Implications of ridesourcing and self-driving vehicles on the need for regulation in unscheduled passenger transport

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ABSTRACT

One of the major recent developments in passenger transport is the arrival of large scale ridesourcing services, such as Uber and Lyft. These actors have challenged the definitions of what private and commercial transport is, by utilizing fleets of private cars and app-technology. Ridesourcing services pose several challenges to the existing transport framework. They exist in-between commercial and private activities, are partly outside the control of governments, and partly in direct contradiction with the current regulations. This paper also looks at how ridesourcing and autonomous vehicles may reshape the market for unscheduled passenger transport.

This paper combines the use of literature on regulation and the economic properties of the markets for unscheduled passenger transport with scenario analyses to look into how ridesourcing and automated vehicles affect the markets in unscheduled passenger transport.

The main findings are that as underlying economic mechanisms that points towards situations that calls for regulation are similar regardless of how the services are offered, the need for regulation will remain. However, as the market properties of the market segments are different, and a shift in the relative importance of the different market segments are likely, the possible and suitable points of regulation will change.

1. Introduction

The arrival of ridesourcing services from 2009 and onwards has radically changed the availability of door-to-door transport in many cities. Schaller (2017), describes how this has changed the transport habits in New York, with an enormous growth in market size, taking market shares from both taxis and transit. Similar developments have been observed in many other cities, including London (Dudley et al. 2017) and San Francisco (Rayle et al. 2016). Similar developments in other cities are making ridesourcing a new and significant mode in many cities, in many parts of the world. At the time of writing, ridesourcing companies are still growing at a tremendous rate.

Automated vehicles consist of a combination of technologies that enable a vehicle to assist in the task of driving (Baker et al., 2016). Autonomous self-driving vehicles are still some way ahead as a commercial option in most cities, although there has been rapid development in self-driving technology. At present, major companies such as GM, BMW, Ford and VW, are working on reaching level 4 automated vehicles (full self-driving automation) in the early 2020s. Tesla and Google are indicating that they will have level 4 vehicles on the market earlier. If or when self-driving level 4 is achieved, it will probably have a significant impact upon the way cars are used and owned. This will also have implications for which kinds of door-to-door services will be offered to the traveling public in cities, both how and by who.

This paper describes and discusses the implications of ridesourcing and self-driving vehicles on the regulation within unscheduled passenger transport. This is done by presenting the economic mechanisms that point towards regulation in these market segments. And by combining this theory with scenarios for discussing how these innovations are likely to affect these markets. With ‘unscheduled passenger transport’, we understand services that can provide door-to-door passenger transport for one or a few persons, using a small vehicle, such as taxis, private hire vehicles, black cabs, limousines etc. Unscheduled passenger transport may also include vans and minibuses. Traditional actors in these markets include taxis, limousine services, and various adjacent services, such as demand-responsive-transport (DRT).

In line with Rayle et al. (2016) we use the term ‘ridesourcing’ to describe app-based, on-demand ride services that are provided commercially by companies like Uber and Lyft. These services dynamically match supply and demand by allowing persons to request and accept trips with private vehicles in real time from potential suppliers, using a smartphone app. The distinction between ‘ridesourcing’ and ‘ridesharing’ is that the former is operated by drivers motivated by profit while the latter is motivated by drivers having a transport requirement themselves. Offering spare capacity in vehicles on a non-commercial basis is outside the focus of this paper, as is car-sharing etc. ‘Ridehailing’ is used in this paper for apps solely providing the connection function (hailing), while payment etc. is handled in the vehicle. A ridesourcing app will include a ridehailing function, but so will apps that use regular taxis or ridesharing services.

2. Material and methods

The background for this paper includes a combination of methods, reviews of literature, document studies, expert interviews, an expert survey, case studies and scenario building. However, the paper is written mainly an independent thought piece. The main sources used in this paper is reviews of literature and empirical work conducted as part of the studies Aarhaug and Olsen (2017) and Aarhaug and Skollerud (2014), supplemented by document studies conducted for this paper.

In particular, the paper utilizes scenarios created from an expert panel survey, conducted for the IRU and documented in Aarhaug and Olsen (2017). This is used to explore possible developments towards 2030. In this survey an Exploratory Factor Analysis was used to examine the panel's underlying attitude structures to the projections. This analysis reveals systematic structures in the data material (Clausen, 2009). The assumption behind this method is that certain sets of projections are being selected simultaneously by the same people, thereby forming factor components. Aarhaug and Olsen (2017) used a principal component analysis with varimax rotation. The initial analysis indicated that seven factors had an eigenvalue higher than one, and could explain 67 percent of the variation in the different projections.

