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IS RIDE-HAILING DOOMED TO MONOPOLY? THEORY AND EVIDENCE FROM THE MAIN U.S. MARKETS

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INTRODUCTION

Since Rochet and Tirole's (2003) seminal paper "Platform competition in two-sided markets", a rich literature about winner-takes-all dynamics in multisided platforms has developed¹. The latter are defined as platforms that operate in "markets in which one or several platforms enable interactions between end-users, and try to get the two (or multiple) sides 'on board' by appropriately charging each side" (Rochet & Tirole, 2006). Some authors argue that in these markets the presence of high switching costs, the impossibility or irrelevance of product differentiation and notably the existence network effects in digital platforms, lead to winner-takes-all dynamics, which poses a threat to competition (Geradin & Kuschewsky,

¹ We will employ along this paper the term "multisided platform" to refer to businesses that are multisided, as the term "multisided market" is ambiguous: sometimes it is used to refer to these businesses and sometimes to refer to the markets in which they operate.

2013; Graef, 2015). Other authors, in turn, have criticized this view by providing arguments that minimize the importance of these factors (Sokol & Comerford, 2016; Evans & Schmalensee, 2017).

The surge in the late 2000s of the so-called ‘sharing economy’ platforms, which have been identified by many authors² as multisided platforms in which the platform is digital, as well as the growth of other types of digital multisided platforms (social media, music streaming, e-shopping, etc.), has revived the discussion on competitive issues related to multisided platforms. The debates have taken two principal directions. On the one hand, scholars, the media and antitrust agencies have taken an interest in allegations of unfair competition practiced by new entrant sharing economy platforms to the detriment of traditional firms in some markets (e.g. Airbnb and hotels, Uber and taxis, etc.). On the other hand, focusing on the (anti)competitive effects of access to data, the discussion on the existence of winner-takes-all dynamics in multisided platforms has reemerged and new arguments have been made by both opponents and supporters of this view.

This paper falls within the latter discussion in the specific context of ride-hailing platforms, which are digital multisided platforms with two sides: drivers and riders. Its aim is to show that, in the specific case of ride-hailing platforms, there are sound theoretical arguments and some empirical evidence to support the view that the appearance of ride-hailing platforms is creating winner-takes-all dynamics in ride-hailing markets. In doing so, we intend to contribute to remediate what we consider to be two weak points of the debate on winner-takes-all dynamics in multisided platforms. On the one hand, most of the debate has revolved around (digital) multisided platforms in general. This ignores the specificities of each type of (digital) multisided platform, which results in general conclusions that draw questionable parallels between heterogeneous businesses (social media, lodging platforms, music streaming platforms, credit cards...) in which competitive dynamics, although sharing common traits proper to multisided platforms, vary considerably. On the other hand, mostly due to a lack of data, there have been scarce empirical contributions to the debate on the existence of winner-takes all markets.

2 See Lougher & Kalmanowicz (2016); Demary, (2014); Hagiu & Wright, (2015) and Evans & Schmalensee (2013).

The paper is structured as follows. Section 1 argues that ride-hailing markets are becoming winner-takes-all for two reasons: product differentiation is not very relevant to carve out market niches and indirect network effects are particularly strong in ride-hailing apps, especially because they are enhanced by the user “data snowball effect” to a larger extent than in other digital platforms. Section 2 provides an empirical corroboration of these findings that builds on available data from the main cities of the United States. After defining the relevant market of ride-hailing platforms, we compare the existent data to show that, as expected in winner-takes-all markets, the market shares of a single firm (Uber) have been increasing to the detriment of that of its competitors’. Finally, we show that Uber’s strategy to conquer these markets seems to be based on predatory pricing and we suggest three ways in which Uber might recoup its losses from predation.

1. AN ASSESSMENT OF THE RELEVANCE OF FACTORS LEADING TO WINNER-TAKES-ALL DYNAMICS IN MULTI-SIDED PLATFORMS IN THE CONTEXT OF RIDE-HAILING

The literature (Kouris & Kleer, 2012; Chen & Tse, 2008) has identified four factors that lead to a winner-takes-all dynamic in multisided platforms, namely: strong direct network effects, strong indirect network effects, difficulty or irrelevance of differentiation between platforms and difficulty of multi-homing in at least one side of the market. Moreover, another factor proper to *digital* platforms in general, the “data snowball effect” (the fact that access to a larger amount of data by a platform helps it improving its services, which in turn attracts more users), has been put forward. In this section, we will present each of these factors and assess to which extent they apply to ride-hailing platforms.

1.1. Network effects and the ‘data snowball effect’

Multisided platforms are characterized by the existence of indirect network effects: the number of users on one side of the market increases the utility of the platform for users on (the) other side(s) of the platform. In

some multisided platforms such as social media platforms, there are also direct network effects: the more users there are on one side of the market, the more attractive the platform becomes to users on that side of the market. For example, the more Twitter users there are, the more attractive Twitter becomes not only for advertisers (indirect network effects), but also for users, as they can reach a wider audience and interact with more people (direct network effects).

In ride-hailing apps, direct network effects do not exist, since the number of users in one side of the market does not increase the utility of the platform for users of that side. There can even be (short-lived) relative rivalry between users of the same side: given a number of drivers in a certain territory, the more riders there are on the platform, the more each rider will have to wait to get a ride. Moreover, because most ride-hailing apps recur to surge pricing, the more each rider will have to pay. Inversely, given a certain number of riders in a certain territory, the more difficult it will be for each driver to get a ride and the lower the price of the ride will be.

Nevertheless, the existence of indirect network effects offsets this temporary rivalry. Given that one of the main features of ride-hailing platforms is, as in any multisided platform, to put in touch individuals from two sides of a market, the utility of the platform for a user of one side of the market (riders) always depends positively on the size of the other side of the market (drivers). If this effect is strong enough, it can create a tendency for users to converge to a single platform once it has reached a critical mass of users in at least one side.

