ENVIRONMENTAL ASSESSMENT OF RIDE SOURCING SERVICES IN LAHORE

By

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Abstract

This research paper attempts to assess the environmental impacts of rapidly emerging phenomenon of private ride sourcing services (including Uber and Careem) in Lahore. Both physical and social characteristics were investigated. The social parameters include changing travelling patterns with the rise of the app-based ride sourcing services, whereas the physical parameters considered impacts of greenhouse gas emissions and air pollution. Data was sourced through structured questionnaires for both ride sourcing users as well as ride sourcing drivers. Major findings indicate that 1) there is a significant shift in transportation patterns in Lahore due to the ride sourcing phenomenon especially women, and that 2) the rise in cars with 1-2 passengers on the road as part of this phenomenon is also contributing to the city's worsening air pollution crisis.

Dedication

Dedicated to my parents. I owe it all to you both. Many thanks!

Acknowledgement

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Chapter 1: Introduction

Earth's environment is suffering from increased population growth. The escalating population is putting pressure on the natural resources; and the economic growth is causing environmental damage, (Mittal 2013; Guria, 2015). The environment not only comprises of the physical, chemical and biological interaction, but according to the Pakistan Environmental Protection Act (PEPA) 1997, the definition of environment involves the entire social and economic conditions which effect community life. The studies of all the processes, which can affect and are related with human life are categorized under the term environment (PEPA, 1997). Transportation trends have evolved with increasing population. In the developing countries nearly 16% of urban household incomes are spent on transport, which rises to 25% in big cities and will continue to increase, (World Bank, 2002).

The trend of sharing economy is a social phenomenon that is expanding worldwide, with particular focus on the transportation sector. Developing countries like Pakistan perhaps suffer from paucity and struggle owing to overpopulation, poverty and other social issues but in the meantime; the economy of Pakistan is under a paradigm shift in technological advancements. According to Punjab Bureau of Statistics (2017), the population of Islamic Republic of Pakistan is growing with an annual rate of 2.40 %. Punjab Province stands with highest population having the average annual growth rate of 2.13 %.

Since the census of 1998, the country shows an increase of 57% in population. Lahore falls in the category of world's largest cities and the population of this megacity is rising with annual growth rate of 4.07% continuously and so is the traffic. The number of vehicles in the city has risen up to 16.5 times since 1980. Javid et al., (2014) states that, the major emissions in urban and peri-urban of industrialized and developing economies are due to road transportation. In developing cities,

the demand for travel has increased the number of cars leading to congestion concerns, which leads to condensed urban mobility. Exacerbated deterioration in air quality is linked with pollutants coming out of the car tailpipes, causing health problems as well. The rise in vehicular population causes emissions and environmental problems, (Han & Naeher, 2006). An increased ratio of cars can be seen within the vicinity of Lahore, leading to traffic congestion issues. According to OICA (2016), car ownership in Pakistan has shown an increasing trend for the years 2005-2007, 2010-2011 and 2014-2015.[1] Pakistan Clean Air Program (PCAP) states that vehicular emissions are a major source of urban air pollution.

According to PBS (2016)[2], the total number of vehicles registered along with the number of cars registered chiefly in Lahore has increased two folds in a span of 5 years i.e. 2010 to 2015. Predominantly vehicular emission gives out carbon monoxide, hydrocarbons, nitrogen oxides and sulphur oxides which are responsible for the formation of photochemical smog at ground level, (Beaton et al., 1995). Lahore city has been experiencing severe smog conditions for the last two years. Environmental Protection Department (EPD) has developed a policy for smog control in Punjab. According to EPD, the level of pollution generated by traffic, fuel burning and pollutants from drains are above the tolerable limits. In the Indian states of Punjab, rice stubble burning, vehicular and industrial emissions are the major causes of smog. Vehicular emissions are particularly addressed in the policy, and the prime focus is on the use of low-sulfur fuel, installation of vehicular emission control devices, and adaptation of EURO-2 standard of vehicular engines along with better traffic management strategies in order to control SO_x, NO_x and carbon emissions.

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[1] Appendix A, Figure 1
[2] Appendix B, Table 1

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According to EPD (2017), reducing congestion through reducing cars is another method to reduce air pollution significantly.

Alam, (2017) argues that Lahore's clean air is only possible if government takes strict actions against industries and automobile emissions. According to Mcdonalds, (2017) hybrid and electric cars seem to be sustainable solution. Electric vehicles are part of China's new energy policy 2025, they're providing subsidies for electric vehicles (EV) China is joining France and Britain by planning to put a ban on petrol and diesel automobiles by 2040. Pakistan is behind implementing technological modernizations in alternative fuel options; Pakistan has started coal exploitation. Furthermore, vehicular emissions are one of the foremost sources of air pollution and owing to mounting numbers of cars major cities like Lahore and Karachi could fall under the notorious category of Beijing & New Delhi, because of their poor air quality, (Zaheer, 2017).

The U.S. Energy Information Administration[3] provides data for Pakistan showing that gasoline (petrol) consumption is being amplified on an annual basis, with a maximum of 82 thousand barrels per day since the 1980s. About 100 grams of carbon monoxide, 20 grams of volatile organic compounds and 30 grams of nitrogen oxides along with other compounds like lead, sulphur and particulates are emitted when 1 liter of petrol is burnt. All these aforementioned compounds are associated with detrimental health impacts, (Faiz, 1996).

According to World Bank (2014), Air pollution is the fourth leading cause of mortality worldwide; with 1 out of 10 deaths. In 2013, nearly 87 percent of world's population was living in areas where air quality was below standards and worsening. According to World Health Organization (2015), nearly 60,000 people died in Pakistan owing to high levels of particulate

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[3] Appendix A, Figure 2

matter in the air. Moreover, in the past year approximately 2200 trees were cut down in Lahore, which meant destroying natural sinks of carbon dioxide and fine particulate matter, (Toppa, 2016). Mass transit is widely considered a better option to reduce vehicular congestion on roads. Lahore Orange Line Metro Train, a public transit project, is expected to get operational in 2018 will serve as Pakistan's first light rail line for quarter million passengers in Lahore.

In the existing system of transportation, the addition of private ride sourcing services of Careem and Uber is the latest trend. These on-demand car services are available through smart phone apps, making appreciable use of technology. This is a new business model introduced in the country known as the "sharing economy" or the "gig economy". Such startups are marked as innovations and have a ripple effect as they promote technology industry and create jobs, these ideas are picked up everywhere in the world, (Flores & Rayle, 2017). In Pakistan, there is lower car ownership ratio (i.e. 18 out of 1000 persons) along with poor transportation system, which serve as the main ground for business expansion. But the legal frameworks for such services are deficient, as the technical infrastructure is missing; there are security concerns and a lack of trained staff, (Tarar, 2017). Since the inception of ride sourcing services, the trend of Uber and Careem proliferating as transportation option is growing, at a faster rate. Careem is available in Karachi, Islamabad and Lahore while, Uber is operating in the latter two. These services appear to be user-friendly and people are largely satisfied with them. However, sometimes these facilities face criticism as well. As said by Junaid Iqbal, CEO of Careem, the company's aim is to reduce the public transportation woes and to bring traditional taxis to an end, (Zaidi, 2017). In the markets of cab/taxi and rikshaw drivers, the facility of Careem and Uber is well-thought-out to be unwelcoming and but the general public in Pakistan is in favor of these services. This private party

involvement in the transportation system could have some serious problems including, surplus fuel consumption by cars, more emissions and traffic congestion.

This emerging phenomenon of Uber and Careem could be one cause of more cars on the roads, which might have dreadful impacts upon the air quality. (Bliss, 2017). Intercity traffic in Lahore is growing at the rate of 7.9 percent per annum, (Jamal et al., 2012). In developing countries air borne pollution is relatively serious as compared to developed countries, (Han & Naeher, 2006). More cars mean more consumption of fuel and pressure on fuel resources. However, the environmental impacts of ride sourcing services are not known. In developing countries, nearly 12% of greenhouse gases emissions are through motorized vehicles and it is damaging the urban air quality, (Faiz, 1993).

The impact of the app-based car sharing phenomenon on industries like traditional taxi services, employment and wages is growing but only few studies have explored the relationship between sharing economy transportation and carbon emissions. According to Jay (2012), the model of sharing economy is based on usage of Internet and smartphones. Currently in Lahore, how the emerging car sharing economy is having impact on the air quality and trends of commuting of residents is yet unexplored. Even though the services have been found to be beneficial to the people in many ways, this research work contributes to the process of interrogating whether and how it contributes to environmental sustainability and how its usage is particularly affecting women. The transit patterns have changed in Lahore as a result of ride sharing economy, which has affect, the environment. This research tries to explore whether increased ride sharing has contributed towards poor air quality in Lahore.

This study primarily focuses on one of the important fragments of sharing economy i.e. ride sourcing, pointing out the question that how ride-sourcing services (Uber/Careem) are linked with changing the transit patterns. Another prominent feature is the usage and preference of ride-sourcing by women. Women have become an integral part of Pakistan's working sector. Female labor participation is 24.93% according of PBS (2017). Their entrance into labor force requires them to have access to transportation and in this research access to Uber and Carem. Moreover, the research is carried out with an aim to investigate and analyze the possible environmental impacts.

1.1 Research Questions

- How are ride-sourcing services like Uber and Careem effecting the environment in Lahore in terms of its physical and social aspects?

