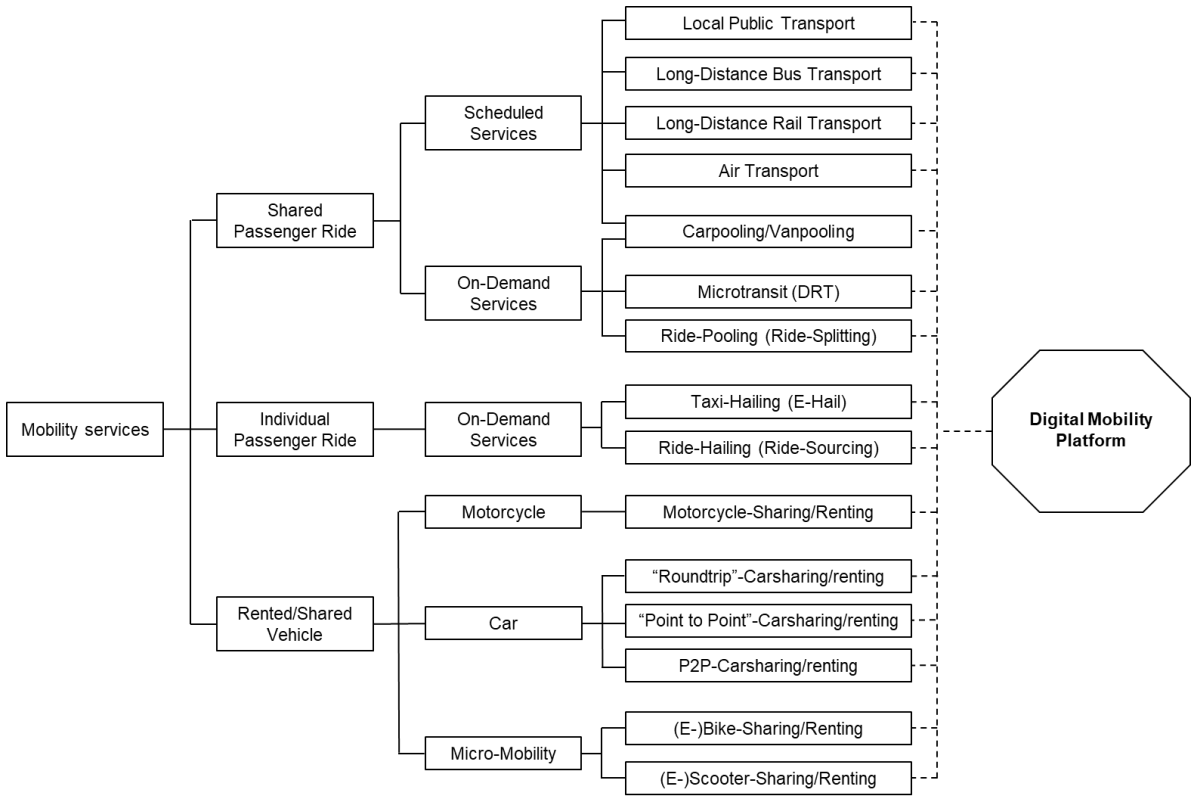

Figure 2. Categorisation of (digital) mobility services
Source: Own illustration, expanded from Hasselwander et al. (2022) and Shaheen and Chan (2016).

Alternatively, providers may adopt a different path, opting to consolidate all their services within a single app under a strong and recognizable brand. This approach, which can even culminate in "super apps" extending into services from other sectors, serves a unified customer base and emphasizes the value proposition of convenience and multifunctionality (Hasselwander, 2024a). Notable examples of this approach can be seen in multinational firms, such as Uber, Grab, Bolt, Didi Chuxing, Gojek, and other major mobility platforms. This strategy of consolidation of services to create integrated and personalized mobility solutions is a concept known in the scientific literature as Mobility as a Service (MaaS) (Hasselwander & Bigotte, 2023; Narayanan & Antoniou, 2023; Scheier et al., 2021), or, in its extended version, Mobility as a Feature (MaaF) (Hasselwander, 2024b; Hensher & Hietanen, 2023). However, it is important to note that while these apps offer users a seamless travel experience and access to other everyday services, they also symbolize market dominance driven by network effects leading to winner-take-all scenarios and monopolistic concentration (Thelen, 2018).