Moreover, some authors claim that in digital platforms such as ride-hailing platforms indirect network effects are enhanced by the “user feedback loop” (Graef, 2015) or “data snowball effect”, as the French and German antitrust agencies call it (Autorité de la Concurrence & Bundeskartellamt, 2016). This effect consists in the fact that the more users a platform has, the more attractive it becomes for users, but not because of network effects. The reason is the existence of a “user feedback loop”: “as a platform gains more users, it can collect more user data, leading to better insights into consumers and their needs, which can be used to improve quality, attracting even more users” (Sokol & Comerford, 2016). This link between user activity data and the quality of the service is explained by the technical

properties of the use of big data. Algorithms not only need large amounts of data to function, they also need it to improve. Once an algorithm (or, more generally, a model) is correctly designed to fit its data³, the more data it can work on, the more likely it will be that it will improve over time. Then, the ‘algorithm race’ becomes a matter of who has more data. As the famous quote by Google’s Chief Scientist Peter Norvig goes, “we don’t have better algorithms than anyone else; we just have more data”. Consequently, “the acquisition of large volumes of data by ‘first mover’ providers may, however, raise barriers to entry and thus deprive users from the benefits of competition” (Geradin & Kuschewsky, 2013).

On the same line, a report commanded by the French government on taxation of the digital economy points out that “all digital economy firms use data to improve their supply, obtain productivity gains, diversify their activities or reinforce their position on the different faces of the business model”⁴ (Collin & Collin, 2013).

Taking into account the data snowball effect, we can expect the existence of a tipping point in which a ride-hailing platform would have a dataset on user activity that would be substantially larger than its competitors’. When that tipping point is met, competitors would be unable to compete on quality. This is all the more important that the literature stresses that offering a high quality service is more relevant than being the first mover for a firm to enjoy the benefits of network effects in multisided platforms (Rangan & Adner, 2001; Liebowitz, 2002; Iansiti & Zhu, 2007).

Some authors have warned that, as a result, winning firms might obtain and exert market power. In Kestenbaum opinion, “if the information necessary to compete on equal footing is not readily available from alternative sources, the potential competitive harm from data-driven entry barriers raises a cognizable theory of competitive harm under the anti-trust laws” (Kimmel & Kestenbaum, 2014). In that sense, as the OECD (2014) has observed referring to companies in general (which does not limit to

3 For a more detailed explanation of under which conditions does more data improve a model, see Amatriain, X.(2015), “Machine Learning, What is Better: More Data or better Algorithms.” Available at <http://www.kdnuggets.com/2015/06/machine-learning-more-data-better-algorithms.html>

4 The translation is ours.

ride-hailing platforms) and echoing Tim O'Reilly's words (Bruner, 2013), "where companies acquiring massive proprietary data sets there is thus a higher risk that we're kind of heading toward data as a source of monopoly power" (OECD, 2014). In the particular case of ride-hailing platforms, the lawsuit filed against Uber for using a software called Hell⁵, which allowed it to track drivers that were also working for its main American competitor Lyft in order to target economic incentives to them so that they would work less for Lyft, is a telling example of how important observed data can be to secure a competitive advantage. Indeed, the data obtained through Hell allowed Uber to practice price discrimination on the drivers' side of the market in order to reduce multi-homing and, therefore, to conquer that side of the market. It is important to point out that firms can lawfully collect and treat personal data because users give their consent to it when agreeing to the general terms and conditions of use of the app. Moreover, in countries covered by the European General Data Protection Regulation ride-hailing firms can also argue that the treatment of this personal data is necessary in terms of their "legitimate interest" (e.g. providing a good service).

Following this logic, we should expect ride-hailing markets to be winner-takes-all markets. Indeed, once the above-mentioned tipping point would be reached by a winning platform, it would be difficult for potential competitors to challenge its position by offering a service of similar or higher quality because of the large asymmetry in the accumulation of the necessary data that would play in favor of the winner. In addition, this mechanism reinforces over time: the more users a platform has and the longer they have been using the platform, the stronger the data snowball effect becomes and the larger the amount of user activity data needed to contest the market becomes.

Nevertheless, not all scholars agree with the idea that indirect network effects enhanced by the data snowball effect can lead to winner-takes-all dynamics in ride-hailing markets. In the following lines, we will develop the arguments that have been put forward in the literature to contest this claim⁶ and provide counter-arguments. As we will see, because these

5 *Michael Gonzales v Uber Technologies, Inc*, Case 3:17-cv-02264-JSC, U.S. District Court for the Northern District of California.

6 We will follow Sokol & Comerford's (2016) and Evans & Schmalensee's (2017) papers since they cover vastly the criticisms that have been made in the literature to winner-takes-all dynamics in multisided platforms.

arguments have been formulated to apply to any multisided platform, they are seldom pertinent when the specificities of ride-hailing platforms are taken into account.

First, it has been argued that in multisided platforms it is not the number of users on each side that counts the most, but the quality of the match between users of each side because “most customers on most platforms are not very good matches for each other” (Evans & Schmalensee, 2017). Nevertheless, this is hardly the case in ride-hailing platforms, where a good match is essentially a nearby rider/driver, as “waiting time is an essential feature of the quality of ride hailing platforms” (Herrera Anchustegui & Nowag, 2017). Then, the more riders/drivers there are on the platform in a given territory, the more likely it will be for a nearby driver/rider to demand/offer a ride. Moreover, the probability of a good match happening depends also on the capacity of the matching algorithm to predict which areas will see a rise in demand and, accordingly, nudge drivers to go there by increasing the price of rides in the area and/or providing benefits (e.g. bonuses or granting more rides), as the above-mentioned case about Uber’s use of the software *Hell* shows. In order to do a proper prediction, ride-hailing apps recur to *past* data on how drivers and riders have interacted in the platform (McLean, 2016). Therefore, the accumulation of large amounts of data by one firm can lead it to secure a competitive advantage that can only increase over time as the data snowball effect keeps operating.