The prime research question will be answered, followed by a set of following sub questions:

- Q#1: How are transit patterns in Lahore changing since the emergence of the app-based ride-sourcing phenomenon?
- Q#2: What impacts are such services having on transport-related air quality and emissions?
- Q#3: What role are these services playing in women's mobility and access to space?

This thesis has been divided into following chapters. Chapter 1 introduces the topic; Chapter 2 gives a detailed literature review regarding topic and its variables and builds narrative. Chapter 3 explains the methodology of thesis; Chapter 4 analyzes the results followed by the findings of the study.

Chapter 2: Literature Review

2.1 Historical Background

Consumption, resource utilization and commuting problems are associated with population expansion in the country. Urban transportation imparts direct impacts on sustainable development (Jamal et al., 2012). According to Imran (2009), Pakistani cities are unable to develop systems of transport that provide high levels of both environmental sustainability and mobility. In the transportation sector, either people avail facility of public transport or use private transport. The historical context of transportation in Pakistan is divided into 3 sections, including (pre-partition, phase from 1947-1991 and phase since 1991) [4]. Pakistan Railways had the largest number of passengers after partition and it was proposed in the first Five Years Plan (1955-1960) that railways and road transportation networks should work side by side, (Imran and Low, 2003).

About 70 percent of public investments were for railway, and 30% for road transportation, (Government of Pakistan, National Planning Board 1957). In the early 1970s, the public transportation faced deregulation and this allowed the private sector to have a major share in transportation industry (Government of Pakistan, Planning Commission 1978). Transportation department was created in 1987 officially and before this, transportation cell existed at regional and provincial levels. Current setup of transportation includes the Secretariat Government Department, Transportation Planning Unit (TPU) and Lahore Transportation Company (LTC). These departments are responsible for implementation of policies, regulations, subsidies and fares (Transport Punjab Portal, (n.d.)).

Major authorities dealing with transport sector are as follows:

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[4] Appendix B, Table 2

- Punjab Provincial Transport Authority- PPTA

- District Regional Transport Authority- DRTA

- Traffic Engineering and Planning Agency- TEPA (LDA)

Imran (2009) states that, the National Transportation Policy was major cause of privatization and private sector involvement and lack of public sector growth. A huge number of private operating companies like Suzuki, Mazda and Toyota Wagons, started to compete with public buses. The growing competition for the space on the roads started leading to traffic congestion at that time. In order to curtail personal vehicle use, taxes and high parking costs are suggested. The study by Japan International Corporation Agency (JICA, 1992) shows that, in Pakistan there are more private vehicle trips as compared to India. Public transport is the major source, which facilitates the people in urban and rural areas at a much low cost. However people of middle to high-income range prefer to have private vehicles as a mode of transportation.

According to TEPA and JICA (1992) trips from private transportation are high as compared to public transportation.[5] The vision 2025 of Pakistan involves developing transportation sector to generate revenue for economy. Road density is an indicator of economic activity (Pakistan Economic Survey, 2007-8). Total roads in Pakistan are about 263,775 km square, out of which 70 percent are paved roads. The road density is lower in Pakistan as compared to neighboring countries, which is around 0.3 km/square km (Pakistan Economic Survey, 2013-14). According to National Transportation Research Center (2015) road length have increased in Pakistan. The major change is in Punjab province.[6]

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[5] Appendix A, Figure 3
[6] Appendix A, Figure 4

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2.2 Current Transportation System (Lahore, Punjab)

Lahore transit system consists of Metro bus system, Trans Lahore, Private/Public bus companies, User owned cars, bikes and auto-rickshaws and the Cab services (Careem, Uber, Albyrak), (NTRC, 2015). 'Metro' is Pakistan's first rapid transit system, which was introduced in February, 2013. The main route has 45 buses that run between 27 stations. Trans Lahore also known as LTC is developed as an Urban Transportation Company. LTC is a regulatory and self-sustaining body, which was established under the Companies' Ordinance of 1984. It has over 650+ buses and is expected to run a smooth transport system. LTC was given responsibilities to control public transit in Lahore, since 2009. Moreover, many bus companies operate in the region to meet the needs of public transportation. User owned vehicles and cab services also exists, (Khan, 2012; LTC, 2017).

2.3 Initiation of Sharing Economy

Wallsten (2015) elaborates the concept of the "Sharing Economy" that was recently introduced. It means to turn under-used products or assets into productive use, through technology driven consumption. These platforms of sharing economy are crafting new markets that increase the purchasing and consumption power in the economy. It is global phenomenon that has ripple effect, (Frenken, 2015; Schor, 2017). The new investors have come up with the idea to utilize the potential of unused houses and cars. The consumers who are willing to use the service generate the value. Litman (2015) argues that, ride sourcing provides job seekers with efficient ways of earning. This shifted trend towards the sharing economy has created a sense of extreme rivalry among many industries. The sharing economy is opening up gates for new entrants by downsizing the conventional industries like taxis and rickshaws.

The sharing economy is supposed to bring more economic benefits resulting in increase in employment opportunities and reduction in carbon emissions, (Pickell, 2016). In the year 2016 Uber expanded up to 450 cities worldwide and completed about 2 Billion trips till then. According to Somerville (2016), one Billion rides were taken within the span of six year while the equal numbers of rides are completed within six months in 2016. It is claimed that car sharing removes about 9 to 23 vehicles from the roads in the West, (Susan, 2009). The Chinese ride-sourcing company Didi, which is similar to Uber and Careem by function claims to have saved fuel/reduced emissions through their car-pooling service. In 2015, an average of 1,143,000 rides per day were made on sharing basis by Didi and it lead to total saving of 510,000,000 liters of fuel & reduced emission of carbon dioxide by 13,550,000 tonnes, (Ziauddin, 2017).

Uber and Careem, turn vehicles that are spare into on-demand taxis, making it possible for customers to get rides quickly and easily. Uber is symbolized as a 'destructive creation' sometimes which is actually benefiting the users, (Birkinshaw, 2017). The findings of the researchers at the University of California, who surveyed about 2,000 random people, show that these services are altering transit patterns and drawing people away from using the public transit system. They also found that 49-61 % of all trips made using ride sourcing services were due to the availability of cars, and thus termed 'additional trips on roads', (Badger, 2017; Hao, 2017).

Uber UK, which has registered 40,000 drivers in London alone launched a clean air program and is taking steps for mitigation of ecological impacts. The company offers free rides worth $2,000 to the members who take their polluting diesel cars off the road. The first 1,000 Londoners that scrap their pre-Euro 4 diesel cars (which cover diesel powered vehicles manufactured before 2005) will be rewarded. The above-mentioned goal is set for more cities like Birmingham, Manchester and Glasgow by 2022, (Holder, 2017; Hughes, 2017).

Uber has created a Clean Air Fund, which will provide the drivers with grants worth £5,000 if they are willing to upgrade their vehicle to hybrid and electric cars. To show that they are playing their part in sustainability Careem appointed Nadia Rouchdy as ambassador for sustainability, environmental and social concerns. However, currently no practices are being implemented to restrain impacts of air pollution in Pakistan (Careem Official). Uber and Careem are operating including the countries like UK, USA, UAE, Canada, China, Pakistan and India etc. [7]

2.4 Ride Sourcing in Pakistan

The emergence of ride sourcing services like Uber and Careem into the existing transportation system of Pakistan is producing a social transformation. Uber and Careem have been functional since 2015 in Pakistan. According to official websites, Careem, which operates in 11 countries and host 6 Million users, has been providing services in three major cities of Pakistan since October 2015 whereas Uber, which operates in 45 countries, has had extended services in Lahore, Karachi and Gujranwala since March 2016. In Karachi, by December 2016, 280 cars were registered with Careem and about 375 cars with Uber, (Ahmed, 2016). These on demand ride services are the new trend these days. The company's stated aim is to provide 1 Million jobs by 2018 and to make transportation simple, while Uber's vision is to make transportation reliable and create 2000 jobs every month. Uber has currently 700 people associated with them. These services now stand in competition with the public transportation system and other modes of private transportation. In November 2016, Uber signed an MOU with Bank of Punjab to work together for placing more than 50,000 green and yellow cabs onto Uber's platform, (BOP, 2016).

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[7] Appendix B, Table 3

In January 2017, the Provincial Transportation Authority declared that both these companies are operating without getting their vehicles registered with any regulatory body. Moreover, they were convicted of using the private cars for commercial purposes causing violation of local laws. Fitness certificates and route permits were not obtained as well. It was requested to PTA to block both the mobile apps, as they had not obtained No Objection Certificates. Both these companies agreed to work upon existing regulations; Uber is expected to invest $500 Million in Pakistan to promote empowerment and job opportunities, (Qasim, 2017).

Ride sourcing services are in competition with traditional transportation system as they are able to provide customer satisfaction through ease of access, lower fares and reduced waiting time, which the traditional services of taxis and auto-rikshaw were not able to provide, (Hordepal, 2015). Studies reveal that increased congestion and inconsistent pricing are some of the concerns the public has regarding the ride sourcing services (Nsw Business Chamber, 2015). Ride sharing has gained popularity due to easy commute, door to door drop and reducing need for personal car leading to convenient parking spaces in the city for app drivers. Moreover criticism also exists, as such services are considered responsible for the following factors like: Invasion of privacy, discrimination among people, aims to be a monopoly- taking over market and puts future of taxi, and courier services in threat, (Rogers, 2015).