The process of platformization is even visible in traditionally rigid sectors such as public transport. In Germany, the "Deutschlandticket", a nationwide flat rate for the use of regional and local public transport introduced in 2023, represents a significant step in this direction. This flat fare ticket is exclusively available in electronic format as an electronic or mobile ticket. However, it is not limited to dedicated apps or apps of regional transport authorities and operators. It can also be booked and seamlessly integrated into multimodal mobility platforms such as FreeNow.

To identify the most important global mobility platforms, we analyse the top 100 most used mobile apps (according to the number of active users) in the Travel & Navigation category in March 2024. The data source is the company data.ai, which provides analyses and market data on the mobile app market (Data.ai, 2024). Figure 1 shows the ten most used mobility platforms that are privately owned and operate multi-nationally. For most of the top-ten mobility platforms, ride-hailing is the core business. However, these platforms typically also integrate other urban mobility services such

as e-scooter and bike sharing. For example, Bolt, Grab, DiDi, and Uber have integrated four or more mobility services into their ecosystems (Figure 1), thereby resembling MaaS-like offerings. In contrast, dedicated MaaS platforms such as Whim (MaaS Global) and UbiGo do not appear on the list, as they failed to scale and, in some cases, even went bankrupt. One notable exception to the dominance of ride-hailing is BlaBlaCar, which operates a carpooling platform and offers intercity bus services. Furthermore, except for BlaBlaCar and Lyft, the most-used apps also integrate non-mobility services, such as food delivery or payments, making them "super apps" and driving a transition to multi-service systems (Hensher & Hietanen, 2023; Weiss & Hasselwander, 2024).

Online travel agencies (OTAs) and other ticket distributors, which primarily sell flight tickets but also train and bus tickets through their apps and websites, could also be considered mobility platforms in a broader sense. Examples based on the top 100 most used apps include Booking.com, Expedia, redBus, Trainline, and Trip.com. However, pure metasearch engines like Skyscanner.com must be distinguished, as flights cannot be booked directly through their apps and websites; instead, they provide “deep links” to transport providers and OTAs. Therefore, they are not mobility platforms by our definition.

In addition, there are major globally operating route and navigation planning services that, like mobility platforms, display mobility alternatives and providers after searching for a specific route. However, as with the metasearch engines, the offers cannot be booked directly via the app or website, so these are not platforms. Major route planning services include Google Maps, the most-used app in the Travel & Navigation category, and Moovit, with a core focus on public transportation connections.

Overall, the observations outlined above can be summarized into three key characteristics of the current mobility platform market: (1) there is a wide range of transport services on offer, with the boundaries between the individual services becoming blurred, (2) some mobility platforms operate in numerous countries and integrate a large variety of mobility services, giving them a dominant position in the global market, and (3) super apps have emerged that combine transport services with non-transport applications within a single app. These market characteristics have far-reaching implications for travel behaviour, competition among service providers, and the need for regulatory adaptation.

3 Theoretical background on opportunities and risks of (mobility) platforms

3.1 Opportunities

Digital mobility platforms, which include MaaS platforms, can have various benefits for users making everyday trips or long-distance travels, as well as for firms and society. User benefits may include better access to information about available transport options, more affordable and convenient mobility, and savings in travel time (Becker et al., 2020; Lyons et al., 2019). Digital mobility platforms present different travel alternatives and providers for a searched route, provide information about travel times and prices, and typically combine several modes of transport to create multimodal trips. While many of these combinations likely involve public transport, others may not, for example, a flight combined with a ride-hailing trip to the airport. Users can then choose the most attractive option from the presented alternatives and book it via the platform, eliminating the need to independently search for each transport provider and its offers. As a result, mobility platforms lower search costs, particularly the opportunity costs of the time spent searching for information (Murati, 2023). Since users stop searching when marginal search costs exceed the expected marginal benefit of continuing the search, mobility platforms can help users make better, more informed decisions, which may translate into travel time savings, more comfortable travel, and lower mobility expenses. However, mobility platforms can not only reduce