Second, following Tucker and Wellford (2014) and Lerner (2014), Sokol and Comerford argue that “online providers can gain scale in users in ways that do not involve user data, and that access to data alone is not enough to improve quality and gain scale in users. Additionally, firms can gather data from other sources than users (e.g. data brokers), and can gain scale in data in alternative ways, such as entering into strategic distribution arrangements” (Sokol & Comerford, 2016). The problem with the first part of the argument is that in ride-hailing platforms quality, as explained above, depends much more on access to large datasets on user activity than in other digital platforms. Contrary to what happens in other digital platforms, differentiation plays a smaller role and takes place largely within platforms, while the service they offer does not have any original content aspect, nor does it rely on the platform’s identity⁷. Moreover, the

7 We will develop this argument in subsection 1.3.

quality of the match, which essentially comes down to matching nearby drivers with nearby riders, also depends on the availability of past data. Then, the quality of the service depends highly on the performance of algorithms, which in turn relies on the availability of large datasets on past user activity that allow their perfection. The second part of the argument is difficult to hold in ride-hailing platforms. To our knowledge, there are no data brokers that could sell relevant data to entrant ride-hailing firms. Moreover, we have to be careful on what data we are talking about. The most relevant data for a new ride-hailing entrant firm is data on how users interact within competing incumbent platforms. Contrary to other data-driven businesses such as search engines, the data collected by ride-hailing platforms about their users' activity cannot be obtained without platforms' consent. For data brokers to have access to it (which, to our knowledge, is not the case for ride-hailing user data), they would need to buy it from ride-hailing platforms. It is difficult to imagine why an incumbent ride-hailing platform would sell that valuable data to a data broker that could in turn make a profit by selling it to its competitors.

A third similar argument offered by Sokol and Comerford is that "data is ubiquitous, inexpensive, and easy to collect (Tucker 2013)" because "customers leave multiple digital footprints on the internet (Lambrecht & Tucker 2015)" (Sokol & Comerford, 2016). While this is true for data in general, it is not the case when it comes to the specific data a new firm would need to challenge incumbent ride-hailing platforms. The digital footprints that are useful to new entrants are mostly located in proprietary databases owned by incumbents. If, for example, a platform cooperative like Juno wanted to capture a significant market share from Uber and Lyft in the United States, it would need large amounts of data of users' trips in those platforms, not any data.

The fourth argument is that data is non-exclusive and non-rivalrous. In other words, "collection of a piece of data by one firm does not occur at the expense of another firm" (Sokol & Comerford, 2016). This claim confuses the technical properties of data with the legal rights applied to it, while in fact economic properties of data are the combined result of the two. Data being non-exclusive and non-rivalrous depends on what data we are talking about. It is true in the case of personal information. For example, a person can provide information about his/her birthplace to two competing platforms. However, it is not true for most of the relevant data

new entrants would need to compete in a ride-hailing market. Following our previous example, if Uber has information about a certain amount of trips users did using its application, Juno will never be able to collect that same data to improve its algorithms because Uber's exclusive intellectual property rights over the database that contains that data and/or its right to use trade secret to keep the data away from competitors gives it a legal right to exclude Juno from its use. In other words, intellectual property and trade secrecy can create rivalrousness where technical conditions do not.

The fifth argument is that "data has a limited lifespan – old data is not nearly as valuable as new data – and the value of data lessens considerably over time" (Sokol & Comerford, 2016). This assertion is taken from Chiou and Tucker's paper (2014), which investigate search engines. There is no reason to consider it holds in the case of ride-hailing platforms. On the contrary, as said before, it is precisely *past* data that allows algorithms to perform an effective matchmaking between drivers and riders.

The sixth argument is that "the possession of data alone therefore, even in large volume, does not secure competitive success – that can only be achieved through engineering talent, quality of service, speed of innovation, and attention to consumer needs" (Sokol & Comerford, 2016). Similarly, Evans and Schmalensee (2017) argue that multisided platforms "have to figure out how to get all sides on board in order to create any value at all". This is certainly true, but it does not imply that the lack of large amounts of data cannot be a barrier to entry for newcomers in ride-hailing markets. New entrants may overcome this barrier by offering a very good service, but that does not mean the barrier does not exist. Moreover, it should be pointed out that this argument, backed in Evans and Schmalensee's (2017) article by the example of Youtube, is weaker in ride-hailing platform than in content-based platforms or social media platforms. While some platforms effectively rely heavily on their distinctive features to engage users to participate, the decision to choose a particular ride-hailing platform depends mainly on short waiting times and low prices for riders and income opportunities and flexible working hours (a feature every ride-hailing platform and taxis share) for drivers (Chen *et al.*, 2017; Ridesharing Guy, 2018). These, in turn, depend largely, for users of each side of the platform, on the number of users on the other side of

the platform, as well as on the matchmaking-improving data that having many users on both sides of the platforms generates.

Finally, Evans & Schmalensee (2017) argue that indirect network effects are a double-edged sword because they can work in reverse. The argument is that, since switching costs are low, once a better platform enters the market, users start multi-homing and eventually drop the first (dominant) platform to join the new one, which leads to an exponential decline (inverse network effects) in the number of users of the first platform. The authors recall the examples of social networks (AOL, Friendster, MySpace, Orkut and Yahoo), mobile providers (Blackberry and Microsoft), search engines (AltaVista, Infoseek and Lycros) and browsers (Microsoft) that suffered from reverse network effects to back their argument. Although we agree on the fact that switching costs are rather small in ride-hailing apps and multi-homing is easy (cf. subsection 1.2), we believe this argument does not hold properly in the case of ride-hailing apps. As said above, contrary to social networks, mobile providers, search engines and browsers, product differentiation plays a small role in ride-hailing apps and it even takes place within the platforms that have the largest users bases. Consequently, the attractiveness of a new ride-hailing platform relies vastly on its capacity to offer low prices and short waiting times to riders and higher income for flexible working hours than competing platforms. Then, the capacity of a dominant platform to avoid reverse network effects relies mainly on its financial capacity to keep rides' prices lower and drivers' income higher than in competing platforms. This attracts each side of the market separately in the first place and activates indirect network effects also by reducing riders' waiting time as the number of drivers increases. Then, as long as the dominant platform is able to obtain more funds than competing platforms for a certain period, it will have high chances of avoiding suffering from reverse indirect network effects. As we will see in the next section, this seems to be the case of Uber and its American competitor Lyft.