Urban transportation is directly connected with sustainable development as it puts pressure on fuel resources. The unchecked level of vehicles on the road is associated with degraded environmental quality, (Mirza, 2013). Emissions from ride sourcing could serve as a factor of poor air quality. According to World Bank (2007), 50 % of diseases and mortality in Pakistan is because of air pollution. The social, environmental and economic dynamics should be analyzed so that the transportation system may work efficiently. Researchers have argued that the energy requirements

of Pakistan will enhance up to three times and the energy consumption by the transportation sector will double by 2050, making more people dependent on private vehicles (Imran & Low, 2003; Amjid, 2011).

According to the Economic Survey of Pakistan for fiscal year 2016 to 2017, oil demand has risen. The quantity of imported crude oil is currently at 5.9 Million Tonnes a clear increase from 4.2 Million Tonnes that was imported during fiscal year 2015-2016. The share of oil consumption in the transport sector has increased from 55% percent to 57 % as compared to last year and the cars ratio has also increased to 4.6 %, (Pakistan Economic Survey, 2016-17). From July 2016 to August 2017 a total of 186,986 cars were produced in Pakistan including 800, 1000 and above CC, whereas 185,781 were sold during this time, (Pakistan Automotive Manufacturer Association, 2017).

Urbanization and motorization leads to unsustainability of infrastructure and environment. A study showed that 33% of Pakistan's vehicles are found in urban Karachi. Traffic Engineering Bureau of Karachi survey, shows that the ratio of private vehicles is increasing, with minibuses as the most important mean of transport. Due to inappropriate policies, comfort level and security reasons, middle and upper classes do not generally use non-motorized transport, (TEB, 1987 & 2004). There are few comprehensive studies on Lahore's changing transport patterns. A study conducted on customer satisfaction in Lahore shows that about 72% users of ride-sourcing services are satisfied with this mobile-based application for their travelling, (Rasheed et al., 2018). Private cars have benefits but their negative impact on public transportation cannot be ignored. Private vehicles use should be minimized to reduce and discourage congestion on the roads, (Mohamad & Kiggundu, 2007). Furthermore, the flyovers and widening of roads will not serve as a long-term solution to sustainable transportation as enhancing the number of cars will take up that space as

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well. Some researchers argue that imposing a congestion price or high parking fees are some strategies that can be used to reduce the number of private cars, for example London and Hong Kong, (Qureshi & Huapu, 2007).

2.5 Transportation and Emissions

Lindau (2015) states that as population grows transportation pattern changes. Transportation industry contributes 73% of urban air pollution. Private cars are responsible for generation of greenhouse gas emissions three times more than public transport. According to Brazil INDC (2015) bus rapid transit projects in countries like Mexico, Columbia, China, India and South Africa serve as a mitigation measure to reduce climate impacts and emissions up to 31.4 Million tons in upcoming twenty years. An interesting example is of Brazil, as per its National Plan on Climate Change it aims to reduce approximately 38 % of emissions by 2020, by investing in urban transportation infrastructure.

Activities like forest fires and dust storms are cause of air pollution but the anthropogenic activities e.g. deforestation, burning of fossil fuels and smoke from industries and vehicles magnify the pollution. The growth in urbanization and population increase in megacities of Pakistan like Lahore and Karachi, have put pressure upon the natural environment, (Kugelman, 2014).

According to a World Bank report, Pakistan is one of the most built-up countries and is currently in the process of motorization and massive energy consumption. Over the last twenty years, the number of vehicles in Pakistan has increased from 2 Million to 10.6 Million, with 8.5% as the annual growth rate. [8] In 2012, air pollution served to be the major cause of 3.7 Million deaths worldwide, for ages fewer than 60. Furthermore, 7 Million people died due to ambient air

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[8] Appendix A, Figure 5

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pollution. According to the Punjab Health Department, there was a 23% rise in reported pulmonary diseases associated with air pollution between the years of 1999 to 2002. These findings prove air pollution as the leading cause of health risk, (World Bank, 2014).

Mass transit system used worldwide help in controlling air pollution and bus transit system has been identified as one of the approaches to deal with air pollution as compared to any other transportation system, (Wright & Fjellstrom, 2003). It is argued that, the improvements in the rail sector will worsen the environmental pollution, and in some cases increased congestion of traffic, (Amer & Bajwa, 2008). Howe (1996) argue that, more focus is on development of the road network instead of improving the existing transportation system. The transport and energy sector are responsible for about two-thirds of particulate matter, carbon monoxide, nitrogen oxides and half of hydrocarbons, whereas particulate matter is associated with health risks and has caused economic damage in Pakistan, (WHO, 2006).

Transport accounts for one-third carbon dioxide emissions, (IEA, 2009). The levels of vehicle sin Pakistan are increasing[9]. The US EPA (2010) states that, the average passenger vehicle emits about 4.7 metric tons of carbon dioxide. According to Emerson (2016), in 3 years Uber contributed about 94,000 metric tons of carbon dioxide in New York City, alone which is equal to 101 Million pounds of coal burning. The emissions of carbon dioxide owing to transportation are projected to double by 2050. The level was observed to be 6.7 Gigatons in 2010, which is about 22% of world's total carbon emissions, (Pyper, 2014).

Pakistan is one of the lowest emitters in the world with 0.2% of total emissions in terms of global contribution, (Zeb, 2017). According to the National Economic and Environmental

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[9] Appendix A, Figure 6

Development Study, 21% of total emissions are because of transportation sector and approximately half of the oil was used by this sector in 2007-8. As stated by GOP Vision (2025), an increase in road density ranging from 32-km/100 km square to 64-km/ 100 km square is expected in the next few years. In the year 2000, there were about 4 Million vehicles on the roads and by 2010 there were 9.8 Million vehicles, more than doubling over ten years, (NEED, 2011). In 2015, Pakistan broke the international record of highest number of cars sold in one month. It is expected that the emissions in Pakistan will increase about 295.73% till 2030, (Zeb, 2017). Ride sourcing not only increased vehicles on road but also decreased traffic congestion in some areas, (Rayle et al., 2016).

2.6 Lahore's Environmental Situation

In Lahore, nearly 1250 people die annually from air pollution. The uncontrolled and unchecked transportation systems are the causes of increased vehicular emissions and traffic pollution is major cause of PM_{10} carbonaceous aerosols in Lahore, (WHO, 2006). Automobile emissions in Karachi, Lahore and other growing cities serve as major sources of air pollution. Moreover, Pakistan has the poor condition in terms of particulate matter concentration. The ratio of PM is going to increase because it is expected that around 60% of the population will live in urban centers by 2050. In Pakistan the level of particulate matter 10 is 200 micro grams per cubic meter whereas the limit defined by WHO standards is 20 to 70 micro grams per cubic meter. According to the World Health Organization, in Lahore the level of Particulate Matter 2.5 is two to fourteen times higher than the prescribed limits of US NEQS and vehicular emissions are one of the significant causes of it, (WHO, 2006; World Bank, 2014).

Hyder et al. (2006) evaluated national health policies of 1990, 1997 & 2001 and found that they do not incorporate road safety issues, emissions and public health concerns. In Lahore, 96% of CO, 76% of NO_2 and 28% of PM comes from vehicular emissions. The average vehicle in

Pakistan emits about 25 times more carbon monoxide, 20 times more hydrocarbons grams per km as compared to vehicles in the United States. Traffic congestion, old engines and low quality fuel are some of the major causes of air pollution in Lahore, (Jalil, 2016).

The existing literature shows a direct linkage between ride sourcing services, increased cars on the roads, and deterioration of air quality, and followed by damage to public transit infrastructure, (Font, 2014). Nitrogen oxides, hydrocarbons and particulate matter are the principle components of smog, released by cars are causing health impacts. In 2016 Lahore's air was monitored, Carbon monoxide level was recorded to be 21.29 mg/m on Mall Road, 17.52 mg/m in Mohlanwal and 6.94 mg/m around Liberty Market, all in excess of permissible levels of 5mg/m. Nitric oxide levels were recorded at over 300 mg/m^3 at various locations whereas the permissible limit is 40 mg/m^3. The condition of smog was worse in areas where there was high traffic congestion, where the level of particulate matter exceeded 270 mg/m^3 against the permissible limit by WHO of 150 mg/m^3. The level of carbon monoxide measured by Seal Laboratories in Lahore was 4ppm in the morning and in the evening it rose up to 5 ppm whereas, the permissible limit is 1 ppm, (Jalil, 2016).

2.7 Ride-Sourcing & Women's Mobility

Men and women act as agents in the environmental management making a connection between gender and environment, but they get different benefits, (Sida, 2016). The urban environments are gender biased. Women naturally have to take domestic responsibilities along with job at times, making them likely to travel between different destinations daily. Travelling in public transportation, slanted fear of ill treatment is a huge issue. According to Duchène (2011), the modes of transit between men and women are significantly different. In the European countries fewer % of women own and use a car. In Sweden 70% of cars and in France 60% men own cars.

In many countries like Japan, Mexico, Brazil, Egypt and India etc. vehicles reserved for women are operational. In the Western world, a woman travelling on buses is considered widely accepted form of commuting and shared taxi is accepted.

In Philippines; the first two carriages in railway are reserved for women and children and same is the case in Mexico. Reserved taxis for women are operational in UK, Mexico, Russia, Dubai, Iran, (Duchène, 2011; World Bank, 2011). According to ADB (2015), In Pakistan women do not feel safe while using a public commuting method. Women have to face harassment, verbal jibes and offensive language frequently. Women are not only affected in a country like Pakistan, instead the cases of harassment are very prevalent in countries like UK, Malaysia, Japan, Mexico and India. In 2016, a national survey was done in Australia; making it clear that women are regularly altering their traveling patterns in order to minimize the risk of harassment. Women have limited their movements and tend to stay home at night, instead of going out. It is interesting to note that in Australia, a female-only ride sharing service known 'Shebah' is operational, (SADAQA, 2018).