mobility expenses by informing users about more affordable mobility options but also by increasing competition between mobility providers through easier comparisons of different offers. This, in turn, can lead to lower consumer prices (van den Berg et al., 2022).

For the rest of society, which is not directly involved in the respective transport process, mobility platforms may generate benefits by inducing a modal shift towards more sustainable transport modes, thereby reducing negative externalities such as emissions and congestion (Becker et al., 2020; Butler et al., 2021; Tirachini, 2020). Planning trips that are to be made exclusively by car, bicycle, or on foot only incurs information costs in connection with the search for the best route. However, this is different for trips that are to be made by local public transport, long-distance rail, and air travel, as there are also different providers, schedules have to be observed, and mobility alternatives can change dynamically over time, such as the availability of sharing vehicles or departure times in case of delays. Mobility platforms can reduce the discrepancy between these search and information costs and thus promote alternative modes of transport to the dominant car, especially in urban transport (Lyons et al., 2019). This potentially reduces the comparatively high negative external costs of car use, such as greenhouse gas emissions, local air pollution, noise, congestion, and accidents, and also lowers the need for parking spaces.

From a welfare-economic perspective, the benefits of mobility platforms also include the profits of the operators (van den Berg et al., 2022). However, if the mobility platforms are owned by foreign investors, a large portion of the profits is not part of national welfare.

3.2 Risks

Digital platforms typically exhibit economies of scale as high fixed costs for platform operation (e.g., app development) are contrasted with low variable costs in platform usage (e.g., additional data traffic) (Brousseau & Pénard, 2007). Additionally, they are characterized by strong positive cross-group network effects, meaning that the attractiveness of the platform to users increases with the number of providers, and vice versa (Brousseau & Pénard, 2007). Mobility platforms, just like other digital marketplaces, can therefore be viewed as intermediaries in two-sided markets (Rochet & Tirole, 2003), with users on one side and mobility service providers on the other. Two-sided market platforms generate revenues by enabling interactions between two sides and try to get both "on board" by appropriately charging each side (Rochet & Tirole, 2006). This can mean, and is quite common, for platforms to charge a zero price on one side and a relatively high price on the other (Rochet & Tirole, 2006). Economies of scale and cross-group network effects can lead to a tipping of the market such that, in the most extreme case, only one monopoly platform remains (Bedre-Defolie & Nitsche, 2020). A mobility platform with market power can, for example, demand excessive commission fees from providers or users, leading to higher prices for consumers and/or lower revenues for providers (de Ruijter et al., 2022; van den Berg et al., 2022). The last point is particularly critical when the mobility providers are self-employed individuals who rely on their income to make a living, such as many drivers for ride-hailing companies. Moreover, market power in the ride-hailing sector can also lead to either inefficiently long waiting times for passengers in an undersupplied market or inefficiently long idle times for drivers in an oversupplied market (de Ruijter et al., 2022). In addition to charging excessive commission fees, mobility platforms with market power may engage in other anti-competitive behaviors, including discrimination, self-preferencing, and exclusionary practices (Murati, 2023; Padilla et. al, 2022). Discrimination can mean that platform operators prioritize high-commission services in the search results and do not display non-commercial, environmentally friendly means of transport, such as walking or cycling. Self-preferencing can become a problem if the platform operator is a vertically integrated firm and distributes its own transport services via its platform. In this case, there may be an incentive to prioritize the own transport services in the search results. Exclusionary practices may involve setting terms and conditions that prohibit mobility providers from selling their products through their own sales channels or other platforms at lower prices.

