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ORIGINAL ARTICLE

Benchmarking ride-hailing regulation in global cities using mixed-method approach and social practice theory

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ABSTRACT

Ride-hailing or private hire has been around the globe for a decade now but even less in Asia. Singapore has had more than three revisions to its ride-hailing regulation in the six years since the arrival of the disruptive technology, the most for an Asian city. Often quoted in the list of cities with a commendable public transport policy, Singapore still manages to find a viable and significant position for ride-hailing. Singapore, to a large extent, has formulated a successful model based on current market parameters and, more importantly, an adaptive one that evolves constantly with the continually disruptive technology. But how does this compare to cities around the globe? Global cities have formulated different policy regulations for the sector, with each one of them enjoying varying degrees of success and failure. Utilizing a mixed-methods approach using qualitative and quantitative data, Singapore's ride-hailing sector was benchmarked with chiefly nine global cities. The qualitative data was analyzed using the 3-element model of the social practice theory as an alternative to conventional behavioral studies, thereby eliminating bias on the commuters and rather shifting focus to the practice. The findings were validated by statistical analysis of quantitative data, namely, trip information from the ride-hailing sector in Singapore and driver earnings. The unique addition of the research to ride-hailing policy is the comprehension of the commonalities and patterns across industrial and technological disruption, practice and policy irrespective of sectoral variations thanks to the utilization of the social practice theory. The first-of-its-kind policy exercise in the sector can be repeated for any city, which is a direct testament to the simplicity and exhaustivity of the methodology, benefitting both operators and investors through equitable policy formulation.

Keywords*: benchmark; ride-hailing; transport policy; social practice theory; transport regulation*

1. Introduction

Asian cities have seen the arrival of ride-hailing chiefly in the latter half of the last decade, and policy intervention in its regulation is still in its nascent stages, with some cities completely bereft of any such policy for private hire or ride-hailing (used interchangeably in this document). Singapore has assimilated taxis and private hire, as the point-to-point (P2P) transport sector, into one network. Singapore has recently enforced the third and its most comprehensive regulation for the industry in the year 2021. But the policy derivates of the Singapore

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model are sometimes in stark contrast to other successful cities. And yet, it is relatively successful in the city-state. Furthermore, the use of social practice theories (SPTs) to analyze and interpret transport policy is also in its nascent stages, in comparison with traditional behavioral theory approaches. Shove, Pantzar and Watson's (2012) 3-element model (**Figure 1**), often cited as the most accessible representation of the field, allows a poignant analysis encompassing the delicate intricacies of policy framing in a sharing economy across borders.

1.1. Validity of research and contribution to ride-hailing regulation

Traditional transport planning research focusing on similar mobility and user behavior modeling neglects the ancillary options of aligning the physical development of cities with infrastructure changes and reinforces existing travel patterns.

Benchmarking not only allows for a comparative study but also facilitates the validation of policy sectors through the evaluation of parametric statistics that allows researchers to gauge a regulation's efficacy even before its execution.

The unique addition of the research to ride-hailing policy is the comprehension of the commonalities and patterns across industrial and technological disruption, practice and policy irrespective of sectoral variations thanks to the utilization of the social practice theory.

The method allows the economy of time and money, permitting the study of processes over a long period of time with completely unobtrusive research. However, it is acknowledged that the research is limited to the examination of recorded data, especially data of foreign cities.

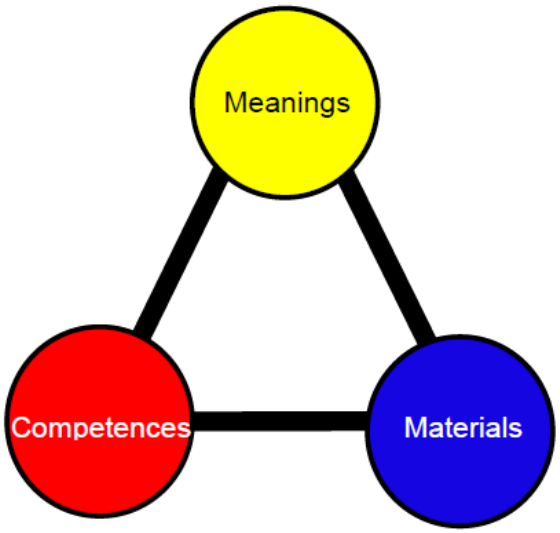

Figure 1. 3-element model

The documented policy exercise can be repeated for any set of benchmark cities, which is a direct testament to the simplicity and exhaustivity of the methodology, benefitting both operators and investors through equitable policy formulation.

2. Review of literature

Prioritizing the practice rather than the individual practitioner gives SPTs superiority over traditional psychological approaches. As per Metcalfe and Dolan's summary on traditional behavioral economics approaches (Metcalfe and Dolan, 2012), it is a model allowing for the juxtaposition of psychological inferences and economics. Yet, such dogmatic models tend to underexplain mobility and travel choices, as the models fail to account for the bias in the travelers' attitude towards the mode choice, as the physical infrastructure for mobility is centered around private travel by personal cars traditionally.

The research gap faced in traditional social theory usage in transport research is elaborated by Cairns et al. (2014) as owed to findings usually validated by theory-building constructive qualitative analysis and rarely validated applying empirical techniques. The 3-element model of materials, meanings and competences investigates the dynamic interaction of the elements developing the practices of mobility. The method is superior to traditional psychology-based approaches, as it comprehends and interprets the influences on the practices of mobility (including ride-hailing and alternate modes) and recognizes the structures and processes that impact the movement of people.

Ajzen's theory of planned behavior (Ajzen, 2011) delves into the choice of the individual or the objective of task execution and states that greater intent ensures a greater likelihood for the occurrence of the task. The likelihood of changing such behavior varies in direct proportion to the degree of control the practitioner has on the externalities. A higher control results in higher predictability. Giddens' structuration theory distances from societal functions and focuses on structures, asserting that the central pillar of structures in social theory is "the structuring of properties allowing the 'binding' of time-space in social systems" (Giddens, 1984, p. 17). At the moment, there is no single unified theory of practices.

The 3-element model is an extension of the structuration theory by superimposing the ambiguity of human actions and the external systems that influence them (Shove et al., 2012). The intersection of elements leads to the formation of a practice, as seen in **Figure 2**. A practice evolves or forms anew with breakages and linkages in the elements. It is at these points that policy interferences must be made for maximum efficacy. A regulator must ensure the creation of opportunity change through interference at element breakage.