3. Theory

This section briefly presents existing theories for market mechanisms in different market segments of unscheduled passenger transport grouped as *street segments* which is the traditional realm of the taxi industry and *pre-book* segments, where various actors have been involved traditionally, including taxis, private hire vehicles, limousines etc. and is also where new entrants such as ridesourcing and autonomous vehicles are and will be located. It focuses on the link between economic mechanisms in these segments and issues that calls for regulatory intervention such as; public safety and security, fair treatment of passengers with respect to quality and price, environmental concerns, congestion, working-conditions and city image and competition. These issues are all affected by the arrival of ridesourcing services and will be affected by automated vehicles, when they arrive commercially.

A complicating factor relating to the markets for unscheduled passenger transport is that they include a series of partially interlinked market segments that have different economic properties. Focusing on private single trip travels, this section presents different theories that explain the mechanisms that calls for regulation in these market segments.

The traditional taxi market segments with street hailing and taxi stands
The earliest documented regularity interventions in taxi market segments dates back to the 1630s (Gilbert and Samuels, 1982). During the 1960-1980's, a series of academic discussions

of the market properties of taxi market segments took place. It has however been recognised that there are few studies on taxi regulation that are based upon empirical experience, and in extension, many theoretical studies reflect the political views of the author (Bekken, 2007, Cooper et al., 2010). When discussing from an economist's point of view whether to have quantitative regulations or not, Moore and Balaker (2006) pointed out that studies were equally split between being in favour and against deregulation (removal of restrictions mostly quantitative). These studied included the mostly model building theoretical studies, as well as the mostly empirical studies, However, theoretical studies were mostly in favour of not having quantitative restrictions pointing towards rent seeking behaviour associated with these restrictions. The long running debate on quantitative restrictions in the taxi industry has largely been side-tracked by the arrival of ridesourcing. Still, having a more general look at the economics of unscheduled passenger transport, not limited to the taxi industry, our reflection is that the underlying economic properties of the market segments that unscheduled passenger transport is operating in, is often poorly understood and communicated. Only to a limited extent is the different properties of these segments included in the discussions on the questions of whether to regulate these markets. And if so; how and why.

Street segments

The economics of the street hail (or cruising) segment have been examined in several empirical and theoretical studies (Schaller 2007, Shreiber 1975), and there seems to be agreement that some regulation is needed, based on the observation that the customer is faced with a temporary monopoly of supply when hailing a taxi (Dimpsey, 1996). For the customer, choosing to wait means uncertainty, as there is uncertainty about when the next vacant taxi will come along or what the driver will charge. This gives bargaining power to the driver, and in an unregulated market one would expect prices to rise and result in a suboptimal solution with high prices and low quality. As an alternative, it is possible to focus the analyses on the atomistic nature of the encounters between driver and passenger, which point towards arbitrary combinations of price and quality, as a result of the absence of continuous supply and demand curves. Adding to this uncertainty in market outcome is the fact that there are few or no economies of scale and limited capital requirements for operating taxis in this market segment; the only capital need is a car. Other capital requirements are induced by regulation. As a consequence, one would expect a high number of taxi vehicles, high or arbitrary fares, low salaries, as well as poor quality and profits in a free market. These effects provide arguments for introducing regulations, either enforced by the authorities, the industry or a third party. Arguments for regulation provided by the governments is particularly related to address public safety and security, fair treatment of passengers with respect to quality and price, environmental concerns, congestion, working-conditions and city image and competition and so on. These regulations can either come in the form of quantitative restriction (limiting the number of licenses), price regulation (setting compulsory fares), or other forms of market intervention, such as safety and environmental minimum standards, and technical requirements such as colour schemes taximeters etc. From empirical evidence there is no clear or obvious relationship between the regulatory approach chosen and a successful outcome (Bekken, 2007).