1.2. Switching costs and multi-homing

Let us now analyze the possibility of multi-homing in ride-hailing platforms. "Multi-homing, whereby suppliers and/or users participate in more than one platform, similarly lessens the ability of platforms to exercise market power, amounting to a form of countervailing buyer power"

(Dunne, 2018). The main reason why multi-homing can be hindered in ride-hailing platforms is the existence of strong switching costs. The latter exist when users refrain from switching to a competing platform because of the (usually non-monetary) costs it implies. In ride-hailing platforms, switching costs can be divided into three categories: learning costs (learning how the app works), bureaucracy-related costs (paperwork such as background checks, proof of insurance needed to join the platform, etc.) and 'reputational costs' (the cost of losing the reputation that has been accumulated in another platform).

Reputational costs, as in many so-called 'sharing economy' platforms, are not negligible in ride-hailing apps, especially for drivers, for which ratings have an important effect on the income they can make through the platform. In Uber, drivers whose rating goes below 4.6/5 are expelled from the platform. In Lyft, only drivers with a high rating can work for Lyft Lux, a luxury version in which rides are more expensive. Moreover, drivers with higher ratings are more likely to get more rides in every ride-hailing app. It is important to point out that reputational costs increase over time because, the longer users have been using a platform, the more solid their reputation score is. Therefore, the more experience they collect in a platform, the higher the cost of losing their reputation becomes. Reputational costs and the obstacles to multi-homing they entail are the consequence of users not enjoying data portability (Van Gorp & Honnefelder, 2015). Then, it follows that "switching costs would be reduced further if consumers were assured data portability between platforms." (Perzanowski & Schultz, 2010)⁸. Consequently, the lack of data portability limits competition in ride-hailing markets (Autoritat Catalana de la Competència, 2016). Nonetheless, it is worth mentioning that reputational switching costs are lower for users that join a competing platform before having cumulated a considerable amount of ratings in another one.

Learning costs, on the contrary, seem to be negligible. Riders and drivers are used to a dynamic market of applications and platforms and can adapt

8 Nevertheless, this would only be the case if a user were able to migrate all data submitted by him/her (volunteered data) and all the data referring to him/her. In that sense, as many commentators have pointed out (De Hert and Papakonstantinou, 2016) the recent article 20 of the European Union General Data Protection Regulation is insufficient, because it only allows *volunteered* data portability. Reputation scores fall outside of the scope of this new European regulation on data portability.

without much inconvenience to new platforms. Riders will not hesitate to switch to a competing platform if prices and waiting time are lower, and drivers will do the same if more and/or better-paid rides can be obtained. Moreover, as mobility-as-a-service apps combining several transportation services (including sometimes even rival ride-hailing apps, as in the case of Go La, in which both Uber and Lyft are present) and offering passengers real-time information, trip planning, booking, ticketing, and payment functionalities (CIVITAS, 2016) develop, multi-homing between ride-hailing platforms through a MaaS platform will become increasingly easy and usual.

Bureaucracy-related switching costs come down to requirements that drivers have to meet to join the platform due to both platforms' self-regulation and government regulation. Examples of bureaucracy-related costs include background checks, vehicle inspection and proofs of insurance. Although these switching costs are non-negligible, it should be noted that they are similar across platforms, even if some platforms are more exigent than others. Consequently, although they do represent an entry cost for drivers, they are rarely a switching cost: once drivers incur into these bureaucracy-related entry costs, they do not have to incur into most of them once again to join a competing platform.

We can conclude that switching costs are relatively low in ride-hailing platforms and that they affect considerably more the drivers' side of the market than the riders'. In accordance with this conclusion, studies show that it is common for drivers and riders to practice multi-homing (Choudary, Parker & Van Alostne, 2015).

1.3. Product differentiation

The literature on multi-sided platforms shows that product differentiation can offset winner-takes-all dynamics. In this sense, following Scheppe and Wambach (2015), Sokol and Comerford argue that "online platforms are highly differentiated, even in the provision of the same type of service" and that "each entrant carves out a niche" (Sokol & Comerford, 2016). Nevertheless, when it comes to ride-hailing platforms, differentiation plays a smaller role in attracting users than in other types of online platforms because the room left for differentiation is small.

When discussing differentiation, the literature on multi-sided platforms usually recurs to examples in which the originality of the content or the identity of the platform is crucial such as newspapers (a certain type of subjects treated, an editorial line, a writing style), social networks (a certain way of interacting online with other people) or night clubs (a certain aesthetic, a certain musical style). In the case of ride-hailing platforms, there is no original content and the identity of the platform is anecdotal. The key role of the platform is the provision of a transportation service in which differentiation plays a smaller role because it is reduced to mainly three variables: luxuriousness of the vehicle, available passenger seats on the vehicle and sharing or not sharing the ride with other passengers traveling along the same route. Consequently, it is hard to carve out a niche in ride-hailing platforms through differentiation because the possibilities of differentiation are limited.

Moreover, precisely because differentiation possibilities are limited, platforms practice within-platform differentiation to make sure they can reach each type of user and adapt to users with swinging needs by offering them differentiated versions of the same service. Indeed, the two main American ride-hailing apps, Uber and Lyft, offer a very similar bundle of services that differ between each other in terms of the three variables mentioned above. Both Uber and Lyft have a baseline option that seats up to four passengers (Uberpop and Lyft), a minivan or SUV that seats up to six passengers (Uber XL and Lyft Plus), a cheaper option that pairs users with other passengers traveling along the same route (uberPool and Lyft Line), a luxury black service (Uber Black and Lyft Lux) and a luxury SUV or minivan service (Uber SUV and Lyft Lux SUV). We conclude that limited and mimetic within-platform differentiation makes of differentiation less of a competitive advantage to carve out a niche in ride-hailing platforms than in other multisided platforms: users can find more or less the same variants of the baseline product regardless of the ride-hailing platform chosen.