Lee, in his study, encompassed most cities in Southeast Asia and explored the use of indices for capturing a sharing economy's market potential (Lee, 2016). The parameters were constructed using an aggregation of data, such as population demographics, GDP, age of citizenry, tourism statistics and network infrastructure and usage. He explained the technological disruptions caused using the number of car ownership, the increase in the number of rental vehicles, and other peripherals, but the research tended to explain trivial findings that would be intuitive regardless of any scientific study.

Ching studied policy shortages in Singapore's P2P sector, even explaining the shortcomings of

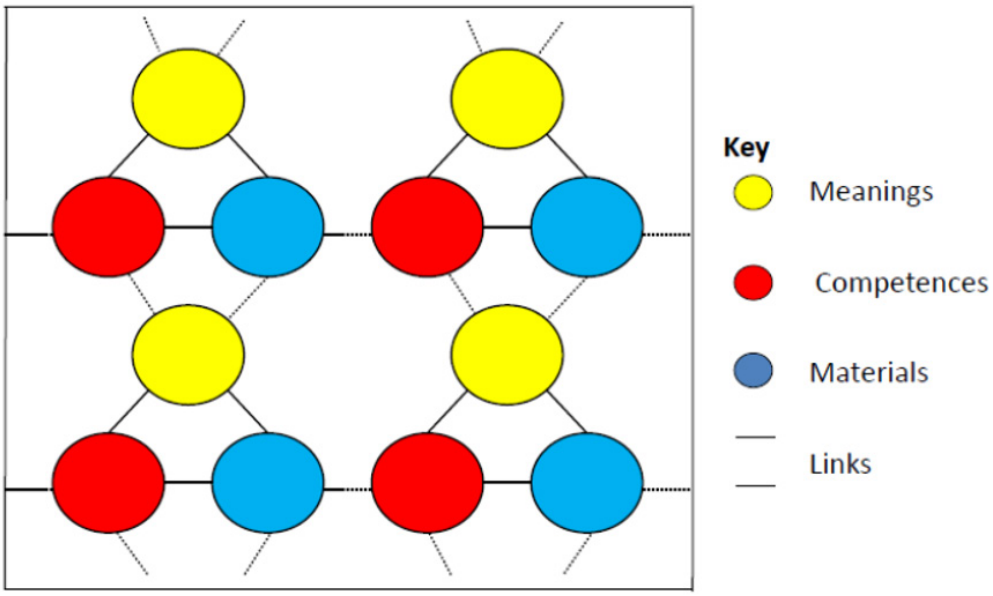

Figure 2. Complexes of practices

the taxi policy and the lack of ride-hailing regulation, which caused the unprecedented growth of the mobility-sharing economy (Ching, 2017). But his study tended to be largely policy-based with a focus upon housing policies and their effect on regulatory oversight in mobility.

Farren, Koopman and Mitchell went one step further and focused upon taxi regulation, with a novel addition of suggesting deregulating the sector to provide a level playing field (Farren et al., 2016). Their usage of scenario-based studies with gradual interference of regulatory input is admirable.

Singapore's transportation policy tends to show a dichotomous bias, with the infrastructure focusing upon personal car travel traditionally and subsequent land-use planning is pertinent to mass transit, thus causing a unique ecosystem for P2P and mass transportation to thrive simultaneously, as explained by Palliyani and Lee (Palliyani and Lee, 2017). The finding was further explored upon in this study.

Williams (2015) utilized the application of the social practice theory to analyze the English system of transportation planning, which was centered around behavioral economics models, augmenting the process with a Systems of Provision addendum to comprehend the evolution within the process. Content analysis of expert interviews with transport professionals within the industry from local and governmental bodies allowed the isolation of the policy action gaps in the English transport planning system, which was elaborated upon by the complexes of practices elucidated from the 3-element model. The same methodology was used to benchmark the ride-hailing policies across the cities in consideration with Singapore's.

3. Methodology

Nine cities were primarily selected for benchmarking with respect to the Singapore case, based on considerations of multiple criteria, such as comparability to the Singapore scenario and the availability of data. For the purposes of simplifying comparative analysis, the cities belong to both

developed and developing nations. Singapore, while being a developed nation, does exhibit certain traits of a developing nation due to its geographical position and relatively young history. The cities were Mexico, Toronto, Shanghai, Jakarta, New York, London, Mumbai, Moscow and Melbourne.

However, in the case of European and American cities, certain data from neighboring cities were incorporated due to the unification of laws based on the European Union and the United States protocols. Yet, the primary cities in consideration were the nine mentioned.

Data were collected in the form of over 110 news articles and over 43 legislative documents from the selected cities for textual analysis using QDA and then aided by a mixed-method approach to complete the policy study.

When it came to selecting news platforms, care was taken to avoid invalidated news agencies and other inferior publications to ensure the credibility of data. The legislative documents were collected both online and through contacts in the respective agencies of the selected cities. Mostly, these were policy white papers or parliamentary bills that were released to the public based on information rights.

Trip data were analyzed using the statistical analysis program JASP to investigate ride-hailing characteristics in Singapore and validate findings in the benchmarking exercise. Data were collected from HDT Singapore Taxi (HDT) for January 2020. The data consisted of only app-based booking, as it was requested to remove street hail data. Since HDT partners with the ride-hailing giant Grab and comes under the platform, essentially the data were a good representation of app-based rides. The standard data points included taxi number, shift start and end times, date and timestamps of start and finish of trip, coordinates of origin and destination, and distance of trip.

Shove, Pantzar and Watson (2012) break a social practice into three core elements in the 3-element model, as shown in Figure 1:

1. Materials: include things, technologies, tangible physical entities and the stuff of which objects are made.
2. Meanings: include symbolic meanings, ideas and aspirations.
3. Competences: encompass skill, know-how and technique.

The evolution of these elements is based on the following rules:

1. Materials are the only elements that can move physically.
2. Materials have physical characteristics (mass, durability, etc.) that can be at times be transformed during processes such as transportation.
3. For all three elements, the extent and rate of circulation vary with the presence and absence of the infrastructures of transport.
4. Materials, unlike competences and meanings, are free from codification and de-codification.
5. Competences can only be transformed if there exists a prior form of base competence.
6. Meanings evolve faster than competences, as skill acquisition takes time.

7. The evolution of one element is dormant in effect until the other two join in the practice.

The text data were coded and analyzed using the abovementioned rules to develop policy derivatives from the content.