The taxi stand market has some similarities with the street hail segment with respect to information asymmetries and temporary monopoly. These effects are often created by having a taxi stand with a strong norm for first-in-first-out arrangements. These are either enforced by

physical design or social norms. This results in an observed tendency for prices to be high or arbitrary in a free market situation. Resulting from customers being faced with a monopoly supplier in most cases. Even if there are taxis from different companies offering taxis at the same stand, the relation between the driver and passenger is 'peer-to-peer', with the driver having an information advantage. As opposed to the 'business-to-consumer' relation indicated by the brand on the taxi vehicle and uniform. As in the case of the hailing segments there are little or no economics of scale in offering the service. Also there are low requirements with respect to driver skills, as the stands typically are clearly marked at transport hubs. The non-regulatory induced barriers to entry are low. In an unregulated market, this would result in a high number of vehicles, low wages, low profits, and accordingly a push towards cutting corners and reducing quality. These market properties typically result in some regulatory intervention with respect to the same issues as in the street hail segment.

Pre-book segments

For the pre-book market segments the mechanisms are different. There is no need for the vehicle and the passenger to be at the same point in space and time, prior to the trip. Rather, it is up to a dispatcher to match the supply and demand. In a way, this market segment is 'business-to-consumer', rather than 'peer-to-peer' as for hail and stand.

The coupling of supply and demand in this segment is a process that traditionally has required a lot of local knowledge and coordination. However, since the 1990s this segment has benefited greatly from the use of computers. As the segment has been the most computerized, this is also the segment that has been influenced the most by the arrival of new communication technology. One consequence is that 'pre-booking' can now can be done instantly. Still, there are economies of scale, with respect to fixed costs. There is also economics of density, with the vehicle closest to the customer typically being the most attractive option. However, in this market segment a potential customer can quite easily contact different companies and compare prices and availability. It is also easier to build up a set of experiences with different companies. These market properties reduce the need for regulatory intervention to ensure the passengers fair treatment, on a single purchase. In an unregulated market, scale and density effects points towards either a monopoly, or a dominant actor with a competitive fringe. This is in accordance with findings in Arnott (1996), Cai (2011) and others. Both solutions may be undesired from a societal point of view, if one assume away the regulated, subsidized monopoly as a realistic solution. And focus on efficiency gained from functioning competition.

In addition to these single trip market segments, many public authorities and private companies have a requirement for unscheduled passenger transport. These services are not necessarily conducted by the same actors that provide the services to the public. However, there is no technical reasons why a vehicle that does single trips should not also be able to be used for multiple trips. This is a 'business-to-business' market segment, for services that can be provided by various actors. Who provides these services are depending more on regulation, both governmental and company, than on the properties of the market.

Consequences for regulation

As the markets in the street and pre-book segments have different properties, this points towards a need for different regulations. A common way to address this has been to use a two-tier system. With different regulation for the street and pre-book segments. Also, as

unscheduled passenger transport is inherently flexible, the way in which these market segments are regulated will influence how these markets evolve.

The principal reasons for regulation in the street markets include; public safety and security, fair treatment of passengers with respect to quality and price, environmental concerns, congestion, working-conditions and city image. Many of these are relevant also for the pre-book segments. This is not the case for fair treatment of passengers, as these market segments have properties that should solve this issue without public intervention. Issues related to density and network economics, and the abuse of market power by the large actors, additionally calls for different regulatory approaches.

4. Results

As part of the Aarhaug and Olsen (2017) study, a business as usual scenario (BAU) was constructed thorough a broad literature study, addressing global trends at the Landscape, Regime and Niche levels. The landscape level refers to slowly changing external factors, including macroeconomic developments, socio-demographic changes, and transport sector trends, while the regime level refers to the 'dominant' configuration of actors, structures and practices. Finally, the niche level refers to a space where non-conformism and innovation can develop (Kern, 2012). While the literature study revealed considerable uncertainty on all three levels, our approach was targeted towards capturing a "median" or "consensual" view from significant contributions.

In addition, a survey targeted at key stakeholders at a global level for unscheduled passenger transport was conducted in Aarhaug and Olsen (2017). The survey mainly consisted of projections of the future, recognised as particularly relevant through the work BAU scenario.

Analysed results from the survey provided two main scenarios as alternatives to the BAU scenario. These scenarios which will form the basis for our discussion in section 5. The alternative scenarios are the Conservative Car-oriented Scenario and the Technology Innovation Scenario.

The Business as Usual Scenario. The projections in this scenario include:

- A smaller share of the population in major urban areas own their own car, but the total numbers of cars increase
- Self-driving automated vehicles are not replacing the traditional car in the short term
- The costs of using taxis are as today as are the cost of using public transport
- Urban congestion is in part addressed by increased use of congestion charging
- Zero or low emission vehicles are gradually taken into use
- Low-income groups increase in size
- Fewer young people own private cars, while car ownership in other groups continue to increase

The factors included in the business-as-usual scenario point toward increased use non-personal vehicles, both for trips within and between cities. However, there are few or no radical changes in terms of new technology within this scenario, rather the technological development is a slow and continuous process.