2. SOME EVIDENCE ON WINNER-TAKES-ALL DYNAMICS IN AMERICAN RIDE-HAILING MARKETS

Having discussed the literature on winner-takes-all dynamics in multi-sided platforms, we have shown that there are two main reasons to expect

winner-takes-all dynamics in ride-hailing platforms. On the one hand, product differentiation, contrary to what happens in other multi-sided platforms, is not very relevant to carve out market niches. On the other hand, indirect network effects are particularly strong in ride-hailing platforms, especially because they are enhanced by the user “data snowball effect” to a larger extent than in other digital platforms. In this section, we will take a step towards corroborating our theoretical findings by contrasting them to some data on ride-hailing markets.

In order to do so, we will provide some (rough) evidence that supports our thesis by focusing on Uber, a platform that seems to be conquering the main ride-hailing markets of the United States. This choice responds to two criteria. The first one is the availability of data. The data required to analyze the existence of a winner-takes-all dynamic in ride-hailing markets is currently scarce and incomplete. Nevertheless, in the case of Uber and its competitors, some scattered sources of data that will help us in this endeavor are available. Although imperfect, the available evidence offers some interesting insights. Second, the United States is a country in which Uber faces severe competition from Lyft, a company it has engaged in a price war with (cf. subsection 2.2). This makes the choice of this country a challenging and ideal test of our theoretical findings.

It should be noted that, as described along the section, the available data is incomplete and in some cases imperfect. It is therefore unfortunately insufficient to arrive to sound empirical conclusions, especially regarding implications for antitrust. Nevertheless, we have decided to include empirical elements because they will allow us to provide a corroboration of our theoretical findings of Section 1 that, although imperfect, represents a contribution to the literature on winner-takes-all dynamics in multisided platforms, which remains highly theoretical and relies on anecdotal evidence on disparate digital platforms (social media, ride-hailing, dating apps, etc.).

2.1. Market definition and market shares

We will begin by analyzing the evolution of market shares. If, as we claim, ride-hailing markets are becoming winner-takes-all markets that Uber is conquering, we should observe an increasing gap over time between Uber’s

market share and its competitors' in favor of the former. In order to so, we need to define the relevant product and geographic market in which Uber participates.

The definition of the relevant product market is particularly difficult in multisided platforms. Traditional approaches based on defining the products that are part of the relevant market and those that are not "are particularly likely to obscure market realities" in the case of multisided platforms (Evans and Noel, 2005), since competition does not take place in a single-sided market over a product or a range of products. Because the aim of defining a relevant market is to understand the factors that constraint business behavior and to assess the contours of competition of a firm, a more fruitful approach for ride-hailing platforms (and for multisided platforms in general) consist in identifying sources of competition constraints (Evans and Noel, 2005). Based on the analysis of Uber's business model made in the recent "Uber Spain Opinion"⁹, Dunne (2018) argues that Uber's market is the underlying services market (the ride-hailing service market) rather than a niche intermediation market. In this market, consistently with the findings of the literature on market definition in multisided platforms, firms compete to attract users on both sides of the market (Evans and Noels, 2005; Dunne, 2018). On the riders' side, two types of Uber competitors can be identified: other ride-hailing platforms (the main and only national one in the United States being Lyft) and other non-platform-based ride-hailing services, out of which the most relevant ones are taxis. Two reasons have been put forward by United Kingdom's Competition Market Authority in *Sheffield City Taxis/Mercury Taxis*¹⁰ to justify this definition of competitors: (i) the similarity of the basic intended use of "private hire transport services" (a category that includes ride-hailing platforms and hailed taxis); and (ii) the fact that, as shown by internal documents and third party comments in the case, private hire operators "have regard to taxi tariffs when setting prices" (Competition Policy International, 2018). On the drivers' side of the market, given that the number of taxi licenses is limited by regulators and their price is too onerous for the vast majority of Uber and

9 Opinion in C-434/15 *Asociación Profesional Elite Taxi* ('Uber Spain Opinion') EU:C:2017:364.

10 ME/6548-15; Completed acquisition by Sheffield City Taxis Limited of certain assets and business of Mercury Taxis (Sheffield) Limited, Decision of 13 October 2015.

Lyft drivers¹¹, taxis are not to be considered as relevant competitors. In other words, ride-hailing platforms do not compete with taxis for drivers because ride-hailing apps' drivers can very rarely become taxi drivers, and taxi drivers can only lose income by becoming ride-hailing drivers.

Regarding the relevant geographic market, Uber's markets are circumscribed to a territory, typically a city or a metropolis. There are two reasons for this. First, ride-hailing firms with vehicles located in two different territories would be too far away from each other to be able to compete on price or in terms of waiting time for the passenger. Second, as stated by the Competition Commission of India in *Meru Travel Solutions Private Limited v. Uber India Systems Private Limited*, "the radio taxis services market is largely regulated by the State transport authorities. Thus, the conditions of competition appear to be homogenous only in a particular city/State" (Competition Commission of India, 2015, p. 10). In that vein, as stated in a report from the European Commission on ridesharing, taxis and hire markets, "the taxi market is also geographically fragmented since the licenses are usually valid only for the territory of the issuing municipalities" (European Commission, 2016, p. 8).