4. Findings and discussion

In the process of benchmarking, 18 indicators were identified to be pertinent in ride-hailing regulations amongst comparative cities, as shown in **Figure 3**. Trip data analysis results are also presented, along with the benchmarked headings for article conciseness. For purposes of brevity, the results are presented first and the findings subsequently, but it must be taken into account that the headlined indicators were a consequence of the analysis text and not vice versa. They are presented below:

4.1. Labor classification

Proper driver classification is absent in most cities. Apart from New York City and London, as a consequence of multiple lawsuits, no other benchmark cities consider drivers as employees and hence drivers are not entitled to benefits. In the case of California, the passing of the AB5 regulation gave drivers more independence and power, enabling Uber to meet the requirements of the new regulation and circumvent paying for employee benefits, such as healthcare, overtime and medical leave. Although driver satisfaction is preliminarily high for the initiative, customers complained about the drop in service reliability and drivers refusing to accept rides. Uber reported 33% of California drivers declined over 80% of ride requests, affecting 20% of passengers' service requests (Said, 2021).

However, strong-arming platforms to take care of drivers as employees, akin to traditional

* Parameter	Mexico	Toronto	Shanghai	Jakarta	New York	London	Mumbai	Moscow	Melbourne
Central Government Legislation	Absent	Absent	Legislated	Legislated	In planning	Absent	Legislated	Absent	Legislated
Trip Data collection	Legislated	Legislated	Legislated	Absent	Legislated	Absent	Legislated	Legislated	Legislated
Data set publication	Absent	Absent	Absent	Absent	Legislated	Absent	Absent	Legislated	In planning
Accessibility	Absent	In planning	Absent	Absent	Legislated	Absent	Absent	Absent	Legislated
License Caps	Absent	Absent	Absent	Absent	Legislated	Legislated	Absent	Absent	Absent
Public Transit Taxation	Legislated	Absent	Absent	Absent	Legislated	Legislated	Absent	Absent	In planning
Vehicle standards	Legislated	Legislated	Legislated	In planning	Legislated	Legislated	In planning	Absent	Absent
Driver training and testing	Legislated	Legislated	Legislated	In planning	Legislated	Legislated	In planning	Absent	In planning
Driving hours cap	Absent	Absent	Legislated	Absent	Legislated	Absent	Absent	Absent	Legislated
Community participation	Legislated	In planning	Absent	Absent	In planning	In planning	In planning	Absent	Absent
Green vehicle policy	Legislated	In planning	In planning	Absent	Legislated	Legislated	In planning	Absent	Absent
Driver pay protection	Absent	Absent	Absent	Absent	Legislated	Legislated	Legislated	Absent	Absent
Surge price regulation	Absent	Absent	Legislated	Absent	Absent	Absent	Legislated	Legislated	Absent
Minimum fare	Absent	Legislated	Legislated	Absent	Absent	Absent	In planning	Legislated	Absent
Insurance	Legislated	Legislated	Legislated	Legislated	Legislated	Legislated	Absent	In planning	Legislated
Background check by authority	Absent	Absent	Absent	Absent	Legislated	Legislated	Absent	Legislated	Absent
Taxi-ridehailing policy differentiation	Legislated	Legislated	In planning	In planning	Legislated	Legislated	In planning	Absent	Legislated

Figure 3. Regulation parameters of cities (as of 2021)[1]

[1] Labor classification is not listed in the figure and hence only 17 pillars are visible.

services, will inadvertently push up costs, which could make the model unviable. A possible division of labor is based on an adaptation from Estache and de Rus' (2008) World Bank model of division of labor for the privatization of transport, as presented in **Figure 4**. There are areas of potential overlap, but it is imperative to protect the independence of the regulator and make sure that it operates with complete transparency within a clear framework for accountability.

In ride-hailing, driver pay is not always a fixed proportion of passenger fare and depends on fare promotions, shared-ride or single-ride selection, and route-based pricing. Hourly pay varies based on passenger volume, service type and time of day.

The floor pay contains the reservation wage, which is the lowest rate at which the worker would perform a job. It is based on the nature of work, the cost of switching employment, education qualification level, health and marital statuses, the amount of vehicle investment capital and the probability of finding work elsewhere. Often, this amount is below the minimum wage in the market.

The volume of freelance workers amongst employed residents in Singapore increased by 10% to 211,000 in 2019 since 2016. Especially during the pandemic, the gig economy is a great avenue for people to recoup lost earnings and a good cushion for the unemployment market.

In 2020, legislation was passed for freelance workers employed by the government: a Contribute as You Earn (CAYE) pilot scheme, where a portion of payment for their services is automatically transferred to their respective Medisave accounts. But workers in the sharing economy of the private sector are not covered under this.

Investor risk assessments must be based on several factors, such as the nature, stability and credibility of the macroeconomic policy, corporate governance, tax policy and labor market policy

Figure 4. Adaptation of division of labor (Estache and de Rus, 2008)

and other non-policy risks. Such risks could be avoided or mitigated, to an extent or completely, through increased stability in the regulator's policy approach. Systemic regulatory, legal and related institutional reforms should be transparent, stable and predictable.

Flexibility is key and gig workers should be capable of changing employment in the sharing economy and the traditional economy without difficulty.

4.2. Safety

According to a 2019 Uber report, 3,045 crimes of sexual assault were reported in rides in the United States in the year 2018. According to the Association of Women for Action and Research (AWARE), Singapore's women's rights and gender equality group, its Sexual Assault Care Centre reported that technology-facilitated sexual violence (TFSV) increased threefold in 2016–19, as shown in **Figure 5** (AWARE, 2020). TFSV is defined as unwanted sexual behaviors carried out via digital technology, such as digital cameras, social media and messaging platforms, and dating and ride-hailing apps.

Grab's responses include number masking and a feature that allows passengers to notify security in an emergency and share their ride trajectory with emergency contacts. It was only as late as 2019 that Gojek allowed Singapore drivers an option to install inward-facing recording devices in their vehicles (Hingorani, 2020). The data is stored for a week and access is granted to authorized data controllers should the need arise. Malaysia launched a women-and-children-only transportation and delivery service called RidingPink a few years ago.

India's double-layered GPS security feature is a valuable addition ("Parliament passes three Labour bills", 2020), much like China's plugin that automatically sends a text message to a rider's emergency contact at the start of the journey (Panayotopoulos, 2018).