In addition to economies of scale and cross-group network effects, high multihoming costs are another contributing factor to the emergence of a dominant mobility platform (Bryan & Gans, 2019). Multihoming costs arise for users when they use several platforms in parallel. They typically include the opportunity costs of time if several apps or websites have to be accessed to find and compare mobility options. Multihoming costs also arise for mobility providers if they offer their services on multiple platforms, but these costs may be kept relatively low through automatization. If multihoming costs at the user level are high, customers may prefer to use only one platform (single-home), which weakens platform competition. Multihoming costs are more likely to be accepted if the marginal benefit of access to additional providers and offers is high. For example, it may be worthwhile using different platforms to compare alternatives for an intercontinental flight, where there is the potential to save several hundred euros and multiple hours of travel time, but this is less likely to be worthwhile for an urban e-scooter trip of a few kilometers.

From a societal perspective, there is also the risk that mobility platforms may incentivize users of public transport and active travel modes to switch more frequently to motorized individual transport options such as ride-hailing, thereby increasing congestion and emissions (Tirachini, 2020). Since mobility platforms reduce search costs by presenting all available transport options for a trip, alternatives that are only attractive in a few specific cases are more likely to be considered in users' decision-making processes, rather than being ignored because of the effort required to obtain information about them. Ride-hailing, for example, may be too expensive for most trips, but can become a worthwhile option when public transport services are limited, such as during nighttime hours.

4 Analysis of the opportunities and threats for mobility companies from a multimodal digital mobility service regulation

Regulation that would require mobility providers to share data with third-party platforms and to permit sales of their own mobility services through these platforms could strengthen multimodal travel. In the EU, Regulation 2017/1926 already mandates data sharing by mobility service providers through national access points. Furthermore, the planned EU regulation on multimodal digital mobility services (MDMS) could also enforce mandatory third-party distribution.

To analyze the impacts of such potential regulation on stakeholders in the transportation industry, we conduct separate SWOT analyses for individual stakeholder groups. The basis for these SWOT analyses is the publicly available online stakeholder feedback in response to the MDMS initiative of the EU (European Commission, n.d.) as well as the economic theory on platforms outlined in Section 3.

Feedback on the MDMS initiative was provided by 41 stakeholders, including public transport operators and associations, rail operators and associations, a carsharing association, an on-demand mobility operator association, travel/mobility platform operators and associations, passenger/consumer organizations, public authorities, and other stakeholders such as private individuals. The typical stakeholder feedback spans one to five pages, but some consist of a single paragraph, whereas others extend up to ten pages.

The analysis of the stakeholder feedback proceeds in three steps. First, we filter the responses to include only those from mobility companies and their representative associations, yielding a total of 22 responses. Second, instead of a complete content analysis, for example, according to Mayring (2015), we apply a deductive approach and analyze the responses for substantive opportunities and threats from a stakeholder perspective. Third, we consolidate the identified opportunities and threats at the level of the following three stakeholder groups: (1) publicly-owned mobility providers, including local public transport operators and long-distance rail operators, (2) privately-owned mobility providers, and (3) pure mobility platform operators and comparable service providers (including travel comparison platforms). These stakeholder clusters were chosen based

on the dimensions of ownership (public or private) and vertical integration (mobility service operator or pure distributor).

The following sub-sections present the SWOT results for these three groups, with the corresponding SWOT matrices shown in Figures 3, 4, and 5.

4.1 Publicly-owned mobility providers

Publicly-owned mobility providers, such as local public transport and long-distance railway operators, control a large share of public transport. In their respective geographical region, they usually have a high market share and high political funding and support. Local public transport providers are often protected by law from direct competition, but under the influence of politics, they do not use this market power to achieve or maximize profits, but to facilitate social and environmental political objectives.