Bhatt et al. (2015) talks about safe transportation routes matter for females. The project was done to maintain the female security while travelling in public transit. According to the report, 88% women were harassed while using public transport. According to Solotaroof et al. (2017), in Sri Lanka's labor force, 90% of women are harassed while traveling in a public transport. Gardner (2017) states that for women, the issue of harassment while using public transportation is an emerging issue. Many studies indicate that women worldwide are hesitant of using public transportation because of lack of surveillance. Moreover, the feeling of security influences the frequency of public transport use.

Ride sourcing has provided a platform for women's mobility with major challenge faced by the ride sourcing companies is the ridership by women in many countries like Pakistan high. Williams (2018) states that nearly 18% of the people globally, have used ride sourcing service (uber) in the past 12 months. Furthermore, an eight times increase in the value is expected by 2030. After surveying over 11,000 respondents, which use Uber, that ride-sourcing helps removing the barriers for women across many countries like Egypt, Indonesia, South Africa, Mexico and India. Moreover 66% women in UK, 60% in Mexico, 73% in Africa and 66% in Indonesia use ride sourcing as a mode of commuting.

In Saudi Arabia, currently 70% passengers of Careem are women. Careem has recently started training sessions for female drivers and interestingly more than 2000 females have participated in the initiative to work as captainahs in Saudi Arabia. The CEO says, 'We've set a longer-term target of having 20,000 females signed up region-wide by 2020.' Till now, Careem has opened doors for female drivers in countries like Egypt, Jordon, Lebanon, Morocco, UAE and Pakistan, (Jafri, 2016).

Females have different commuting patterns than male counterpart and the literature shows a growth in travelling patterns. Researchers found that women have a precautious attitude with respect to travelling security as compared to men. They are less likely to own cars therefore they have to rely on taxis and auto-rikshaw for daily commuting. As the household income goes up, the dependence on car use will increase and transit use will decrease. A study by Neilsen (2014) shows that nearly 65% of people in about 44 major countries are planning to purchase a car and out of them approximately 42% are women.

In Middle East and Asia, percentage of women who want to own car is lower than men, (Bianco, 2011). Even though this service tends to be extremely useful particularly for women but the cases of harassment go on side by side. This issue needs to be resolved to maintain well reputation in the growing market. 90% of women in UAE, Egypt, Jordon, India, earn additional income by working as ride sourcing drivers, which adds to their empowerment and independence, (Zahid, 2016).

In Pakistan, Careem introduced women drivers in 2016 in areas of Karachi, Lahore and Islamabad for providing safe transportation to females. By working for these ride sourcing services, women are earning flexible, easy and extra money by working independently, (Sattar, 2016). The increased fraction of women as drivers and riders shows increased demand and supply, (Williams, 2018). The succeeding segment of this study aims to describe the methodology which is used to assess the change in travelling behavior among general public. Moreover, it targets the social dimension in terms of gender and mobility.

Chapter 3: Methodology

This research work is exploratory and evaluative in nature. This study aims to identify the environmental along with the social impacts of ride sourcing services, which are changing swiftly. In this particular research data is gathered and analyzed to form a theoretical baseline for future research and planning.

3.1 Study Area

Lahore[10] is the capital of Punjab province and is the second most populous city in Pakistan after Karachi. Lahore is selected for this research owing to its developing infrastructure in transportation sector. It's already exposed to the ride sharing economy, since Uber and Careem have been operating here for recent years and growing. The city is suffering a smog-related public health crisis; moreover residents face frequent traffic jams. Lahore city is one of the largest cities in the world and its population is 11,126,285. Moreover, the number of vehicles is continually growing at a rate of 3300 per month in Lahore, (PBS, 2017).

3.2 Data Sampling and Variables

The questionnaires were used to collect the data. In order to complete primary data collection, one questionnaire was developed for ride sourcing users and the other was for the ride sourcing drivers. Data sampling was done using snowball sampling technique. Snowball sampling is selected for this research work as it can help with the data collection. A series of referrals and consociates were selected to make data collection easier. Representative number of sample of public users and drivers working for ride sourcing services was taken, statistical software were used to analyze the results. The variables on which data was measured are:

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[10] Appendix A, Figure 7

Travelling pattern changes (TP)
Additional trips and pollution (ATP)
Women's satisfaction with Uber & Careem (WMS)
Women's access to space (WMA)

Table 4: Categories of study variables

3.3 Instrumentation

Bianco and Lawson (2018) identified certain components that indicate women's mobility that can be affected because of Uber and Careem usage, making the access to space easier for women. Henao (2017), Dawes (2016), Rayle et.al (2016) and Zhen Chen (2013) defined the independent variables along with the constructs, which can measure changes in travelling patterns, and public preference and opinions on ride sharing. The questions on demographics and additional trips were also added (Er. et al., 2017). The following table shows the variables and its associated questions.

Construct	Source
Travelling patterns (TP) • How often you were taking public transportation for travelling weekly, BEFORE ride sourcing? • How often you were taking public transportation for travelling weekly, AFTER ride sourcing?	Henao, 2017; Dawes, 2016; Zhen Chen, 2013

• How often do you take family car for travelling, BEFORE ride sourcing? • How often do you take family car for travelling, AFTER ride sourcing? • How often do you take rikshaw for travelling, BEFORE ride sourcing? • How often do you take rikshaw for travelling, AFTER ride sourcing?	
Additional trips and pollution (ATP) • In the past month, how many times you have taken a trip just because of ride sourcing (say additional trip) that you might not have taken otherwise? [You can see MY RIDES option in your app] • Out of the additional trips you have taken, what was the approximate average kilometer distance traveled? • Has ride sourcing reduced the travelling on your own private vehicle/ family vehicle?	Zhen Chen, 2013; Henao, 2017

Women's Satisfaction (WMS)	Dawes, 2016; Fleischer & Wahlin, 2016; Rayle et al., 2016
• Have you ever reported any driver since you are using ride sourcing services? • Do you prefer and would feel safer with a female driver instead of male driver? • Will you be interested to work as a driver for ride sourcing? • Is your family satisfied with your use of ride sourcing?	
Women's Access to Space (WMA)	Bianco & Lawson ICF report World Bank, 2018; Williams, 2018
• Is ride sourcing contributing to your increased freedom to travel? • Is ride sourcing providing you with sense of security? • Do you rely on ride sourcing for your daily travelling? • Have you started travelling more because of ride sourcing?	

Table 5: Variables and questions along with the sources from literature

A diverse sample of Uber/Careem users was surveyed using a research questionnaire in order to analyze the travelling behaviors before and after ride-sourcing initiation. Moreover,

women participants were asked particular set of questions based on access to space and mobility behavior and satisfaction owing to Uber/Careem.

3.4 Regression Equations

$$TP_i = \alpha_0 + \alpha_1 UCU_i + \varepsilon_i$$

$$ATP_i = \delta_0 + \delta_1 UCU_i + \varepsilon_i$$

$$UCU_i = \gamma_0 + \gamma_1 WS_i + \varepsilon_i$$

$$WMA_i = \beta_0 + \beta_1 UCU_\square + \varepsilon_i$$

3.5 Hypotheses

H1: Uber and Careem usage (UCU) has significant and positive impacts upon travelling pattern changes (TP)

H2: Additional trips and pollution (ATP) are significant and positively linked with Uber and Careem usage (UCU)

H3: Women's satisfaction (WMS) is significant and positively linked with Uber and Careem usage (UCU)

H4: Women's access to space (WMA) is significant and positively linked with Uber and Careem usage (UCU)

3.5 Model Diagram

Theoretical Framework

| Uber and Careeem Usage (UCU) | → | Travelling Patterns (TP) |

Figure 8: UCU and TP

| Uber and Careeem Usage (UCU) | → | Additional Travelling Patterns (ATP) |

Figure 9: UCU and ATP

| Women's Satisfaction (WS) | → | Uber and Careeem Usage (UCU) |

Figure 10: WMS and UCU

| Uber and Careeem Usage (UCU) | → | Women's Access to Space (WMA) |

Figure 11: UCU and WMA

3.6 Objectives

This research work has the following objectives:

1. To see that how travelling patterns and behaviors of general public are changing because of Uber and Careem usage.

2. How women's mobility and access to space is influenced or impacted by the Uber and Careem.

3. To identify the various factors and reasons for which people are using Uber and Careem.

4. How Uber and Careem has contributed towards environmental degradation through air pollution.

The eventual aim is to do structural modelling in order to examine and identify the measurement model and proposed hypotheses. To make an attempt to identify the environmental impacts of emerging private ride sourcing services, including Uber and Careem. Environmental impacts ion physical and social characteristics. Physical parameters focus on the traffic congestion and environmental sustainability issues whereas, social parameters incorporate women access to space and mobility. To highlight and map that how the transit/commuting patterns are being changed. No such study considering these factors has been conducted particularly in Lahore, thus far.

Chapter 4: Results and Discussion

The following chapter describes the detailed analysis obtained through questionnaires and gives an indication of the findings.