Moscow's vehicle speed monitoring system tracks vehicle speeds via GPS and compares them to the road speed limit as a means to monitor speeding (Mikhailova, 2018). Should the driver receive

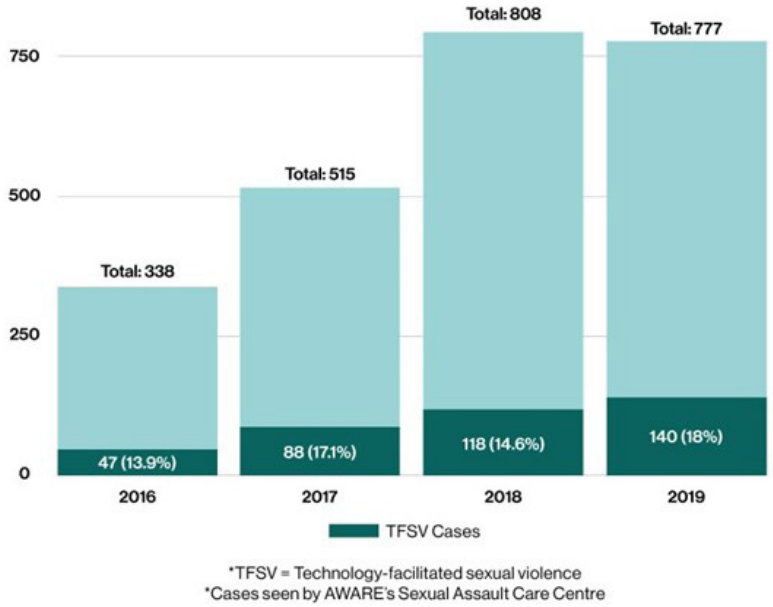

Figure 5. TFSV cases in Singapore, 2016–19

an excess of a certain number of warnings, they are barred from the app.

Safety in most western cities is an issue of privacy vs. safety and, as such, any legislation on increased safety measures meets with heavy rebuttal from the citizenry. In Asia, the culture ignores such questions, but every city turns out to be different. The research opines that safety must take priority.

4.3. Governance

While most benchmark cities displayed characteristics of multilevel governance, aspects of policies on sustainable urban development and city governance are increasingly uniform even across different national contexts. Almost half of the benchmark cities enforce regulations based on the national government's guideline, with the more successful cases, such as in China, showing the national government providing autonomy for local governments to adapt the executed legislation. The practice is praiseworthy due to their adaptive nature, as they transformed from the initial understanding of the sharing economy from one that utilizes idle resources to a new economic modality that optimizes the allocation of scattered resources by making use of network information technology through the internet platform.

Considering city administrative regimes, European cities, such as London, traditionally represent a more decentralized or network approach with independent boroughs across units of local government, whereas Asian cities, such as Shanghai, have a more centralized or hierarchical system dominated by a citywide government. The primary difference contrasting them is that hierarchical systems allocate resources in a single interaction, but networked systems are accompanied by repetition and stability (Peters, 1998). Hierarchical systems, however, do come with a caveat of the risk of alienating the higher management from ground issues (Rhodes, 2002). In contrast to authoritarian structures, due to the presence of the social nature and the reliance on reciprocal exchange and interdependence between stakeholders, networked systems are ubiquitous in networked systems (Powell, 1990).

Rather than focusing on hierarchical or networked forms of integration, ideal planning and policy integration convene on a hybrid model that combines hierarchy and networks. The best form of planning has been identified to be centralized transparent policies, and since Singapore is a city-state, the default is the absence of dual government. In Singapore, the Land Transport Authority (LTA), being the sole regulatory authority with the ceremonial involvement of the Public Transport Council (PTC) in terms of fare regulation, is a model that ensures directed and clear execution.

Ideally, federal and state policymakers must offer local governments the flexibility to use available funding in the manner that best addresses local needs, with supervision from a regulatory authority to facilitate a hybrid model. Federal regulations should not limit the ability of local governments to address local pollution, congestion and accessibility, while allocating a buffer for a certain degree of self-regulation by platforms.

4.4. Data transparency and regulation

Almost all benchmark cities have detailed data collection procedures with periodic reports to the authority, with shortages in terms of publicizing the data, with Moscow and New York being the only exemptions.

Moscow's practice of analyzing popular routes and traffic intensity and even immediate parking and design transit systems is admirable. Singapore possesses stringent data security laws and yet the regulator accepts the need to adapt over time. Singapore's Personal Data Protection Act (PDPA) includes requiring organizations that are breached to notify consumers upon alert; in the case of over 500 patrons' data are compromised, the Personal Data Protection Commission (PDPC) must also be notified within 72 hours, and in the case of a critical infrastructure being compromised, Singapore's Cyber Security Agency (CSA) must be informed.

As a consequence of regulation, passenger data sharing is a requirement and not a request. However, it does present a risk of jeopardizing passenger privacy, as detailed by the EU General Data Protection Regulation (GDPR). Although regulators claim that the sharing of geolocation data is secure, it is found that 95% of individuals could be easily identified using just four of their anonymous geolocation datapoints (de Montjoye et al., 2013).

In the United States of America, despite matured data sharing policy and cyber security, regulators are prohibited from requesting geolocation data in the absence of a warrant, as it is extremely easy to match datasets for central authorities. Since data sharing measures for regular yellow taxis were first introduced in 2017, the number of accidents involving taxis increased by 50% from 2017–2018 and by 80% from 2018–2019. By comparison, the number of taxi rides only increased by 25% from 2017–2019 (Shestoperov, 2019). Safety considerations as the justification for stringent data-sharing requirements for ride-hailing platforms is hence not a valid argument either. Governments in France and Egypt have also been unable to collect data, as the courts determined that it undermines "constitutional principles" and "violated privacy" (Hamdi et al., 2018).

Toronto's requirement of trip cancellation submission prevents false representations by platforms (City of Toronto, 2019). New York collects data regarding the time elapsed between accessible-vehicle service requests and passenger boarding.

Data collection is necessary for fare design to facilitate sustainability and equity. In Singapore, operators are required to submit trip and driver data to the LTA for regulatory and transport planning purposes.

4.5. Accessibility

Self-regulation for accessibility is common in most cities around the globe except for Melbourne and could be a direct legacy of capitalist competition. Melbourne provides a subsidy for disabled passenger fares and even for the purchase of accessibility-equipped vehicles and the upgrade of vehicles into accessibility-equipped vehicles ("Multi purpose taxi program", n.d.).

However, subsidies in cities such as Tokyo and Singapore, with a majority aging population, might not be profitable. In public transport, the goal of subsidies is to move output away from the market to a social-optimum level to improve allocative efficiency, thus encouraging a modal shift away from private cars and, in turn, creating positive externalities and improving sustainability. Another objective is social equity improvement and social exclusion minimization, as low-income households have access to transport. But in Singapore, in 2030, the demographic aged 65 years and above will be 28% of the projected 6.9 million population, distorting the working of the free market ride-hail mechanism. A possibility of government failure would be imminent, where intervention leads to a worse distribution of resources, particularly for individualized transport. Subsidies used

in isolation are less effective than part of the strategic integrated solution to a particular economic/social problem, so the research recommends indirect subsidies, such as encapsulating ride-hail–public transport trips, which provide ride-hail support for merely first/last mile steps with marginal discounts for the elderly.