Internal	**S**trengths • Large market share in local or domestic transport • High political support and funding • Often protected by law from direct competition to achieve political objectives	**W**eaknesses • Lower IT expertise and innovative power • Inflexibility and rigidity because of classical processes and high dependence on political decisions • Small organizational size in case of municipal providers
External	**O**pportunities • Moderate growth in ticket sales through integration of own services into third-party mobility platforms • Additional commission revenues through sale of third-party services on own mobility platform • Door-to-door mobility services through combination with third-party services • Usage of the mandatory provided data to improve own mobility services and mobility policies	**T**hreats • Intervention of EU into local mobility and the role of local public authorities resulting in a loss of political influence • Increasing competition with third-party mobility services and platforms • Dominant third-party platforms charging excessive commission fees and engaging in discriminatory behaviour towards providers • Loss of direct customer contact, access to customer data and control on pricing, and ticketing • Cost increases due to mandatory data provision
	Positive	Negative

Figure 3. SWOT analysis for publicly-owned mobility providers

As weaknesses, publicly-owned companies often have difficulties attracting professional IT staff due to less flexible labor agreements and remuneration schemes. In addition, the software development process may be slower because of classical bureaucratic routines and dependence on political decisions. Both hampers building own mobility platforms and the integration of third-party services. In addition, especially small municipal mobility providers have a lower critical mass, which does not allow them to benefit from economies of scale and spread fixed costs over a large number of users.

Opportunities for publicly-owned mobility providers generally arise from both, the possibility of selling more tickets by integrating their own services into third-party mobility platforms, but also

of using their own platforms to distribute third-party services, thereby potentially generating commission revenues. In addition, integrating third-party mobility services can enable seamless door-to-door mobility solutions. This is particularly relevant not only for long-distance rail operators but also for local public transport operators that can bridge the first and last mile with micromobility services such as bike or e-scooter sharing. Further, publicly-owned providers and public authorities would benefit from data that are mandatorily provided by mobility service providers and platform operators, as it would allow them to adapt mobility policies and tailor mobility services more closely to people's needs.

On the other hand, the possible intervention of the EU in local mobility is a threat for publicly-owned mobility providers, as it could weaken their influence on local transport policy. Additionally, third-party platforms may increase competition with private mobility providers by providing users with a more complete overview of the available transport options. Another threat is that these platforms could achieve market power through network effects, allowing them to charge excessive commission fees or engage in other discriminatory behaviour, such as preferentially presenting their own services over others. Publicly-owned mobility providers could also lose control over pricing, ticketing, and contact with customers to these platforms. Finally, the effort required to provide data and interfaces to external parties can increase operating costs.

The assessment of the feedback on the EU MDMS initiative shows that public transport operators and associations are generally more critical of the proposed regulation. They point out that the EU should respect the principle of subsidiarity and emphasize the role of public authorities in shaping local mobility with reference to the public service obligation (PSO) regulation 1370/2007. The German association of public transport operators is against a mandatory integration of their members' services in third-party mobility platforms. In France, there is already a regulation with the "Mobility Orientation Act" since 2019, which grants platform operators access to the digital distribution systems for local and regional mobility services. A French association of public transport operators is therefore more in favour of the EU MDMS initiative and sees the "Mobility Orientation Act" as a balanced framework considering both public and private interests and hopes to see a European framework inspired by this law.

4.2 Privately-owned mobility providers

Privately-owned mobility providers operate on their own account and must cover their costs and generate profits over the long term, as they generally do not receive any state subsidies, unlike local public transport providers. However, they are bound by regulatory requirements and are indirectly supported by state-funded infrastructure or transport services that have been put out to tender. These providers include transport companies for bus, train, and air travel, as well as vehicle hire companies for bicycles, e-scooters, and cars.

Ride-hailing providers are also classified as privately-owned mobility providers in this SWOT analysis. Although they are undoubtedly platforms and not operators of transport services, they do create a mobility service by aggregating individual ride offers from drivers. From the customer's perspective, this is perceived as a single, unified service. Therefore, they are to be distinguished from pure mobility platforms, which function solely as digital marketplaces for mobility services, where the various offerings remain clearly distinguishable to users.