Having defined Uber's relevant product and geographic market, we should begin by studying the evolution of its market shares. Two preliminary observations need to be made in this respect. First, because, as said above, Uber competes over users on both sides of the platform (drivers and riders), ideally, the measurement of market shares should be done on both sides: the share of rides and the share of full-time equivalent drivers of each competitor. Unfortunately, there is no such available data on drivers. Therefore, we will have to limit our analysis to measurements of market shares that only consider the riders' side of the market. Nevertheless, *ceteris paribus*, unless mean waiting time increases considerably, because of the existence of indirect network effects, an increase in a firm's riders' market share will translate into an increase in its drivers' market share. Otherwise, average waiting time would increase because of congestion effects, which would in turn reduce riders' market shares as passengers shift to competitors with lower mean waiting times. Then, although

11 A recent study by the MIT (Zoepl et al, 2018) shows that, in the United States, 74% of Uber and Lyft drivers earn less than the minimum wage in their state.

we will not be able to measure drivers' market shares, we can make conclusions about their dynamics (and not their magnitudes) by looking at how the riders' market shares evolve¹². This is not very problematic as what we need to corroborate is if there is a widening gap between Uber's and its competitors' market shares over time. Second, although calculations of Uber's market shares on the riders' side of the market exist, they generally define the market narrowly, as most of them consider either Lyft or taxis as the other market participant and not the two, while some measurements include both of them. Given that data sources are scarce, we will use each source for a different purpose. Sources that define the market properly (with both Lyft and taxis as competitors) will be used to show that Uber's market share is increasing steadily in detriment of both taxis' and Lyft's. Sources that define the market narrowly (i.e. by considering either Lyft or taxis as Uber's only competitor) will be used to show the increasing gap between Uber's and one of its competitors' number of rides or revenues in a certain territory. The numbers taken from these sources should not be interpreted as correct measurements of market shares, but rather as pieces of evidence that, although insufficient by themselves, support our theoretical findings in Section 1 regarding winner-takes-all dynamics in ride-hailing markets.

When we look at the existing evidence on Uber's market share properly calculated (i.e. when both taxis and Lyft are taken as market participants), they all show that Uber is on its way to dominating the market. By combining different data sources on 1.1 billion trips in New York, and taking Uber, Lyft, Green Taxi and Yellow Taxi as market participants, Schneider (2016a) finds that between May 2015 and September 2016¹³ Uber has steadily increased its market share measured in number of trips much more rapidly than Lyft and to the detriment of Yellow Taxi's. It follows from this tendency shown in Figure 1 that Uber is on its way to dominating the New York City market, including every borough (Brooklyn, Queens, Manhattan, Bronx and Staten Island) and airport trips.

12 It is interesting to point out that none of the current or past antitrust cases involving ride-hailing apps has estimated market shares on the riders' side of the market, as they have not adopted the theoretical framework of multisided platforms.

13 This timeframe, like all the other timeframes used to calculate the other market shares that will be presented in this section, are not the most pertinent to draw conclusions by any means. Lacking additional sources of data to calculate market shares, we have no option but to take these numbers knowing they present limitations.

Figure 1. New York monthly pickups –May 2015 and September 2016

Source: Schneider (2016a)

The same tendency is verified when the analysis is narrowed down to each borough (Schneider, 2016b) and airports: Uber's market shares grow exponentially, Lyft's grow at a decelerating pace and taxis' fall.

This tendency is corroborated by analyses that show that the gap between Uber and taxis in terms of number of rides increases over time. Using data provided by the New York City Taxi and Limousine Commission, Fischer-Baum & Bialik (2015) estimate that between 2014 and 2015 Uber's share of pickups has increased by 12 percentage points for the April-June period in New York City counting all the boroughs. The same tendency is observed by Certify (2015) for business travelers in all main cities of the United States during the first quarter of 2015. Nelson (2016), in turn, finds that since Uber and Lyft started operating in Los Angeles, taxi rides have declined by 30% over three years (2012 to 2015). Similarly, "in San Francisco, the corporate home of both Uber and Lyft, the number of trips

taken per taxi dropped by more than two-thirds over a two-year period” (Nelson, 2016).

Finally, calculations that only take into consideration Uber and Lyft as market participants show that Uber is taking an increasing share of the trips and the revenues taxis are losing to ride-hailing apps. A report from 7Park that compares the (miscalculated) market shares of these two platforms by revenue shows that Uber’s market share was considerably larger in the twenty main U.S. cities in the second quarter of 2016. During that period, its market share varied from 62% to 83% depending on the city (7Park, 2016). This is in line with the (optimistic) claim Uber made to its investors in August 2016 according to which its market share (which only includes other ride-hailing apps as market participants) in the U.S. was between 84% and 87% (Bloomberg Technology, 2016). If we turn now to the evolution of the gap between Uber and Lyft, we corroborate what is expected in a winner-takes-all market: it widens over time in favor of the winner (Uber). Using anonymized credit and debit card spending data of a sample of 3.8 millions of users, a report by FutureAdvisor shows that, between June 2013 and September 2014 Uber’s revenue has increased 10 to 11 times faster than Lyft’s in absolute terms. In the same period, Uber has increased its number of rides 6 to 7 times faster than Lyft in absolute terms (FutureAdvisor, 2014). Moreover, during that period 82,000 people used Uber, while only 14,200 people (5.8 times less) used Lyft.

We can conclude that the available figures of the main United States ride-hailing markets, although certainly imperfect and incomplete, point out in the same direction: Uber is increasing its market share to the detriment of both taxis’ and Lyft’s. These market shares, although not large enough to raise suspicions of dominance neither by European (above 40% of the market) or U.S. (65% market share being “doubtful”) antitrust standards (Dunne, 2018) when both taxis and Lyft are taken as market participants, are evolving in favor of Uber and to the detriment of its competitors, as expected in winner-takes-all markets. Nevertheless, it should be noted that even if these market shares were large, they would not necessarily be indicative of market power. Market shares provide an indication that may be disproved by other factors. Moreover, dominance is not problematic *per se*, as it can be based on merits and it does not necessarily imply a harm to competition. In the next section, we will study Uber’s behavior in the

main U.S. markets to argue that the increase in its market shares are the result of a predatory pricing strategy that can only be rational if ride-hailing markets are winner-takes-all markets in which, once Uber becomes the winner, it will gain market power, which will allow it to recover the losses induced by predation.