Toronto legislates an accessibility fund for drivers to offset the cost of providing wheelchair-accessible services ("City of Toronto unveils taxi relief program", 2021).

4.6. License caps

Most cities (except London and New York) do not enforce a license cap, as they consider the flexible nature of ride-hailing drivers. However, the ride-hail's model presents a contradiction for driver earnings. The principle of minimizing response times by maximizing driver supply requires a large number of idle drivers in the system at a given time, keeping driver utilization low and hourly pay low, causing a gap between drivers' objective of maximizing earnings (maximize trips/hour) and the company's objective of minimizing response time. Such a contradiction can be mitigated through license caps. In high-density urban areas, a 10% increase in driver utilization rate increases the response time by 6%, which is just 18 seconds (Cook et al., 2020). So, license caps may be draconian, and stringent entry controls would be enough.

Singapore's 2020 amendments to the P2P framework raising the age limit to 30 is a good first step, but more stringent control mechanisms, such as a clean driving record for a stipulated time period prior to application, clearance of background check by the authority and extensive PDVL training, are avenues where measures can be tightened. Toronto's regulation of three-year minimum driving experience prior to application is a good benchmark (City of Toronto, n.d.).

A deeper policy investigation relays that private hire has the government's backing in Singapore, as they provide an excellent opportunity for people who are in-between jobs and for full-time employees too. Driving part-time could be a viable way for retirees or those in-between jobs as an alternate income. Grab quoted that in Singapore, people from three professions prefer to drive private-hire cars for alternate income, which are insurance agents, real estate agents and full-time tutors, due to the flexible nature of their jobs (Ho, 2017).

Not only could drivers choose to supply relatively small numbers of hours per week, they could also allocate these hours flexibly over the days and hours of the week, adapting on an hour-by-hour basis to changes in demands. While traditional workplaces do compete to provide flexibility to workers, lower-wage and lower-skill workers typically have limited ability to respond to everyday shocks (Ching, 2017).

Singapore continues to experience a diminishing workforce, and in order to attract new employees, companies will increasingly look towards flexible work. Flexible work would provide an advantageous edge for companies to remain competitive in the shrinking labor market (Straughan and Tadai, 2016). Ride-sharing companies have gone one step further and converted this economic obstacle into an advantage.

4.7. Public transit taxation

Taxation in ride-hailing in contribution to public transport, taxi subsidy or accessibility is common amongst most benchmark cities, especially in regions that require external funding for

deficits in infrastructure.

In Denver, public transport fares can be paid through UberApp, thus taking a step towards Mobility as a Service (MaaS). In Mexico, every ride-hail driver must contribute 1.5% of each ride to the Taxi, Mobility and Pedestrian Fund for public works related to mobility. However, there is criticism in execution that only the federal government has access to the fund ("Taxi drivers' protest provokes commuter backlash", 2019).

In the U.S., it was observed that ride-hailing added 2.6 miles for each mile of personal driving replaced (Schaller, 2018). New York observed that ride-hailing diverted passengers from public transport, so taxation is crucial for sustainability. Other by-products include lowering of city speeds and congestion exacerbation. Taxation is not only justified but warranted. As deadheading further adds to congestion and the lowering of road traffic service levels, it seems appropriate to derive from the sector for the damage.

Surge pricing revenues could be selectively taxed, as the rationale is to boost public transport usage during peak hours anyway.

4.8. Vehicle standards

Most cities have stringent standards to adhere to, particularly in terms of emission and vehicular parameters, with the exception of Moscow and Melbourne. The age of vehicles is a well-regulated parameter. Platforms typically self-regulate by removing fleets over 10 years.

In Singapore, the regulator increased the frequency of vehicle inspections for ride-hailing to once a year in 2020 to ensure safety and equate the road tax payable for the P2P sector with that for private cars.

Fleet upgradation is the best possible outcome for environmental sustainability and driver earning maximization.

4.9. Driver training and testing

Driver training and testing must be in line with taxi standards; however, Singapore's particular approach, much like London's, to cross-regulate taxi training in line with technological advancements in ride-hailing emphasizes the ever-evolving requirement of acclimating to the times. Increased frequency of testing, particularly on a yearly basis, is most desirable. New York tests the vehicles three times a year. Excluding Moscow, all cities require training and regular testing of drivers.

In Singapore, the burden of vehicle testing and standard adherence falls upon the operators. The LTA increased vehicle inspection to once a year to ensure safety and that ride-hailing and private car road taxes are aligned. But currently, new vehicles undergo an inspection every 3rd, 5th, 7th and 9th year. This is because these vehicles are under warranty for three years. Only vehicles of 10 years or older undergo an annual inspection.

The training of taxi drivers in GPS technology and smartphone integration to trips is a major method identified that could boost the Individual Public Transport (IPT) sector and level the playing field.

4.10. Driving hours cap

The allure of ride-hailing comes from the flexibility of its work nature that does not require minimum work hours; however, from the perspective of commuter and driver safety, the adoption of maximum driving hours, much like those in Shanghai and Melbourne, is paramount.

In Singapore, it is observed that the average shift time per day is around the 9-hour mark, or more precisely around 8.21 hours, across the four weeks of analysis, as shown in **Figure 6**. The ANOVA of weeks 2, 3 and 4 gave an F(2,2207) of 0.464 with a P-value of 0.63 (95% CI). Failing to reject the null hypothesis, the analysis showed that, under normal conditions, driver hours are uniform at 8 hours.

Furthermore, in Singapore, mass transit ceases after midnight and P2P transport is the only option. The increased presence of ride-hailing drivers at these odd hours is a cause for concern if they are not well-rested. New York's policy of a 10-hour limit in a 24-hour window (City of New York, n.d.) and a 60-hour limit in a week is a good benchmark. Shanghai's policy of a 20-minute offline after a continuous 4-hour shift (Lin, 2019) is also a good point of reference.

4.11. Community participation

Some cities adopted expert reviews for regulation, while others had a community involvement exercise. Cities such as New York, London and Mumbai appointed experts in the field to make regulatory suggestions. Singapore too had invited suggestions from the community for regulation in the P2P sector in addition to expert panel reviews within the LTA. However, a notable parameter in the most successful cities is the periodic update of regulation either annually or biannually. Mexico's system of working tables that involve field experts rather than everyday people seems to be a better technocratic procedure.