The Conservative Car-oriented Scenario. The projections loading into this scenario include

- A larger share of the population in urban areas own their own car
- Self- driving vehicles have NOT replaced the traditional car
- The costs of using a taxi is higher than today
- The costs of using public transport is higher than today
- Urban congestion is worse than today
- The problem of transport sector emissions has NOT been resolved by technological advancements
- Low-income groups cannot afford to live in central urban areas

These factors influence travel mode choice and costs. There will also be an increased share of the population owning their own car, more expensive taxi and public transport, and subsequently increased urban congestion.

The conservative car-oriented scenario also includes characteristics that opposes to projections on technological advancements. This means that the conservative car-oriented scenario rejects the notion that technological advancements will solve transport sector emissions, as well as that self-driving vehicles will replace the traditional car.

The Technology Innovation Scenario. The projections loading into this scenario include

- The middle-income group has declined; a polarization of labour has taken place
- The different transport modes will be more integrated than today
- There has been a considerable automation of labour
- Mobility-as- service (MaaS) will be provided
- The population value experiences and recreation higher than purchases of goods and services

These factors concern a belief in automation of labour and its subsequent consequence; a decline of the middle class and a polarization of labour.

This scenario also includes projections such as the introduction of MaaS, and a subsequent belief that different transport modes will be more integrated than today.

5. Discussion

5.1 Implications on regulation in the Business-as-Usual scenario

This scenario points towards ridesourcing becoming an increasingly dominant mode in the segments for unscheduled passenger transport. Also, unscheduled passenger transport gain market shares from private cars and scheduled public transport. It is mostly the increased role of ridesourcing which has implications for regulation. In this scenario autonomous vehicles are still a way ahead in the future. Self-driving vehicles retaining the driver, changes the skill set required for driving, but not the economics related to having a driver in the vehicle.

Looking at the *Street segments,* the main effect of ridesourcing is from increased competition from the pre-book market segments, where the ridesourcing services are a part. From a passenger point of view and a regulatory perspective this is good thing. As the street segments require regulation at the lowest level. A transfer of passengers from street to pre-book reduces the number of actors that face the information asymmetry that creates mechanisms pointing towards strict regulation of prices and quality. However, the arrival of low cost ridesourcing

means, as observed in many cities, that large parts of the established taxi industry need to change its business model, accept being side tracked or get a form of regulatory protection. Within this scenario, although evidence such as Schaller (2017) point towards the street market segments becoming less important, the street segments does not disappear, at least not in the short term.

From a theoretical point of view, ridesourcing is part of the *pre-booking* market segments, as there is no need for the vehicle and passenger to be at the same point in space and time when the trip starts. Ridesourcing also have the same economic properties as traditional actors in this segment. The main change within this segment is therefore that the supply side has received a large shock, as ridesourcing has made it a lot easier to enter as a driver/operator. Similarly, the transaction costs created by dispatching has presumably been reduced, as the connection between driver and passenger is increasingly automated and scalable with an app-based dispatching system. This has allowed dispatching to move from a city scale to a global scale, increasing the concerns related to network economics and tax evasions.

As a consequence, maintaining *competition* between actors is a key issue in this scenario. The question of how to ensure continued competition within the unscheduled passenger transport markets, where the network economics point in the direction of a monopoly, and also to direct intermodal competition in a way which results in an undesired modal split.

The questions related to regulation of labour also increase in this scenario. This is a reflection on the role of ridesourcing companies compared with more traditional dispatchers. An important point is the shift in focus from efficiency towards redundancy. This has been pointed out, on a more general note on the 'collaborative economy' by Rolandson (2016). He states that one of the advantages of platform technology is the scaling possibilities. Platforms can handle huge volumes of small contributions. This can result in a shift in focus, on the production side, from cost efficiency to redundancy. Which is a point that has significant impacts related to urban planning, not only within the transport sector. Production efficiency point in the direction of high rates of vehicle utilization, while redundancy point towards having large fleets of vehicles available. Rolandsson (2016) identify some characteristics of the collaborative economy, in particular that the focus has shifted to underutilized resources and that innovation no longer is in terms of new services but in new ways of starting and conducting business.