4.1 Questionnaire for Riders

A total of 168 respondents filled the survey and the answers were gathered, 7 responses were discarded on the basis of missing information and 161 responses were selected. This questionnaire includes dimensions like demographic information, transit pattern information, and the trends of commuting before and after the phenomenon of ride sourcing services. The demographic characteristics of the study are:

Variables	Description	Frequency	Percentage
Age	18 to 25	125	77.6
	26 to 35	34	21.1
	36 to 45	1	.6
	More than 46	1	.6
Occupation	Self employed	10	6.2
	Part time employee	7	4.3
	Business owner	11	6.8
	Student	102	63.4
	House wife	5	3.1
	Full time employee	26	16.1
Monthly Income	Less than 20,000	76	47.2

	21,000 to 50,000	29	18.0
	51,000 to 80,000	18	11.2
	81,000 to one lac	8	5
	More than a lac	30	18.6
Car Ownership	Yes	63	39.1
	No	98	60.9
Gender	Male	75	46.6
	Female	86	53.4

Table 6: Demographics of users

The individuals who do not own a car majorly use Uber and Careem services. 63% of the sample size are students who need transportation daily whereas 16% are full time employees who are dependent on ride sourcing for their daily commuting. In our random sampling 53.4% are females showing that a prominent number of women use ride sourcing for their daily travelling. The majority of respondents are between 18-25 years indicating that the respondents who use ride sourcing more belong to 18-25 years of age.

The table shows income analysis which indicates that majority of respondents have income level less than 20,000 with 47.2% showing that the majority users of ride sourcing services have income level below 20,000 but in relation with other factors these are mainly students and employed persons. The respondents were asked about their personal car ownership and 61% respondents do not own a personal car.

Variables	Description	Percentage
Security	Agree	44.6
	Disagree	16.3
	Neutral	39.1
Reliance on ride sourcing for travelling	Agree	47.8
	Disagree	28.3
	Neutral	23.9
Preference of female driver	Agree	57.1
	Disagree	11
	Neutral	31.1
Freedom to travel	Agree	84.8
	Disagree	2.2
	Neutral	13
Family satisfaction	Agree	60.9
	Disagree	13
	Neutral	26.1
Travelling more because of ride sourcing	Agree	53.3
	Disagree	26.1
	Neutral	20.7
Reported any driver	Agree	48.4
	Disagree	41.8
	Neutral	9.9

Will you work as driver	Agree	17.4
	Disagree	64.1
	Neutral	18.5

Table 7: Women's mobility

Out of the total sample size 53% were women users. Questions were asked about security, dependence on ride sourcing, travelling frequency and preference of female driver. 44.6% of female users agree that ride sourcing provides them with a feeling of security and 47.8% rely solely on ride sourcing for daily commuting. 53.3% of users responded that because of Uber and Careem usage their travelling has increased; moreover, 84.8% of female users agree that Uber and Careem has increased their mobility and freedom to travel more. The results show that large numbers of women rely on Uber and Careem for their daily commute resulting in increased mobility. Women consider it a safer option and would prefer to have ride with a female driver.

Variables	Description	Percentage
Using ride sourcing since	Less than 6 months	7.5
	More than 6 months	23
	More than a year	69.6

Reasons for using ride sourcing?	No other mode available	39.8
	Easy accessibility	31
	Cost effectiveness	14.6
	No need to drive	9.4
	Security	29
	Time efficiency	1.8
	Avoid parking	0.6
Frequency of usage	Always	8.1
	Regular	21.7
	Sometimes	39.8
	Rarely	30.4
Public transportation use before ride sourcing	Always	8.7
	Often	18.0
	Sometimes	30.4
	Never	42.9
Public transportation use after ride sourcing	Always	6.8
	Often	11.2
	Sometimes	24.8
	Never	57.1
Family car use before ride sourcing	Always	31.1

	Often	33.5
	Sometimes	20.5
	Never	14.9
Family car use after ride souring	Always	16.1
	Often	33.5
	Sometimes	29.8
	Never	20.5
Rikshaw use before ride souring	Always	8.1
	Often	26.1
	Sometimes	37.3
	Never	28.6
Rikshaw use after ride souring	Always	3.7
	Often	13
	Sometimes	36
	Never	4.2
Organization's van use before ride souring	Always	21.7
	Often	9.9
	Sometimes	18.6
	Never	49.7
Organization's van use after ride souring	Always	8.1
	Often	16.1
	Sometimes	18.6
	Never	57.1

Own car use before ride souring	Always	28
	Often	21.7
	Sometimes	13.7
	Never	36.6
Own car use after ride souring	Always	18.6
	Often	23
	Sometimes	18.6
	Never	39.8

Table 8: Travelling pattern changes

Table 8 shows the trends for travelling pattern changes through before and after commuting means. It can be seen that the use of public transportation, rikshaw, organization's van, personal and family cars have significantly reduced since people have started using ride-souring. Results show that majority of people are using ride sourcing for more than a year, the main push factor for usage is because no other mode of transit is available as indicated by 39.8% of respondents whereas cost-effectiveness being the second main reason of usage as responded by 15% users. The percentage of people who use public transportation after Uber and Careem dropped from 18% to 11%. Similarly, the before and after ride sourcing; family car usage trend shows that the percentage of people using family car after ride sourcing reduced to 16% as compared to 31% which was before ride sourcing. Responses also show that the number of people using a rikshaw dropped to 3.7% from 8.1%, and people using organization's van dropped from 21.7% to 8%. Lastly, personal car usage has also reduced from 28% to 18.6%. This shift clearly indicates that after the emergence of Uber and Careem people have opted for ride souring and dropped their previous means of commuting to a greater extent.

Variables	Description	Percentage
Additional trip frequency	1-4 times	35.4
	5-8 times	11.8
	9-12 times	12.4
	13-16 times	4.3
	More than 16 times	1.9
	I have not taken additional trip	34.2
Distance of additional trip	1-15 km	37.9
	16-30 km	23
	31-45 km	6.8
	More than 45	3.1
	I have not taken additional trip	28.6
Travel occupancy	I travel alone	54.7
	One more person	24.8
	Group of 3	13
	Group of 4	5.6
	Group of 5	1.9

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Trip because of car availability	Agree	47.8
	Disagree	29.2
	Neutral	23
Travelling more because of ride sourcing	Agree	28.6
	Disagree	43.5
	Neutral	28
Effect of ride sourcing on private/family vehicle	Agree	31.1
	Disagree	28.6
	Neutral	29.8
	I don't have family vehicle	10.6
Buying a new car in spite of ride sourcing	Agree	42.2
	Disagree	34.2
	Neutral	23.6
Number of family members who have started using ride sourcing	1-3	60.2
	4-6	21.1
	7-9	2.5
	10-12	2.5
	No one has started using	13.7

Table 9: Additional trips and pollution

A greater number of people are taking trip just because of car availability that might not have been taken otherwise; this may result in additional pollution. 35.4% respondents took

additional trip 1 to 4 times which might not have been taken otherwise and 47.8% users took a trip just because of car availability. The travel occupancy shows that 54.7% people travel alone, one person in one car is vice versa of mass transit and results in air pollution. Out of the total sample 42.2% respondents are willing to buy a new car in spite of ride sourcing. The trend of using Uber and Careem is increasing among people as 60% of respondents said that their 1 to 3 family members have started using ride sourcing. Results show that people have started travelling more because of the availability of Uber and Careem.

Variables	Description	Percentage
Frequency of usage of uber and careem for work	Never used	13
	1 time	18
	2 times	23
	3 times	23.6
	4 times	13
	Regular use	9.3
Frequency of usage of uber and careem for College/University	Never used	6
	1 time	23
	2 times	20/5
	3 times	26.1
	4 times	13.7
	Regular use	10.6
Frequency of usage of uber and careem for Leisure	Never used	32.3
	1 time	23

	2 times	11.2
	3 times	18
	4 times	5.6
	Regular use	9.9
Frequency of usage of uber and careem for Visiting Relatives	Never used	27.3
	1 time	17.4
	2 times	16.1
	3 times	19.9
	4 times	8.7
	Regular use	10.6
Frequency of usage of uber and careem for Doctor's Appointment	Never used	19.9
	1 time	16.1
	2 times	13.7
	3 times	24.2
	4 times	12.4
	Regular use	13.7

Table 10: Uber and Careem usage

The table shows the frequency of usage of Uber and Careem for various modes like work, college, leisure etc. Results show that 26% of the respondents use ride souring frequently for college, 23.6% use it for work, 24% use it frequently for doctor's appointments, 20% use it for visiting relatives and 18% use it frequently for leisure activities.

4.2 Structural Equation Modeling

By using AMOS 23, structural equation modeling was performed in order to determine that how the independent variables like the travelling patterns, women's mobility, additional trips and pollution along with public perception and opinion are linked with the dependent variable i.e. uber and careem usage as specified by Zhen Chen (2013), Dawes (2016), Ertz. et al. (2017) and Henao (2017). There were no missing values in the data. Table shows the travelling patterns, women's mobility, additional trips and pollution along with public perception and opinion as dependent variables and Uber Careem usage as independent variable for this particular research with their Cronbach's alpha and factor loading.