On the other hand, Toronto's system of involving provincial governments, municipal governments and planning authorities in the discussion only added more red tapes and complications in the framework execution.

4.12. Green vehicle policy

Varied methods included a fee per trip against emission in Mexico and congestion pricing in

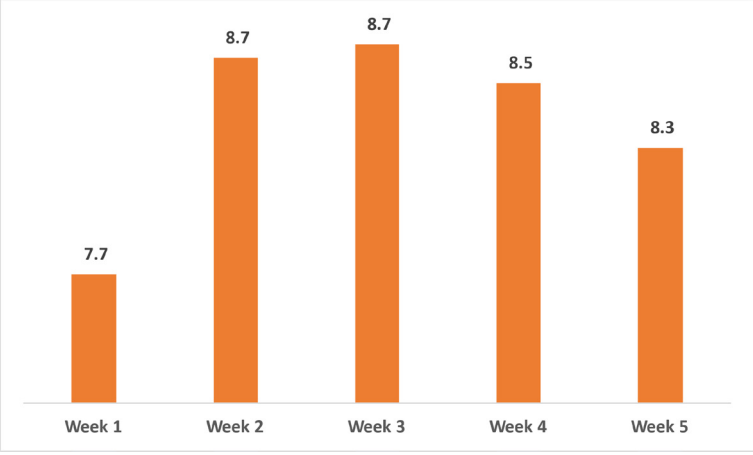

Figure 6. Driver shift hours across weeks of study (January 2020) in Singapore

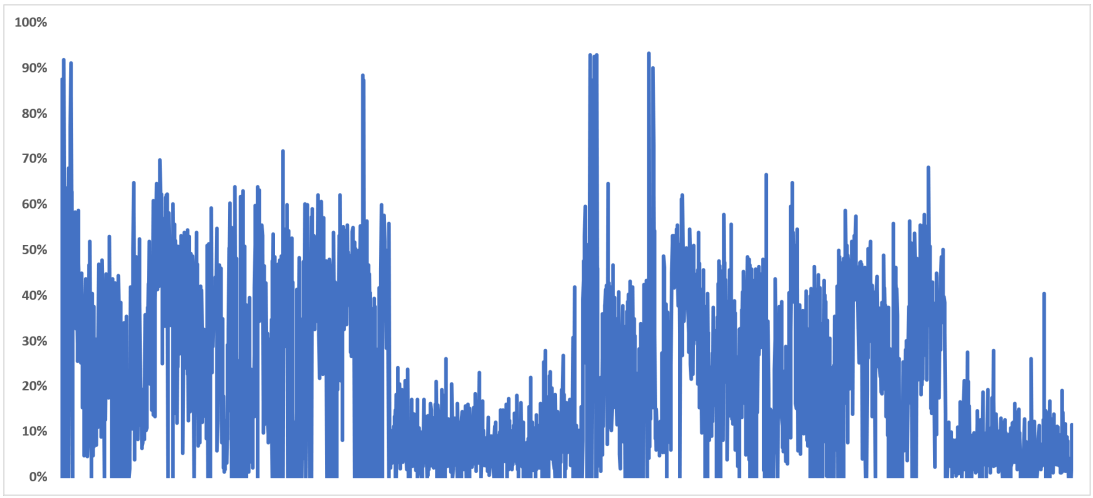

Figure 7. Trip time with passenger in car expressed as a percentage of total shift time

London. Cities such as Toronto, Shanghai and Melbourne have pledged to go with a fully electric fleet soon. Shanghai offers free special license plates to new consumers of electric vehicles in the period of 2020–22. Some measures include congestion/emission charges or encouraging fully electric sustainable fleets within a stipulated timeframe. Singapore does extend the Electronic Road Pricing charge to these vehicles, but the notion of a fully electric fleet is questionable, as most of Singapore's electricity is generated through natural gas. Singapore intends to have 60,000 charging points for electric vehicles by 2030. Self-regulation is an important contributor to this pillar. Grab's policy to phase out cars older than 10 years by 2022 (Toh, 2020), and additional safety and maintenance courses for drivers of cars seven years and older, is estimable.

In Singapore, vehicles used as taxis must be scrubbed after seven years, whereas ride-hailing vehicles have no such regulation. However, platforms such as Grab do exercise some degree of self-regulation in this aspect.

Toronto does not allow vehicles older than seven years in the fleet and aims to go for a 100% low-carbon fleet by 2050 ("City of Toronto unveils taxi relief program", 2021).

Ride-hailing trips have a higher carbon impact than that of private-car trips—the average ride-hailing trip produces an estimated 69% more carbon emissions, as it displaces other lower-carbon modes, such as walking, biking and transit. Against a private-car trip, a non-pooled ride-hailing trip produces about 47% more carbon emissions due to deadheading (Cook et al., 2020).[2]

In Singapore, trip data analysis indicated that deadheading accounts for over 50% of shift time in Singapore, as shown in **Figure 7**. Deadheading is a serious problem not just in terms of environmental sustainability but also congestion exacerbation and driver cost. In 2020, Singapore's ride-hailing generated an estimated 0.3 million tons of carbon emissions from trips. This is about 4% of the estimated 7 million tons generated by the land transport sector. 60% of Singapore's taxis are also hybrid or electric vehicles ("Amy Khor on cleaner energy vehicles", 2021). Singapore has also removed the $5,000 minimum additional registration fee which green cars are liable for. But a pooled ride-hailing trip between two passengers is similar in emissions to a private-vehicle trip and

[2] Miles driven with no passengers.

about 33% less polluting than a non-pooled ride-hailing trip. Electrifying ride-hailing vehicles also dramatically improves emissions. An electric-ride-hailing trip would cut emissions by about 50% compared with a private-vehicle trip; a pooled electric-ride-hailing trip would lower emissions by nearly 70% compared with a private-vehicle trip (Anair et al., 2020).

California's 2018 Clean Miles Standard focuses on emission/passenger-mile rather than emission/vehicle-mile, giving companies incentives to increase pooling as part of measures to meet the emissions standard (California State Legislature, 2018). It also requires that all autonomous vehicles should be electric, considering the inordinate amount of cruising these vehicles will ensue. Another effective policy is reduced license fees for vehicles that produce lower CO_2, including electric vehicles, such as the policy in South Oxfordshire, U.K.

4.13. Driver pay protection

The parameter of driver pay protection is difficult to regulate and is related to the labor classification problem. It involves finding an equilibrium between minimum work-hour wage and flexible work-hour bonuses. However, the research opines that if drivers continued to be classified as independent contractors, then minimum wages are unnecessary.