One of the strengths of privately-owned mobility providers lies in their IT expertise and innovative power. They attract IT talent through flexible performance-related remuneration schemes and attractive working environments, which is an advantage in the hotly contested market for IT experts. In addition, these companies are characterized by their flexibility and agility, especially start-ups with their entrepreneurial mentality, flat hierarchies, and lean corporate structures. These strengths are advantageous in the development of mobility platforms and the integration of third-party services. Lastly, access to private capital markets and possibly strong investors in the background enable the financing of software development and expansion into new markets.

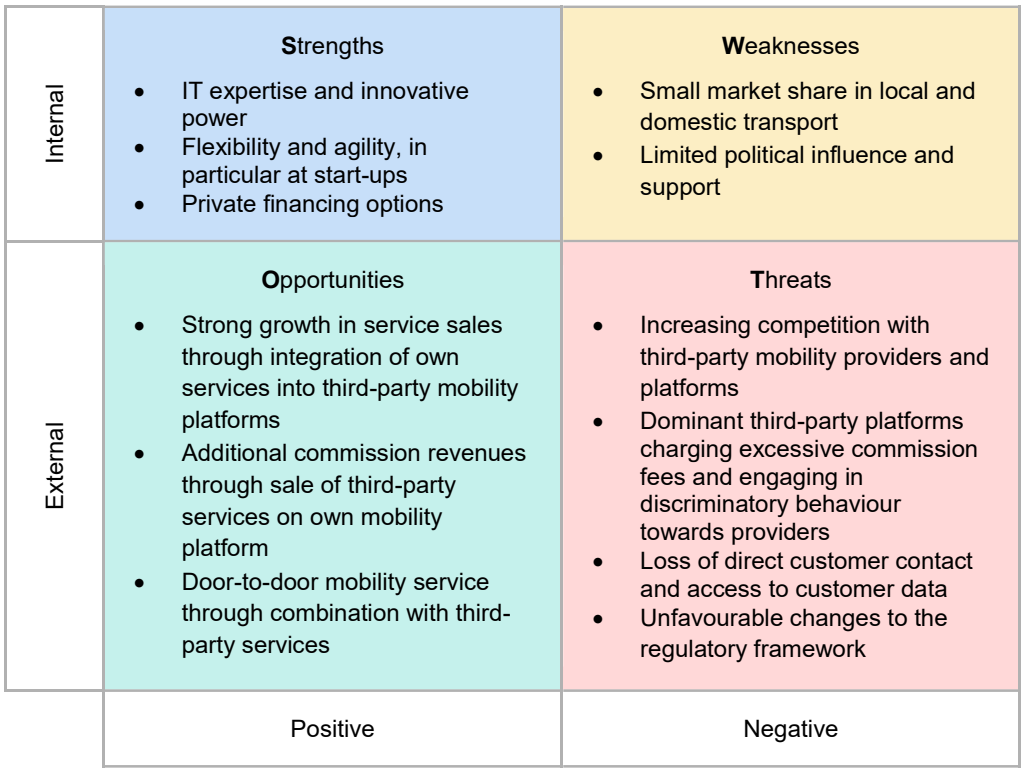

Figure 4. SWOT analysis for privately-owned mobility providers

A weakness of privately-owned mobility providers is their comparatively low market share in local and domestic passenger transport. Consequently, their influence on politics is rather low, although they typically form alliances in politically motivated organizational forms. Moreover, political support for private companies is generally lower, as their profit orientation tends to be viewed critically by the public and contrary to social objectives.

The opportunities and threats for privately-owned mobility providers are generally similar to those faced by publicly-owned mobility providers, but their significance is quite different. Given their comparatively low market shares, integrating their services into third-party platforms presents an attractive growth opportunity that offers substantial potential for increased sales. Additionally, transport services of private transport companies are usually part of multi-modal travel chains; therefore, creating door-to-door mobility solutions by combining their own services with third-party services is a compelling opportunity. However, a significant threat for private providers, due to their limited political influence, is the risk of unfavorable changes to the regulatory framework.