As efficient vehicle utilization become less important, compared with having access to a lot of vehicles. This has consequences for regulation, in particular related to working-conditions, where this shift points towards lower income per vehicle kilometre; and congestion, as access to more vehicles means that more vehicles need to be out on the streets.

5.2 Implications on regulation in the Conservative Car-oriented scenario

In this scenario, the use of private cars increase, while other modes, such as car sharing, taxis, ridesourcing and public transport lose ground.

As all unscheduled passenger transport modes lose ground, the net effect is that there is little change in the issues related to the street and the pre-book segments, compared with the business as usual scenario.

As the main development in this scenario is increased car use *congestion* gets increasingly worse in the major cities. This impacts regulation, related to the use of city space and environmental regulation. The direction of this effect is not obvious within this scenario. On the one hand, congestion point toward increased use of congestion charging on private vehicles limiting making it less attractive to use private cars in peak hours. A question being to what extent this regulation also will be targeting commercial passenger transport vehicles. Similarly, congestion caused by increased use of private cars points towards changing the use of city space, promoting the use of other modes and ridesharing, as an alternative. As part of promoting other modes, promotion of non-personal vehicle use, by creating better stands, and giving access to priority lanes for high occupancy vehicles etc. may be relevant. However, it is doubtful these measures would be as effective as using some form of conventional public transport, with respect to alleviating congestion. On the other hand, a very possible political implication of the conservative car-oriented scenario is that private car use is increasingly being supported by the government, at the expense of other modes. If car use dominates one would expect that the interests of private car users will be given priority in political processes. This points towards an uphill fight for non-personal vehicles, in all market segments. And tightening competition for to the use of the scarce resources that city space is.

Further, in this scenario an increasing share of the population will move to the suburbs, with private car based commuting. From a regulatory perspective, this again points towards congestion charging, and promoting scheduled public transport, rather than regulatory measures that are affecting the market segments for commercial unscheduled passenger transport directly. The condition being that car-pools and ridesharing do not continue to grow (as opposed to a continuation of the trends of rapid increase in car-sharing and related services described by Bert et al. 2016, and the developments in the BAU scenario). On the one hand this scenario plays well with increased use of ridesourcing, with a more car centric culture and use of space, together with an increased share of the population being more cost sensitive. On the other hand, the scenario is focused on the private use of cars.

In the conservative car-oriented scenario *environmental* concerns are not addressed by the arrival of new technology. This means that these concerns has to be addressed by policy measures, and very likely also on city level. How these policies are shaped will influence how the different industries within unscheduled passenger transport evolve.

5.3 Implications on regulation in the Technology Innovation Scenario

This scenario point towards autonomous vehicles being available commercially. This will radically affect the market for unscheduled passenger transport, as labour costs are reduced. As a consequence, one would expect the fares the passengers pay to fall. Using a Norwegian example (Aarhaug et al. 2013), labour cost typically constitute about 60 percent of total cost in taxi operation. Consequentially, we expect this market segment, unscheduled passenger transport with autonomous vehicles, to both induce new demand and to gain market shares from other modes, in particular scheduled public transport.

Autonomous vehicles will be able to function on the *street segments* in a way that ridesourcing is not, or at least is regulated out of. In this way, autonomous vehicles would merge the street segments with the *pre-booking* segments. Lowering cost would point towards increased use, both from induced demand and transferred demand from other modes. Consequentially one would expect a move towards higher density in supply, which again, trough Mohring-effects result in higher welfare and usage. The answer to the question of to what extent autonomous vehicles are opening up for the shared usage of vehicles at a higher rate than today, will play a key part in deciding the environmental consequence of this. Within this scenario, autonomous vehicles are shared more than conventional cars. This can be regulated by focusing on ownership.

If we look at ownership as the key question for addressing the regulatory impact of automated vehicles in unscheduled passenger transport, we are also looking at how is this market to be organized. If the market for these vehicles are organized in a way where the vehicles are owned by a public entity, or by a company acting on a public entity's behalf, possibly provided to the public at a subsidized rate; one would expect that larger vehicles for joint use are given priority and that the number of passengers per vehicle kilometer would be substantially higher, compared to a situation where the vehicles are to be owned by private individuals. Private fleet ownership is also an option. In any case, a fleet or joint ownership solution point towards shared use, not necessarily that each trip will be shared between individuals, but that each vehicle will transport other persons than its owners. This would, all other things being equal, increase the vehicle kilometers provided.