Innovation has created an economic value in terms of livelihood opportunities and productivity gains through time saved. Setting base fares and minimum wage rules will increase the costs associated with ride-hailing, ultimately making demand for the services expensive. The U.K. court's decision to calculate wages based on the time between log-in and log-out is inequitable and would lead to payments twice as much when trip driving time is considered. In Singapore, as shown in Figure 7, deadheading accounts for almost 50%. It also adds to emission and congestion costs. Holiday time is based on 12.07% of driver earnings, paid every fortnight ("Uber drivers are entitled to worker rights", 2021).

A survey published in 2018 found that half of all Uber drivers in the U.S. earned less than $10/hour (S$13.57/hour) after driving costs were deducted (Helling, 2018). In the U.K., drivers reported £17 (S$30.85) per hour in London and £14 (S$25.40) outside on the Uber platform. Seattle proposed $5/trip (S$6.78) as minimum pay for the drivers (Murphy, 2021). Singapore shows S$10–S$12 per hour (detailed in Appendix).

There is no pay protection for drivers in Singapore. Singapore does not have a minimum wage and works on a progressive wage model. There is a base salary that varies by sector and then, as workers upskill, their salary increases progressively. This applies to industries such as cleaning, landscape and security.

As an example, for cleaners, the minimum payable salaries are S$1,236 for general cleaners, S$1,339 for table-top cleaners, S$1,442 for dishwasher/refuse collectors, S$1,648 for multi-skilled cleaners/machine operators and S$1,854 for supervisors. Apart from this stipulation, employers can pay as much or as little as they want. It is balanced out by competition/market forces.

The LTA prohibits drivers only driving for one platform through the exclusivity clause, as it would be difficult for newer smaller players to enter the market. However, drivers who are directly employed by operators as full-time employees are exempted from this rule and remain exclusive to the employing platform. A pay standard policy that incentivizes driver utilization over earnings

would be more successful. Controlling the entry of new drivers is one way to increase the former. Drivers would receive higher pay per trip, with greater trip volume and higher passenger time per hour. An increase of 4%–6% in utilization will not impact waiting time significantly but starkly improves earnings (Hall and Krueger, 2017).

The benchmarking exercise proposes a model like the NYTLC's recommendation, which matches the minimum wage standard. Also, the exercise proposes adding to it 6% for paid time off, with payroll tax percentage varying according to country (usually 8%) and added incentive for shared rides (City of New York, n.d.). 6% is equal to the average cost of paid leave for the occupational group for transport providers. Furthermore, it is proposed to include ride-hailing drivers into the Singapore Government's Contribute as You Earn (CAYE) scheme and allow automatic contribution of a proportion of earnings to their Medisave accounts.

4.14. Surge price regulation

The fundamental principle of the sharing economy is to benefit from underutilized resources, and surge pricing incentivizes public transport usage during peak hours. Hence, we infer that although surge pricing is significant in demand management, there must be a regulation for the maximum multiplication. A fare ceiling was successfully introduced in Jakarta ("Go-Jek prepared to further dominate Indonesia", n.d.) and Mumbai (Fingas, 2020). Similar trends were also noticed in Southeast Asian cities. Mumbai allows a maximum surge pricing of 1.5 times. Shanghai, Mumbai and Moscow have strict surge price regulations, but the other cities have forgone the policy. Melbourne has no fare ceiling.

Singapore requires all operators of street-hail and ride-hail trips to publish booking charges, metered charges per distance and other additional surcharges to the commuters upfront before the start of the trip.

4.15. Fare regulation

Fare regulation is an easy regulation so that ride-hailing does not undercut taxi operations and there is a level playing field, and the fare is most often the minimum tariff for taxis. However, most cities tend to reserve the right for fare regulation to the authority, but rarely enforce them. Fares must be in symbiosis with driver-pay maximization and customer-benefit maximization.

In Singapore, operators can independently set flat fares for both booking trips on taxis and private-hire cars (PHCs). The fares, however, must be indicated before the start of the trip to the commuters. In Singapore, the industry average is around 18%–20% for the commission charged by platforms. In comparison with other technology providers, Amazon is the closest with 15%. E-bay is next with 7.7% and Shopify with 2%. Visa, PayPal and Mastercard payment services charge about 2%, with Europe mandating that credit card transaction fees must be 0.3% for anti-competitive practice restrictions. So, the research quotes slightly higher than the New York City Taxi and Limousine Commission's recommendation (6%–8%), such that the industry can afford to bring down the number to 8%–10% and still remain profitable.

Chicago in 2019 developed a ride-hailing fee structure to support three goals: managing congestion, supporting mass transit and advancing equitable mobility ("Chicago proposes new TNC fees", 2019). The fee structure charges passengers the most for single-person rides to/from

the downtown area during peak hours, with lower fees for pooled rides. Reduced fees outside the downtown area enable ride-hailing options in areas less served by public transport. Symbiotically, pooled rides are much more common in low-income neighborhoods.

Mumbai does not allow fares to go below 50% of the original fare to increase trips. Jakarta too has a price floor.

4.16. Insurance

All cities have provided at least third-party insurance, if not more comprehensive coverage, and Singapore has strict enforcement of complete insurance coverage. However, clauses such as in Didi's user agreement in China (now revoked), where the passenger is also an employer responsible for the damage caused to external parties if the driver is not at fault, must be identified within the platforms' user agreement and terminated.

4.17. Background checks by the authority

Only three cities, which are New York, London and Moscow, have adopted the practice. The regulatory authority must periodically and stringently perform background checks on the drivers to protect the commuters and extend the legitimacy of the business. Elsewhere, the responsibility falls upon the platform and hence calls into question its legitimacy. More often than not, platforms practice a rule of thumb, where complete checks of drivers are conducted at random for cost savings.

4.18. Taxi policy regulation symbiosis

Most cities regulated taxis and ride-hailing differently, but at the same time would make allowances for taxis, so that taxis might be competitive with their disruptive twin. Although not an explicit regulatory parameter, the practice of differentiating and cross-regulating taxi/ride-hailing is the most effective means to avoid cannibalization. The oversupply of vehicles must be avoided in consideration of congestion and emission protocols, in addition to economic sustainability.

Singapore segregates street-hail and ride-hail licenses, but on the other hand, a company can have both arms. In which case, they need to hold two separate licenses, which is the only bar to entry. To protect smaller players, any platform with less than 800 fleet size is exempt from obtaining a ride-hail service license.

Singapore removed taxi availability standards from 2020 in view of the higher availability of P2P vehicles. This is an example of individual public transport assimilation, seeing P2P transport as one unit (taxis and ride-hailing).