The feedback from stakeholders on the EU MDMS initiative indicates that the majority of privately-owned mobility providers appear to support the initiative, suggesting that the opportunities outweigh the threats. However, the position is not uniform among private mobility providers. While an association of private European rail undertakings is clearly in favor of the planned legislation, an on-demand mobility association, which also represents some large ride-hailing companies, is more critical and rejects mandatory integration into third-party platforms. One possible reason for this could be that these ride-hailing providers may themselves be aiming to become dominant platforms benefiting from network effects.

4.3 Pure mobility platform operators and comparable service providers

Mobility platforms that do not provide mobility services themselves include ticket distributors (e.g., Omio and Trainline) and online travel agencies. In addition, there are comparable service providers that, according to our definition, are not platforms, but could be regarded as potential entrants in the market for the distribution of mobility services. These providers include, for

example, route and trip planners, which already provide information on mobility offers, travel times, and frequencies in their apps and link directly to these offers via so-called deep links.

Pure mobility platform operators share as private companies most of the strengths and weaknesses of privately-owned mobility providers discussed in the previous section. One additional weakness of pure mobility platforms is that they are completely dependent on mobility service providers as partners. Hence, a regulation that would require mobility service providers to open up their products for resale to third parties would enable significant growth opportunities for these firms. By expanding their product portfolio through a variety of mobility services and multimodal combinations thereof, they would become increasingly attractive to platform users, and thus benefit from network effects. Of course, regulation would also make it easier for other companies to enter the market, which is a threat. As a result, business relationships that have been built up with mobility providers over the years would lose value.

	Positive	Negative
Internal	**S**trengths • Innovative power and IT expertise • Flexibility and agility, in particular at start-ups • Private financing options	**W**eaknesses • Small market share in the distribution of mobility services • Dependency on mobility service providers • Limited political awareness and support
External	**O**pportunities • High growth potential in commission revenues through the integration of additional mobility services and expansion into new markets	**T**hreats • Competition from other mobility platforms • Unfavourable changes to the regulatory framework

Figure 5. SWOT analysis for pure mobility platform operators and comparable service providers

As the proposed EU MDMS regulation would essentially only impose obligations on mobility providers, the pure mobility platforms are favouring the proposed regulations, as is evident in the stakeholder feedback. Two mobility platforms and an association of travel distributors support the proposed directive and express concerns that it may not go far enough.

5 Conclusions and recommendations for policy makers

In recent years, digital business models for mobility services such as ride-hailing (e.g., Uber, Freenow), carpooling (e.g., BlablaCar), or car, e-scooter, or bike sharing (e.g., Lime, Tier) have become indispensable, which is a global phenomenon. The majority of such business models started operations after the year 2010 due to the rapid development of mobile applications and the spread of smartphones (Mitropoulos et al., 2021). Meanwhile, many of these companies have increased their user numbers significantly, and some operate internationally and now have many millions of users worldwide.

As stated above, this paper aims at answering three main research questions:

(1) How can the current global market for digital mobility platforms be described? Our research indicates that some platforms have attained a dominant position in the global market through geographical and horizontal expansion. The largest mobility platforms operate in up to 70

countries and integrate up to six different transport services into their mobile apps. With the growing number of transport services on offer, the boundaries between the individual services are becoming increasingly fuzzy. In addition, so-called "super apps" have emerged that combine mobility services with non-transport services in a single app. These market characteristics have far-reaching implications for travel behavior, competition among service providers, and a need for regulatory adaptation.

(2) What economic impacts can be expected for mobility companies from a possible EU regulation to facilitate platform-based bookings and multimodal travel (e.g., the EU MDMS initiative)? In general, regulation requiring mobility providers to share data with third-party platforms and to permit sales of their own mobility services through these platforms could strengthen multimodal travel. In the EU, Regulation 2017/1926 already mandates data sharing by mobility service providers through national access points. The planned EU regulation on multimodal digital mobility services (MDMS) could enforce third-party distribution and thus extend this process. However, the opportunities and possible threats arising from the EU MDMS initiative differ depending on which group of stakeholders the respective companies belong to.