Latent variable (Cronbach's Alpha)	Measured variables (items)	Item loading
Uber Careem Usage (0.824)		
UCU1	What is your frequency of usage of Uber and Careem for work, on a scale of 0 to 5?	0.494
UCU2	What is your frequency of usage of Uber and Careem for leisure/hangout, on a scale of 0 to 5?	0.626
UCU3	What is your frequency of usage of Uber and Careem for medical reasons/ doctor's appointment, on a scale of 0 to 5?	0.851
UCU4	What is your frequency of usage of Uber and Careem for visiting relatives, on a scale of 0 to 5?	0.853
UCU5	What is your frequency of usage of Uber and Careem for going to college/university, on a scale of 0 to 5?	0.605

Travelling Patterns (0.781)		
TP13	How often you were taking public transportation for travelling weekly, BEFORE ride sourcing?	0.416
TP14	How often you were taking public transportation for travelling weekly, AFTER ride sourcing?	0.405
TP17	How often do you take family car for travelling, BEFORE ride sourcing?	0.490
TP18	How often do you take family car for travelling, AFTER ride sourcing?	0.574
TP19	How often do you take rikshaw for travelling, BEFORE ride sourcing?	0.835
TP20	How often do you take rikshaw for travelling, AFTER ride sourcing?	0.875
Women's Access to Space (0.882)		
WM1	Is ride sourcing contributing to your increased freedom to travel?	0.875
WM2	Is ride sourcing providing you with sense of security?	0.714
WM3	Do you rely on ride sourcing for your daily travelling?	0.784
WM5	Have you started travelling more because of ride sourcing?	0.848

Women's Satisfaction with Uber and Careem (0.826)		
WM4	Is your family satisfied with your use of ride sourcing?	0.807
WM6	Have you ever reported any driver since you are using ride sourcing services?	0.789
WM7	Do you prefer and would feel safer with a female driver instead of male driver?	0.673
WM8	Will you be interested to work as a driver for ride sourcing?	0.693
Additional Trips and Pollution (0.674)		
ATP 1	In the past month, how many times you have taken a trip just because of ride sourcing (say additional trip) that you might not have taken otherwise? [You can see MY RIDES option in your app]	0.688
ATP2	Out of the additional trips you have taken, what was the approximate average kilometer distance traveled?	0.933
ATP7	Has ride sourcing reduced the travelling on your own private vehicle/ family vehicle?	0.206

Table 11: Dependent and independent variables

4.3 Confirmatory Factor Analysis

Each item was loaded and analyzed for CFA. Only those were retained which showed significant relationship. There was no correlation between error terms of the items. The model fit for all the variables can be seen in the given table. It is recommended by Hu & Bentler (1999) to use a mix of these values since each one has its own strengths and weaknesses.

Index	Recommended Value	Observed Value
Chi-square/df	It should be between 1 to 3 (Segars & Grover, 1998)	2.008
NFI	It should be > than 0.8 (Segars & Grover, 1998)	0.716
GFI		0.773
CFI		0.830
TLI		0.810
RMSEA	It should be < than 0.10 (Hair et al., 2009)	0.079

Table 12: Confirmatory Factor Analysis- A Model Fit Summary

4.4 Measurement Model

Structural Equation Model (SEM) is used to examine the measurement model and the hypotheses which were proposed. A three stage approach is developed by Shah and Goldstein (2016) in order to confirm the reliability, uni-dimentionality and validity of the data.

4.4.1 Reliability Testing

The test of construct reliability (also composite reliability) by average variance extracted (convergent reliability) was done to check the reliability of the constructs. Usually, the acceptable levels of analysis show AVE greater than 0.5 and composite reliability of more than 0.7 (Salman et al., 2014). The given table shows the reliability values for each construct.

Constructs	Convergent Reliability (AVE)	Construct Reliability	Discriminant Validity
Uber Careem Usage	0.491	0.822	0.0045033 (holds)
Travelling Patterns	0.395	0.781	0.048034967 (holds)
Women's Access to Space	0.652	0.882	0.280459473 (holds)
Women's Satisfaction with Uber and Careem	0.552	0.830	0.283214593 (holds)
Additional Traveling Patterns	0.462	0.674	0.00047088 (holds)

Table 13: Reliability of constructs

4.4.2 Uni- dimentionality Testing

The purpose of this test is to determine that whether the used items in the scale fit in a solitary underlying construct. There was no uni-dimentionality found from the results. (Chi-square p value= 0.000, X^2/df= 2.008, GFI=0.773, NFI=0.716, TLI=0.810 and RMSEA= 0.79).

4.4.3 Validity Testing

The validity is analyzed using discriminate validity, which is defined as the extent to which the constructs are divergent to each other (John and Reve, 1982). The convergent reliability is equated with average shared variance (which is the average of squared correlation of all the constructs). This value is thought to be lesser than the value of AVE.

4.4.4 Correlational Analysis

When the validity and reliability for all the constructs was identified, all the constructs were examined for the correlational analysis.[11] Following table shows the correlational matrix. It

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[11] Table 14, Appendix B

was found that traveling patterns changes, women's access to space, women's satisfaction and additional trips and pollution are positively correlated with the usage of Uber and Careem.

4.5 Result Estimations

The table gives summary of the structural model results. Four hypotheses were tested based on one on one regression, and by using controls such as (age, income, occupation and car ownership). Table 15 shows the trends below:

VARIABLES	(1) TP	(2) TP	(3) ATP	(4) ATP	(5) UCU	(6) UCU	(7) WMA	(8) WMA
UCU	0.0295**	0.0283**	0.0527**	0.0432*			0.0607**	0.0285
	(0.0115)	(0.0116)	(0.0236)	(0.0239)			(0.0239)	(0.0213)
Age		-0.0235		0.0448		0.000592		-0.252***
		(0.0281)		(0.0575)		(0.0999)		(0.0513)
Occupation		0.0133		0.0125		-0.0634		-0.0500**
		(0.0113)		(0.0232)		(0.0399)		(0.0207)
Income		0.000679		0.0286		0.0764**		0.0143
		(0.00936)		(0.0192)		(0.0329)		(0.0171)
PersonalCar		0.0240		0.151**		0.433***		-0.593***
		(0.0311)		(0.0637)		(0.116)		(0.0568)
WMS					0.117*	0.0444		
					(0.0650)	(0.0714)		
Constant	2.222***	2.161***	2.215***	1.816***	2.458***	1.665***	2.452***	3.824***
	(0.0285)	(0.0758)	(0.0587)	(0.155)	(0.154)	(0.362)	(0.0593)	(0.139)
Observations	161	161	161	161	161	161	161	161
R-squared	0.011	0.016	0.008	0.022	0.005	0.032	0.011	0.241

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 15: Hypotheses

4.5.1. Travelling Patterns

The hypothesis was supported and a significant relation was found between changing travelling patterns and the usage of Uber and Careem. Results were found significant with a path

weight of 0.029. When the controls for the model were added (age, occupation, income, personal car) the model improved travelling patters was still significant but not the controls.

4.5.2. Women's reliance on Uber and Careem

A significant relation was found between women's reliance on Uber and Careem for travelling. No insignificant result was recognized. The significant results were found with the path weight of 0.060. When the controls for the model were added (age, occupation, income, personal car) the model improved, additional travelling patters was still significant only personal car ownership came out to be significant that implies that as personal cars increases additional travelling patterns would increase.

4.5.3. Women's Satisfaction with Uber and Careem

A significant relation was found between women's satisfaction for travelling for both the services. The significant results were found with the path weight of 0.046. When the controls for the model were added (age, occupation, income, personal car) the model women access to space became insignificant and only personal car ownership came out to be significant that implies that as personal cars increases women access would increase. Also age and income came out to be significant too. As age increase use of women access to space would decrease. Furthermore income has a positive relation with women access to space.

4.5.4. Additional Trips and Pollution

The results between additional trips and pollution in relation with Uber and Careem usage were found to be significant with a coefficient value of 0.052. When the controls for the model were added (age, occupation, income, personal car) the model women satisfaction became

insignificant and only personal car ownership came out to be significant that implies that as personal cars increases women satisfaction would increase.

4.6 Questionnaire for Drivers

A total of 60 drivers were interviewed using the questionnaire. Questions about demographics, travelling hours, kilometers driven and fuel consumption were asked. Table17 shows the results. The information acquired through fuel consumption and kilometers driven was used for CO_2 emission calculation.

Variables	Description	Percentage
Age	18 to 25	41.7
	26 to 35	26.7
	36 to 45	25
	More than 46	6.7
Occupation before working with Uber and Careem	This is the first job I am doing	27.1
	Driver (somewhere else)	13.6
	Office job	16.9
	Own business	10.2
	Working abroad	22
	Farmer	0
	Labor	8.5
	Freelancer/ part time work	0

Monthly Income	Less than 10,000	0
	11,000 to 20,000	18.3
	21,000 to 30,000	48.3
	31,000 to 40,000	30
	41,000 to 50,000	3.3
Working tenure	Less than 6 months	20
	More than 6 months	26.7
	More than a year	53.3
Working hours	5 to 8 hours	15
	9 to 12 hours	70
	13-16 hours	15
Other job with Uber and Careem	Yes	11.7
	No	88.3
Reason to work for Uber and Careem	Time flexibility	16.7
	Good income	21.7
	Unemployment	53.3
	Easy to do	8.3
Working for which service	Uber	36.7
	Careem	38.3
	Both	25
Car financing	Self	23.3
	Loan from Bank	30

	Loan from Relatives	3.4
	Third party	23.3
	Family support	20
Car status	Own personal car	40.7
	Own Family car	35.6
	Driving someone else's car	23.7
	Taken car on rent	0
Will you invest another car in Careem and Uber?	Yes	65
	No	26.7
	Maybe	8.3
Daily kilometers driven daily	250	20
	200	38.3
	180	13.3
	150	11.7
	120 and less	13