Policies by Shanghai and Toronto deserve praise because of the cities' ability to identify competitive parameters, such as fare and method of hailing. Toronto cross-subsidizes by reducing renewal fees and other regulatory charges, such as the suspension of the cancellation of licenses for non-payment of renewal fees for taxis.

China classified ride-hailing as a taxi service (during policy formulation) but later separated them as "non-cruising" and "cruising" online taxi-booking services. Melbourne deregulated taxis by replacing entry bars with a one-time registration fee and even providing financial aid to taxis by

taxing $1/trip for ride-hailing (State Government of Victoria, n.d.).

5. Conclusion

The ride-hailing sector was first deployed on a large scale nearly a decade ago in the U.S. and its entry into Singapore has been for almost half that time. Yet, there have been multiple interventions by the Singapore regulators to find the right touch of policy. When benchmarking other cities of contention, the conclusion inadvertently drawn is that no city is perfect and there is no one-size-fits-all solution. The remarkable similarity of numbers in terms of earnings per hour by drivers in the U.S., the U.K. and Singapore indicates that, despite geographical differences, sectoral behaviors are constant. The usage of the social practice theory is justified and validated thanks to the mixed-method approach employed in the research. The findings indicate that regulation is not a solitary execution and requires symbiotic association across multiple themes. Singapore has come a long way in terms of regulation for private hire—and is more significantly headed in the right direction—to finally materialize its car-lite vision.

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Appendix

Singapore driver model

In Singapore, Grab is the largest private-hire operator and charges a standard 20% commission rate uniformly for all drivers. There is no transaction fee when drivers transfer their earnings from the app's credit system to individual bank accounts. Another operator, GoJek, has a model fairly similar to Grab. The smaller platform Ryde has a percentage commission model too, offering slightly lower commission rates than those by Grab, at the expense of lower customer volumes.

TADA (formerly MVL), another Korean ridesharing platform operating in Singapore, charges a fixed fee per trip that amounts to less than 20% instead of a percentage. TADA further charges drivers a transaction fee of less than a dollar when they withdraw earnings from the app's credit system. But TADA has no acceptance rate, unlike Grab, which requires drivers to accept 80% rides. Drivers can cherry-pick trips. TADA charges high cancellation fees though, and the drivers are penalized.

Unlike other cities, Singaporean ride-hailing drivers rarely or never provide their own cars due to the high ownership costs involved. There is not much research done on ride-hailing and the post-expense earnings of drivers. Drivers have a one-time capital investment in the form of administrative costs and later have recurring costs, such as license renewal and vehicle inspections, on top of operating costs.

The one-time upfront administrative costs are primarily fixed by the LTA and include the costs of PDVL acquisition, driver registration and related requirements, which amounts to over S$1,600.[3]

Operating costs include acquiring, insuring and operating a vehicle. In January 2021, in Singapore, based on the expert survey and investigation, it was found that the cheapest four-seater sedan, such as the KIA Cerato, in the Grab platform costs a daily rental of S$60. This is inclusive of minimum liability insurance coverage. For a brand new four-seater, the price is up to S$80.

Aside from the rental expense, drivers must pay for season parking and fuel costs. Season parking can be anywhere between S$110–S$170 a month. A base value of S$110 was fixed.

For the analysis, the 2018 Cerato was considered, which, based on current Singapore fuel prices (February 2021), would cost close to S$90 for a full tank. Based on mileage estimations derived from the data acquired from HDT, with urban driving conditions, drivers would clock 700–900 km in three days, which is about 250–300 km a day. In addition to vehicle miles, cruising miles to pick up passengers, traveling back to the service area, driving to home at the end of the shift and driving from home at the beginning of the shift are also included. In the calculation, the total vehicle mileage was approximated to reflect cruising for passengers, pickup and other business-related non-trip mileages. The average shift time was taken to be eight hours, which was confirmed to be validated in this research's section on the driving hours cap.

The average weekly total expenditure for a driver operating a 2018 Cerato comes to about S$750 a week, excluding vehicle maintenance and inspection costs, amounting to about S$3,000 a month.

[3] As of January 2021.

This value is underestimating the time value of drivers, health costs and other miscellaneous costs. For a new/premium vehicle with premium fuel, this could go anywhere between S$3,600–S$4,000 a month. And the value goes even higher for premier services and high passenger-volume cars.

Grab divides its company drivers based on earnings produced into tiers: Diamond, Gold, Silver and Basic. The Diamond category is essentially the top 18,000 drivers in terms of earnings. These drivers are given the added incentive of receiving 12% of Grab's commission (20% of fare) as the quarterly bonus. Based on trip data, an empirical number of at least 66–70 hours a week is required to achieve the Diamond category, which is the mileage of nearly 300 km a day.

Top-tier drivers make around S$7,000–S$8,000 a month if they drive an average of 8 hours for 7 days a week. This was further confirmed in the driver data analysis.

Deducting Grab's commission of 20%, a value of S$3,200–S$3,400 a month is obtained, amounting to S$13.37–S$14.10 per hour before vehicle maintenance costs. The bonus of 12% quarterly for top-tier drivers only amounts to an additional S$168–S$192 a month.

Table A1. Driver expenses and earnings analysis

Expense	Detail	Vehicle 1 (S$)	Vehicle 2 (S$)
One-time upfront administrative costs	Vocational license acquisition, driver registration, renewal, inspection	Over 1,600	
Rental cost	Daily	60	80
	Monthly	1,800	2,400
Season parking cost	Monthly	110	170
Fuel expense on a full tank (Grade 92 petrol)	-	90	100
Weekly fuel expense for 3 refills for 250–300 km mileage for 8–10 hours of daily driving (value substituted from data analysis)			
Monthly fuel expense cost	Monthly	1,080	1,200
Fare collected for top-tier drivers with 60–80 driving hours per week			
Reported fare collected	Monthly	7,000	8,000
Earnings before commission	Monthly	4,010	4,230
Earnings after commission	Monthly	3,208	3,384
Earnings per hour	Per driving hour	**13.37**	**14.10**

Notes:
Vehicle 1: Used 4-seater KIA Cerato (inclusive of minimum liability insurance coverage)
Vehicle 2: New 4-seater KIA Cerato (inclusive of minimum liability insurance coverage)
Above table excludes one-time upfront administrative costs from analyzing monthly earnings. Only operating costs are included.
Vehicle maintenance costs are also excluded.
Season parking varies depending on area of city and type of parking
Base-level Grade-92 petrol was used for analysis based on March 2021 values. Grades such as 95 and 98 are 2%–28% more expensive.
Driving hours per day is calculated as 8 hours based on information from trip data values.