2.2. Signs of Uber's predatory pricing strategy aimed at securing a winner-takes-all ride-hailing market

We have seen so far that Uber's market shares are increasing exponentially to the detriment of Lyft's and taxis'. What strategy is it employing to get there? On the riders' side of the market, Uber has expanded by systematically cutting fares in more and more cities every January for three years in a row since 2014. In that year, it did so in 16 of its 24 US cities. In 2015 it cut fares in 48 cities and in 2016 in 100 cities. While this boosts demand, it decreases the size of the drivers' side of the market, since drivers earn money by getting a cut of the fare charged to riders. Moreover, Uber has been increasing the commission it takes from drivers, lowering so drivers' revenue per trip. Until 2014, Uber's commission was 20%. It then rose to 25% and it is as high as 30% in some cities. In addition, Uber started charging flat fees to drivers in 2014, the amount of which began at 1 dollar and is now as high as 2.5 dollars in some cities (Bloomberg Technology, 2016). To avoid losing drivers, Uber has started offering them bonuses, incentive programs and earning guarantees. It is worth noting that the conditions that drivers need to meet to be eligible to these benefits make it almost impossible for them to work for other platforms at the same time (i.e. to practice multi-homing). In other words, Uber has been systematically subsidizing both sides of the market.

As a result of this strategy, Uber has been reporting losses since its foundation in 2009. In 2015 it lost 2 billion dollars and in the first half of 2016 it lost 1.27 billion dollars. Uber's former head of finance, Gautam Gupta, claimed that subsidies to drivers explain the majority of the company's losses (Bloomberg Technology, 2016). Nevertheless, Uber has been able to raise increasingly large amounts of funds.

Figure 2. Uber's vs Lyft's cumulated funding (in million US dollars)

Source: own elaboration based on www.crunchbase.com

As Figure 2 shows¹⁴, Uber raised 3,700 million dollars in 2015 (equivalent to 185% of the losses of that year) and 4,850 million dollars in 2016 (equivalent to 328% of its *mid-year* losses) and 9,000 million dollars in 2017. In August 2016, Uber's valuation was set at 69 billion dollars, a number that seems astronomical (roughly 35 times the value of Uber's yearly losses of the past 2 years!) considering the company has been making losses for 9 years in a row since its foundation.

These trends indicate that Uber, which has no other substantial source of revenue but the commission it takes on each trip, is engaging in predatory pricing to conquer a winner-takes-all market. Predatory pricing requires two conditions to be met. The first one is a firm pricing below "an appropriate measure of its cost" (Passaro, 2018, p.42), typically average variable costs or average total costs, depending on the case (OECD, 1993, p. 156; European Commission, 2002, p.37). The second one is a dangerous

¹⁴ The numbers shown in Figure 2 do not include the funding rounds with undisclosed figures that took place in the following periods. For Uber: December 2011, February 2015, April 2017 and January 2018. For Lyft: April 2014, October 2016 and December 2017.

probability of recoupment of the costs of pricing below cost. In the particular case of multisided platforms, pricing below cost takes place when a firm makes losses over the whole platform (Evans & Schmalensee, 2007), and not over the most elastic side of the market, since multisided platforms' pricing schemes are characterized by one side subsidizing the other one. This seems to be the case with Uber, which systematically cuts fares (riders' side of the market) and gives bonuses, incentive programs and earning guarantees to drivers (drivers' side of the market) and, as a result, has been making losses over the whole platform for 9 years. This strategy echoes traditional predatory pricing models based on financial constraints in which, as long as a firm can secure more financial resources than its rivals to sustain a price war long enough, it will be rational for it to practice predation (Roberts, 1985). As Figure 2 shows, Uber benefits from considerable financial asymmetries in respect to Lyft: being a year younger, Uber has been able to secure about four times more funds than its main American rival. Moreover, Uber's last valuation has been estimated at 70 billion dollars, while Lyft's has been estimated at 11 billion dollars¹⁵. More specifically, Uber's price war with Lyft is a textbook example of a "pocket picking" or "cross-subsidizing" strategy in which "to discipline a price-cutter in one geographic market, a firm operating in several geographic markets can undercut the chiseler in one market and recoup the resulting losses from other market revenue" (Dugger, 1985, p. 348). Indeed, Uber is present in about 777 cities in 72 countries, while Lyft is present in around 600 cities in only two countries (United States and Canada)¹⁶. Far from being a United States phenomenon (a country in which there are five ongoing litigations accusing Uber of practicing predatory pricing¹⁷), predatory pricing strategies take place in other countries' ride-hailing markets. In Asian markets, Uber left the market after losing a price war with Grab (South East Asia), on the one side, and Didi (China), on the other side.

¹⁵ Last valuations available on 13 May 2018.

¹⁶ Estimates based on data from Quartz Index (<https://index.qz.com/1088078/lyft-is-in-600-cities-in-the-us-with-uber-out-of-the-way-london-could-be-next/>) and Uber estimator (<https://uberestimator.com/cities>).

¹⁷ A White and Yellow Cab, Inc., No. 4:15-cv-05163, Doc. 114 at 14 (N.D. Cal. Mar. 5, 2018); Miadeco Corp. v. Uber Technologies, Inc., No. 1:15-cv-20356, Doc. 120 (S.D. Fla. Mar. 30, 2017); ArieKat v. Uber Technologies, Inc., CGC-17-557728 (Cal. Sup. Ct. Mar. 24, 2017); Friendly Cab Company, Inc. v. Uber Technologies, Inc., RG-17-858247 (Cal. Sup. Ct. April 27, 2017); Malden Transp., Inc. v. Uber Technologies, Inc., 2017 U.S. Dist. LEXIS 213023 (D. Mass. 2017).

In both cases, as stated recently by Raphaël Morel, Uber's Head of City Development in France¹⁸, Uber left these markets because it did not have as many financial resources as its competitors to survive the price war.

Then, because price wars are likely to persist or even multiply in other markets around the world, the success of a pocket picking strategy based on operating in several geographic markets is not likely to last. There would be not enough profitable markets to recoup the losses if one considers that Uber has already been making losses overall for 9 years while engaging in price wars in the United States, South East Asia and China. The only possible explanation of Uber's predatory pricing strategy is that, consistently with our analysis in Section 1, investors are providing enough funds for Uber to be the winner of a winner-takes-all market in which it will eventually be able to make up for the losses of the previous years by leveraging on its (future) dominance of the markets conquered. Uber would be able to recoup the losses of predation in three combinable ways.