Opportunities arise for mobility providers, both public and private, primarily through additional distribution channels when their products are offered on third-party platforms. For private providers, the opportunities are relatively large because they typically have small market shares in local and domestic transport, and some of their services are little known to the wider public. Additionally, most of these companies can only offer door-to-door transport services through a combination with public transport products. Threats for mobility providers arise from the potential emergence of dominant third-party platforms that charge excessive fees for the distribution of mobility services or engage in other discriminatory behavior towards mobility providers. For public mobility providers, there is the additional threat that the EU-intervention in local mobility will result in a loss of influence on local transport policy. For pure mobility platform operators and potential entrants into the distribution market, the planned regulation presents almost only advantages, as it primarily imposes obligations on mobility providers. Consequently, pure platform operators would have strong growth opportunities.

(3) Which overarching recommendations can be derived for policymakers concerning a possible regulation to facilitate multimodal travel? In principle, transport policy should enable a level playing field for all mobility service providers and platform operators and promote both competition and multimodality. As the current EU proposal would lead to relatively clear advantages for mobility platforms not operating mobility services themselves, there may be a fundamental risk that dominant platforms with market power will emerge. This, in turn, could lead to a loss of competition as well as higher prices and less choice for travelers. Consequently, it may be necessary to expand the planned EU regulation by additional elements. Against this background, we believe it is important that mobility providers have access to dominant platforms and are not prevented from offering their services outside the platform. A price regulation of the mobility platforms' commission fees would also be conceivable, comparable to the debit and credit card market in the EU (with capped interchange fees) or the telecommunications market (with maximum termination rates). A regulated distribution commission would, on the one hand, ensure that consumers do not pay excessive prices, but on the other hand, also ensure that platforms can be operated on a cost-covering basis and do not require subsidies.

Furthermore, we recommend introducing clear regulations on passenger rights when travelers - possibly even unknowingly - combine tickets from different providers and miss connections. The EU offers a comprehensive package of passenger rights for all relevant modes of transport. Corresponding EU legislation was mainly adopted between 2004 and 2011 and is intended to ensure a high level of standardized protection throughout the EU. Key elements are Regulation (EC) 261/04 on air passenger rights and Regulations (EU) 2021/782 and 181/2011 on passenger rights in rail and bus, and coach transport, respectively. Regulations on irregularities in integrated,

multimodal travel chains are not included in the above-mentioned passenger rights regulations, although the EU already called for the legal framework to be supplemented to include multimodal passenger rights in a 2011 White Paper (European Commission, 2011). Hence, it is still unclear which company is responsible for refunding the costs of missed connections in intermodal trips. This is a fundamental question of most multimodal journeys and has to be solved at the European level.

From a broader societal perspective, there is the additional risk that mobility platforms will incentivize users of public transport and active modes to switch more frequently to motorized individual transport services, such as ride hailing, thereby increasing congestion and emissions. While there is some evidence for this phenomenon, it is important to note that the underlying issue lies in the insufficient internalization of the external costs associated with car use. Measures such as the introduction of a congestion charge, higher pricing for parking, or stricter emissions regulations can help internalize these external costs in a targeted manner, thereby contributing to a socially desirable modal shift. Therefore, drastic measures such as a ban of platform-based ride-hailing services do not appear justified.

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Data Access Statement

The stakeholder feedback in response to the public consultation on the EU MDMS initiative is publicly available from the European Commission here. The data on the most used apps are proprietary data from the company data.ai and can only be accessed for the last 90 days and require free registration (see here).

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Use of AI

During the preparation of this work, the authors did not use AI.

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Conflict Of Interest (COI)

There are no conflicts of interest.

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