Table 16: Questionnaire for drivers

Findings show that majority of 41.7% drivers are between 18 to 25 years of age and their most preferred reason to work for Uber and Careem is unemployment, says 53.3% of respondents. 48.3% of drivers are earning monthly income of Rupees 21,000 to 30,000. It is interesting to note that 88.3% respondents are not doing any other job except working for Uber and Careem and about 70% are working for 9 to 12 hours daily. 65% of the respondents are interested to invest another

car in Uber and Careem. The average kilometers driven by drivers daily is 206 kilometers and the average fuel consumption is Rupees 1100 daily.[12]

4.7 Impacts of Ride-Sourcing on Air Quality (Emissions Calculation)

The drivers were asked questions about the petrol consumption and the distance travelled by their car daily. Through this, an attempt to evaluate the emission burden via fuel burning, on the environment was done. The emissions of CO_2 was calculated using data on fuel consumption and kilometers driven, using the emission calculation formula provided by (US Environmental Protection Agency, 2011).

$$CO_2 \text{ Emissions per mile (grams)} = CO_2 \text{ per gallon / Miles per gallon}$$

$$\text{Annual CO}_2 \text{ emissions} = (\text{CO}_2 \text{ per gallon / Miles per gallon}) * \text{Miles}$$

The values were converted in Liters and Kilometers instead of Gallons and Miles, according to Pakistani standards. In Pakistan, 1.65 kilometers are approximately equal to 1 US Mile and 3.8 liters of petrol is approximately equal to 1 US gallon. Currently, the cars in Pakistan produce about 140-170 grams of CO_2 per kilometer and 1 liter of petrol produces 2.34 kilograms of CO_2, (Rehan & Farhan, 2012). Emission estimation is shown based on average kilometers & days a car is driven. If an Uber/Careem car is driven for 7 days a week using average distance travelled it gives out **19.7 Metric Tons of CO2** whereas, if a car is driven for 6 days it gives annual emissions of **16.89 Metric Tons of CO2.**

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[12] Appendix A, Figures 66-67

Extensive study needs to be done at a larger scale in order to find the environmental burden. Traffic congestion adds to air pollution. The data obtained through public opinion on traffic congestion shows that these services are actually a cause of traffic congestion. Literature shows that the increase in traffic congestion can ultimately lead towards exacerbated air pollution through tailpipe emissions, (Beaton, 1995; Javed, 2014). Gorham (2002) states that carbon dioxide emissions via road traffic will increase up to 92% from 1990 to 2020. Ride-sourcing in this regard could make the situation worse.

Kakouie (2012) shows that in the case of Tehran city, around 88% of all the anthropogenic carbon dioxide comes from private cars whereas; the emissions from the public sector are significantly low. Cities where public transportation exists in an efficient manner produce less CO_2.

4.8 Discussion

The major aim of this research is to identify the impacts of ride-sourcing of physical and social aspects of environment, including the change in public transit patterns is noted along with a special focus on women access to space. Carbon emission calculation along with traffic congestion issue is addressed. Ride sourcing creates job opportunities and provides safe mobility for women. On the other hand, the number of cars on the roads increases this creating congestion problem along with CO_2 emissions. This economic model may prove profitable in monetary terms but has negative impacts on the environment.

This research shows that maximum number of Careem and Uber users travel alone, whereas people might using the option of car-sharing, using organization's van or pubic bus in the past that has possibility little impacts on the environment as compared to one person travelling alone in a car. Careem and Uber are ultimate easy traveling solution, the public opinion on

environmental situation in relation with Careem and Uber shows that many users disagree that this app-based transportation system is an environment friendly option. Moreover, majority people agree that Careem and Uber in their opinion play no significant role in reducing traffic congestion issues. However being a feasible option, majority of people don't feel any savings in their money owing to Careem and Uber.

A prominent social and environmental phenomenon is the gender accessibility and mobility, which is to be considered while initiating startups like ride-sourcing. Ride-sourcing is serving as a major source of commuting for women worldwide. Results of the survey have shown that women in Lahore find Careem and Uber a stress-free way of commuting. Majority women agreed that ride-sourcing have increased their freedom to travel and they feel secure. The female passengers have also agreed to the fact that their parents and family is satisfied with their use of Uber or Careem. Moreover, a majority of women currently rely on ride-sourcing for their daily travelling. In spite of the fact that maximum numbers of women have reported some driver still ride-sourcing has become an importance part of their routine. Women have started travelling more because of ride sourcing as result of which their mobility is increased.

The findings also demonstrate that majority of the female riders would prefer having a ride with a female driver but the irony is very few percentage is willing to opt being a driver. Even though Careem has started hiring of female drivers even in Pakistan but the ratio is significantly low as compared to ladies working for the same platform in countries like India or UAE. There is a need to carry out an extensive research to find out and investigate the parameters, which are driving women to work as drivers in other countries, and are actually lacking in country like Pakistan. But the findings clearly depict that ride-sourcing have become a prominent feature of commuting for women in Lahore.

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Ride-sourcing is serving for the time being need of people and in spite of customer satisfaction majority respondents still plan to get a new car but the irony is that they think public transportation as a sustainable transportation system for city. While the mass transit options are available in the vicinity of city the results of this survey show that some percentage of people might not prefer to use public bus just because of the availability of Careem and Uber. The same trend is applicable to conventional rickshaw services and even staff/student vans; people are moving away from the usage of these means and have adopted the new trend. Ride-sourcing is limited scrutinized phenomenon which is expanding in Pakistan. This research proves the transit shift; however, the environmental along with the economic impacts of this transition needs further research.

Appendix A
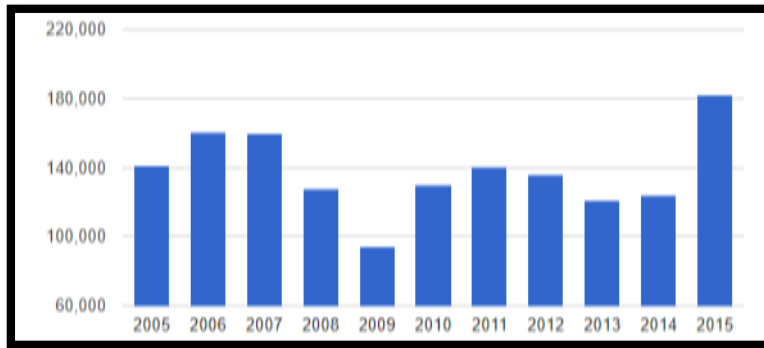
Figure 1- Number of passenger cars in Pakistan
Source: (OICA, 2016)
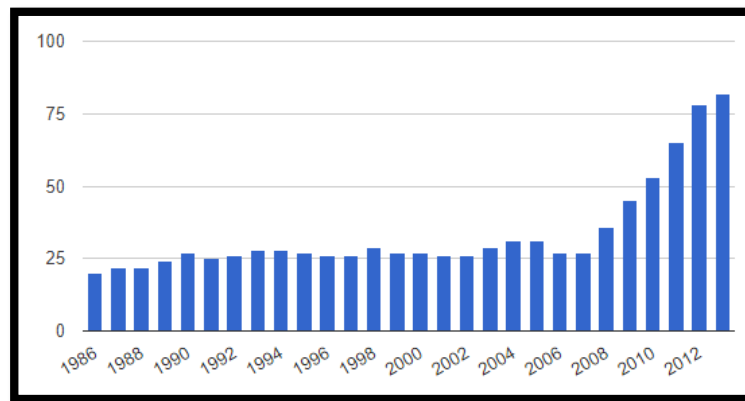
Figure 2- Gasoline consumption in Pakistan
Source: U.S. Energy Information Administration, 2014

Cities	Total Trips		
	Private Transport (%)	Public Transport (%)	Non-Motorized Transport (%)
Lahore	24	16	60
Karachi	27	23	50
Delhi	18	40	42
Mumbai	18	60	22
Kolkata	5	78	17

Figure 3- Public and private trips comparison
Source: TEPA and JICA, 1992

Years	Category	Punjab	Sindh	Khyber Pakhtunkhwa	Balochistan	GB & AJK	TOTAL
2009-10	Total	105,085	81,618	42,765	29,727	1,565	260,760
	Low Type	32,179	24,993	13,095	9,103	480	79,850
	High Type	72,906	56,625	29,670	20,624	1,085	180,910
2010-11	Total	105,253	80,625	42,550	29,500	1,535	259,463
	Low Type	32,147	24,000	13,000	9,000	450	78,597
	High Type	73,106	56,625	29,550	20,500	1,085	180,866
2011-12	Total	106,455	80,960	42,975	29,625	1,580	261,595
	Low Type	32,590	24,335	13,140	9,125	465	79,655
	High Type	73,865	56,625	29,835	20,500	1,115	181,940
2012-13	Total	107,805	81,385	42,980	29,655	1,590	263,415
	Low Type	33,090	24,685	13,140	9,130	470	80,515
	High Type	74,715	56,700	29,840	20,525	1,120	182,900
2013-14	Total	107,973	81,493	43,035	29,692	1,592	263,755
	Low Type	32,729	24,415	12,996	9,030	465	79,635
	High Type	75,214	57,078	30,039	20,662	1,127	184,120