First, once it dominates a ride-hailing market, it could raise prices, like the Chinese ride-hailing app Didi did once it won a price war to Uber in China (Beijing Review, 2016). To do so, it could rely on its competitive advantage in terms of quality that the data snowball effect, as explained above, would give it. Nevertheless, Uber's capacity to raise prices in ride-hailing markets will be limited by their contestability. Given that entry is not costly both in regulatory (in most American cities ride-hailing platforms are not banned and there are no restrictions to the number of vehicles they can work with) and financial (the cost of developing an app and providing basic support functions and marketing) terms, we can expect Uber not to raise prices to deter competition. As shown by the literature initiated by Fudenberg and Tirole's (1984) seminal work, when entry is endogenous, a (future) leader will always find it optimal to adopt a "top dog" strategy consisting in overinvesting to reduce its price below the price of its competitors in order to gain a larger market share, limit entry and reduce its average cost of production (Cato & Oki, 2011; Etro, 2006, 2007). Then, we can expect Uber to maintain its future dominance by overinvesting in offering drivers bonuses, incentive programs and earning guarantees that prevent them from multi-homing and allow Uber to lower

¹⁸ Statement made during the conference « Plateformes et territoires » organized by the Cities and Digital Technology Chair of Sciences Po on May 3rd 2018 in Paris.

consumer prices without reducing drivers' revenues, maintaining so its future dominance over the riders' and the drivers' sides of the market.

Second, it can use its dominance over ride-hailing markets to make profits in other markets, even while keeping prices low enough to deter entrance in ride-hailing markets. This option is particularly likely if Uber is expected to adopt a top dog strategy in which overinvesting entails pricing below cost instead of reducing costs. Indeed, drivers' incentives do not increase productivity and they increase Uber's marginal and average cost. One way of profiting from its dominance in ride-hailing markets to create revenue in other markets is to use the data generated there to gain a competitive advantage in a market in which competition takes place through innovation. This is what Uber is currently doing by using ride-hailing data to develop artificial intelligence software that will allow it to enter the autonomous vehicle (software) market. Given that the amount of data is a crucial factor affecting the speed of innovation in artificial intelligence, Uber's driving and traffic data, which amounts one billion kilometers driving per month worldwide (Durand, 2017), is a precious asset. Indeed, Uber has acquired in 2016 the autonomous vehicle startup Otto for 680 million dollars and launched an autonomous vehicle research hub in Toronto in 2017. That same year, the company spent 1.17 billion in research and development, much of which has been devoted to autonomous-driving technology. This figure is significant in terms of Uber's strategic choices, since it represents a quarter of its losses that year -4.5 billion- (Newcomer, 2018). Another option is selling data or data analytics to third parties. As stated by Andrew Salzberg, Head of Transportation Policy and Research at Uber, the company is "actively looking in a bunch of different directions to be able to share data in different ways and for different purposes" (Marghall, 2018). A first step in that direction has been taken with Uber's Movement Platform, which opens certain aggregated data for free. The platform has been successful in awakening city halls' interest. We can expect this to grow into a traffic analytics service based on the amounts of data collected through ride-hailing that can interest public agencies. This revenue model is in line with the multiplication of agreements between Uber and municipal governments, metropolitan planning organizations and transit agencies to complement or replace transit services that is taking place since 2016 in the United States (Schwieterman, Livingston & Van Der Slot, 2018).

Finally, Uber could recoup its losses by following a business group structure similar to that of the Chinese net giants Tencent, Alibaba and Baidu, in which “the different platforms can both feed one another and be leveraged to expand into other business areas” (Jia & Kenney, 2016) by cross-feeding traffic to other platforms and using cross-platform personal data to customize offers. Uber has given a first step in this direction by diversifying into a food delivery platform, Uber Eats, a service to drive patients to medical appointments (Uber Health) and, similarly to Chinese net giants, a credit card offering a cashback reward program and other incentives.

CONCLUSION

Ride-hailing markets have been disrupted by the emergence of multi-sided platforms. After having discussed all the existing arguments for and against the existence of winner-takes-all dynamics in the multisided platforms literature, and having provided some novel arguments, we have shown that there are strong reasons to argue that ride-hailing markets are winner-takes-all markets. The reasons are that, although switching costs are not relevant in ride-hailing platforms, product differentiation plays a smaller role than in other multisided platforms and indirect network effects, enhanced by the data snowball effect, are particularly strong.

We have also provided some empirical corroboration of our theoretical findings, which represents a contribution to the literature discussing winner-takes-all dynamics in multisided platforms. Indeed, this literature has been so far merely theoretical and only recurred to scarce anecdotal evidence that conflates heterogeneous multisided platforms such as social media, dating apps or e-commerce. We have shown that the existing evidence regarding ride-hailing markets in the United States, although scarce and not without methodological shortcomings, points out to a winner-takes-all dynamic: Uber’s market shares have been increasing exponentially, while Lyft’s have been increasing at a decreasing pace and taxis’ are decreasing sharply. This seems to be the result of a predatory pricing strategy: Uber has been subsidizing both sides of the market (drivers and riders) and, as a result, has been making losses over the whole platform for nine years. Nonetheless, its funding, which allows it to sustain this strategy, keeps growing exponentially. This supports the view that Uber is on

its way to conquering a winner-takes-all market and that, if it succeeds, it will be able to use its dominance to recoup the losses of predation. We have suggested three complementary ways in which Uber can recover its losses: raising prices, using the data obtained in ride-hailing markets to develop autonomous vehicles and sell transit data analytics and following a business group structure. These results invite researchers and competition agencies to pursue research on competitive dynamics in multisided platforms narrowed down to a specific type of platform and producing more complete and precise empirical evidence.

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