Given some form of common ownership, one would expect that the market structure of today's pre-book market segments would prevail, based on the network effects. With its associated possible regulatory solutions, either to auction the operation of such vehicles as a private monopoly, as it today is the case for the bus sector, following the Scandinavian model (Bekken et al. 2006) or to enforce a competitive solution using regulation in a similar way as can be used on some taxi markets today, with licenses and regulation on the maximum market shares of each operator in each region.

With individual ownership of automated vehicles, the regulatory context will be very different, more like that of private cars. Consequentially instruments such as congestion charging and vehicle standards for environmental regulation become more appropriate policy measures. Competition will not be an issue, outside what is covered by ordinary competition laws. However, the need to regulate the use of city space, will be substantial as one would expect the vehicle mileage to increase, and the number of passenger kilometers per vehicle kilometer to drop, both from lower occupancy, as the vehicles can be used to drive back empty to park, and from induced demand, lower generalized cost associated with each trip and transferred demand from other modes, in particular public transport as the cost, and disutility of using a private vehicle is reduced.

5.4 Summary discussion

Unscheduled passenger transport on the street market segments has some properties that calls for some regulation more than what is necessary in other markets and market segments. The future scenarios; both the business-as usual scenario created from literature and the

alternative scenarios created from the expert survey points in directions where the street market segments become less important. However, only in the case where autonomous vehicles dominate, will the issue of information asymmetry between transport provider and passenger be addressed, and this is the major rationale for regulatory intervention in this market segment.

On the pre-book market segments, other issues than information asymmetry and the fair treatment of passengers are more important. As this segment gain both in terms of shares of the transport market but also in terms of total size in both the business as usual, and technology and innovation scenarios, regulating it in a good way become important. In particular the issues related to network economics are important to take into account. Also, geographically the areas outside of the densest parts of the cities. Defined according to market properties the densest parts of the cities is where the cruising segment without any form of hailing apps today is a viable solution.

In these places, where unassisted street hailing is a real option, such as on Manhattan in New York, the network effects would probably be less important, as more than one network can have a competitive number of vehicles available for hailing within a reasonable time. But, for most cities the network effect points towards regulation focusing on creating an even playing field for competition. This include limiting the largest operator's possibilities for using their market power to curb competition. In this we assume that the first best solution of the subsidized monopoly, is not an option. This situation also points towards a need for research on what the relevant markets are, both in terms of intermodal competition and geographical scope. A monopoly in a market segment, is only a bad thing, as long as the monopolist has a possibility to extract monopoly rents. If there are viable options, such as scheduled passenger transport and private car, arguments for a monopoly in the unscheduled passenger transport markets can the best solution, can be presented. This is will not be the case if we take the contract segments into account. Still, a monopoly as the best solution is doubtful as it is easy to imagine such a monopolist creating situations where rent can be extracted. Specially, since such an actor could combine being monopolist towards the consumers, with being a monopsonist towards the suppliers.

Also in all scenarios congestion remains an issue. But, the regulatory options to address this, will depend upon which business models are allowed to be used, in particular with respect to the ownership and use structure of automated vehicles, in the technology innovation scenario. Similarly, the need for environmental regulation will remain, regardless of development scenario, but the toolbox available will depend upon the market structure.

6. Conclusions

This study argues that both ridesourcing and autonomous vehicles will influence the need for regulation of unscheduled passenger transport. Not so much reducing the need for regulation compared with todays' situation but, rather changing the parameters that are important to regulate. In all the scenarios discussed, the street market segments that today is dominated by taxis, loose out. Either to private cars or to pre-booked trips, provided by ridesourcing, taxis, ridesharing or similar services. This reduces the need for regulation to ensure fair treatment of

passengers, the market will solve those issues, given that there is functioning competition on these markets. However, the last condition is becoming increasingly important, as the pre-book market segments are influenced by network economics. And that as long as the playing field is divided between actors following different rules, it is difficult to enforce proper competition rules. Also, the issues related to information and fair treatment of passengers on the street segments may not disappear before manned vehicles and cash payments no longer are an option. Meaning that suitable regulation of these segments must continue to be found.

In the scenario with autonomous vehicles, the key question influencing the regulatory options at city level is how the market will be organized. Will the vehicles be owned and operated by private individuals, by companies operating them as taxis or are the vehicles going to be operated as part of public transport? In the first case, congestion and environmental issues may call for substantial regulation, in the latter these issues may be dealt with in contracts between the authorities and operators without the need for much explicit regulation.

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