Figure 4- Length of roads in Pakistan
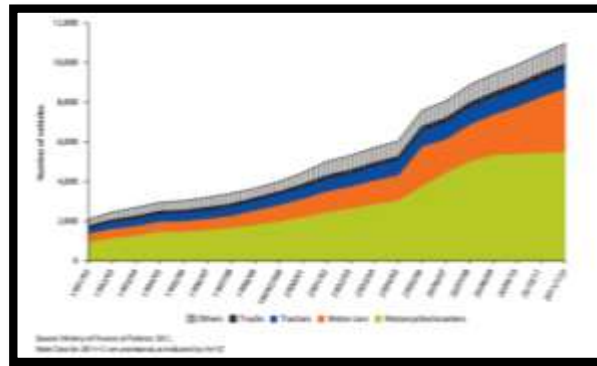**Source: National Transport Research Centre**

Figure 5- Levels of vehicles in Pakistan
Source: World Bank, 2014

Average	PM$_{2.5}$ (µg/m³)	SO$_2$ (µg/m³)	NO$_2$ (µg/m³)	O$_3$ (µg/m³)	CO (mg/m³)
ISL	61 ± 31	6 ± 3	49 ± 28	47 ± 29	1.4 ± 1
QUE	49 ± 26	54 ± 26	37 ± 15	40 ± 13	1.1 ± 1
KAR	68 ± 38	34 ± 34	46 ± 15	27 ± 13	0.6 ± 1
PES	71 ± 38	39 ± 34	52 ± 21	35 ± 19	1.5 ± 1
LAH	143 ± 69	71 ± 48	49 ± 25	42 ± 22	1.3 ± 1

Source: Dell'Orto 2012.
Note: PM$_{2.5}$ = particulate matter of less than 2.5 microns, SO$_2$ = sulfur dioxide, NO$_2$ = nitrogen dioxide,
O$_3$ = ozone, CO = carbon monoxide.

Figure 6- Average level of pollutant sin 5 major cities of Pakistan
Source: World Bank Report, 2014

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Figure 7- Map of Lahore
Source: Google Map, 2017

Appendix B

Year	Total number of vehicles registered	Number of cars and jeeps registered
2010	2,387,993	722,012
2011	2,687,987	764,265
2012	3,022,126	801,403
2013	3,391,268	871,244
2014	3,991,517	1,023,110
2015	4,287,662	1,07,0243

Table 1- Number of cars registered in Lahore
Source: Punjab Bureau of Statistics, 2016

1853	First public transit system was developed as railway
1865	All major cities were connected through public transit network
1885	First steam tramway was introduced for inter-city transport
1904	Transportation system in Lahore started to evolve
1908	Petrol tramways started to operate
1951	Road transportation board was formulated in Punjab
1970	Trams were abolished and Omni bus service started to operate
1991	Draft National Transportation Policy was formulated supporting bus based transit system instead of railways
1998	National Transportation Strategy served as a major breakthrough which attracted private sector investment in transportation system
2000s	Transportation policy by Federal Planning Commission, highlighted reserved lanes for buses

Table 2- Historical events in transportation sector
Source: Imran, 2009

COUNTRIES IN WHICH ONLY UBER IS OPERATIONAL

COUNTRIES IN WHICH UBER & CAREEM ARE OPERATIONAL

COUNTRIES IN WHICH ONLY CAREEM IS OPERATIONAL

Argentina	Australia	Austria	Azerbaijan	Belarus	Bahrain	Bangladesh
Belgium	Bolivia	Brazil	Cambodia	Canada	Chile	China
Colombia	Costa Rica	Croatia	Estonia	Denmark	Ecuador	Egypt
El Salvador	Finland	France	Ghana	Guatemala	Greece	Hungary
India	Ireland	Italy	Japan	Jordan	Lebanon	Macao
Malaysia	Mexico	Norway	Philippines	Portugal	Qatar	Myanmar
Russia	Saudi Arabia	Slovakia	Germany	Sweden	Kazakhstan	Kenya
Hong Kong	Switzerland	Tanzania	Trinidad	Turkey	Ukraine	UK
UAE	USA	Vietnam	Uganda	Uruguay	Thailand	Taiwan
Singapore	New Zealand	Peru	Pakistan	Panama	Poland	Romania
Morocco	Netherlands	Nigeria	Israel	Spain	Indonesia	Lithuania
Dominican Republic	Czech Republic	South Korea	Sri Lanka	South Africa	Kuwait	Oman
Palestine						

Table 3- Countries in which ride sourcing services are operational
Source: www.careem.com; www.uber.com

Pairwise correlations

Variables	(1)TP	(2)ATP	(3)WR	(4)WS	(5)UCU
(1) TP	1.000				
(2)ATP	-0.020	1.000			
(3) WR	0.259***	-0.031	1.000		
(4) WS	0.277***	0.005	0.879***	1.000	
(5) UCU	0.048	0.069	0.080	0.050	1.000

*** Shows significance at the .01 level

** Shows significance at the .05 level

* Shows significance at the .1 level

Table 14- Pairwise Coorelation

Appendix C

CO2 Emissions Calculations Estimations

I US Mile= 1.65 Kilometers---------------1

1 US Gallon= 3.8 Liters-------------------2

I Liter = 2.34 Kilograms-------------------3

2.34 kg= 2340 grams (Thus1Liter gives out 2340 grams of Carbon dioxide) ----------4

Using 2 & 4

3.8 Liters (1 US Gallon) = 8892 grams of CO_2--5

By US EPA (2011), Miles per gallon = 21-------------------- 6

Using 5 & 6

CO2 per mile = 8892/21= 423 grams--------------------------7

The average kilometers driven are 206 km daily

206/1.65= 128 miles a day---------------------------------------8

Using 8 and if a car is driven 7 days a week:

128*7= 896 (multiply with 52 weeks for annual emissions) = 46592 annually--------------9

By putting the values obtained through 7 & 9 in Annual CO_2 emissions formula:

19.7 Metric Tons of CO_2

Similarly, using 8 and if a car is driven 6 days a week:

 128*6= 768 (multiply with 52 weeks for annual emissions) = 39936 annually--------------10

By putting the values obtained through 7 & 10 in Annual CO_2 emissions formula:

16.89 Metric Tons of CO_2

Appendix D

Questionnaire # 1: Ride Sourcing and Public Travelling Patterns

This form is to get an opinion from (PEOPLE USING UBER/CAREEM & LIVING IN LAHORE ONLY) regarding ride sourcing services. It includes questions like usage, preference and comments upon this phenomenon which is prevailing in Lahore. It's an interesting survey, which will take 5 minutes out of your precious time. Please add your genuine, valuable comments. THIS FORM IS NOT FOR UBER/CAREEM DRIVERS.
*Required

Are you currently stationed/ living in Lahore? *

Yes

No

Do you frequently use ride-sourcing i.e. Uber/Careem? (i.e. 3-5 times a month) *

Yes

No

DEMOGRAPHICS

Your age?
•18-25
•25-35
•35-45
•45-55
•Above 55

Your profession?
• Self employed
• Part time employee
• Business Owner
• Student
• Housewife
• Full time employee
Other:

What is your monthly income level?
• Less than 20,000
• 20,000-50,000
• 50,000-80,000
• 80,000-100,000
• More than a Lac

Does your household own a car?
•Yes
•No

Do you own a personal car/vehicle (that you drive)?
•Yes
•No

Select your gender *
Male
Female
Other:

(Only women will go to the following section, rest will continue to fill the later section automatically)

<div style="background-color:teal;">

WOMEN ACCESS TO SPACE

</div>

Is ride sourcing contributing to your increased freedom to travel?
Agree
Disagree
Neutral

Is ride sourcing providing you with sense of security?
Agree
Disagree
Neutral

Do you rely on ride sourcing for your daily travelling?
Agree
Disagree
Neutral

Is your family satisfied with your use of ride sourcing?
Agree
Disagree
Neutral

Have you started travelling more because of ride sourcing?
Agree
Disagree
Neutral

Have you ever reported any driver since you are using ride sourcing services?
Agree
Disagree
Neutral

Do you prefer and would feel safer with a female driver instead of male driver?

Agree
Disagree
Neutral

Will you be interested to work as a driver for ride sourcing?
Agree
Disagree
Neutral

TRAVELLING PATTERNS

Since how long you have been using ride sourcing service like Uber/Careem? *
Less than 6 months
More than 6 months
More than a year

Typically how often do you use ride sourcing?
• Always (Daily)
• Regularly (at least 4 times a week)
• Sometimes (at least 1-2 times a week)
• Rarely (special occasions/monthly)

What is your most preferred reason for using Careem/Uber?
• Security
• Cost effectiveness
• No need to drive
• Easy accessibility
• Time efficiency
• Avoid parking
• No other mode available

Has ride sourcing reduced the travelling on your own private vehicle/family vehicle?
Agree
Disagree
Neutral
•I do not have private/family vehicle

Has ride sourcing curbed/suppressed/affected your previous means of transport?
Agree
Disagree
Neutral

In the past month, how many times you have taken a trip just because of ride sourcing (say additional trip) that you might not have taken otherwise? [You can see MY RIDES option in your app]
• 1-4 times
• 5-8 times
• 9-12 times
• 13-16 times

• More than 16 times

• I have not taken any additional trip

Out of the additional trips you have taken, what was the approximate average kilometer

distance traveled?

• 1-15 km

• 16-30 km

• 31-45 km

• More than 45 km

• I have not taken any additional trip

For a trip what would you have taken if Uber/Careem wouldn't have been available?

• Personal Car

• Family Car

• Motorcycle

• Rikshaw

• Quingqi (Open rikshaw)

• Public transportation

• Organization's Staff Van/Student Bus

• Taxi service other than Uber/Careem

• Car sharing (Someone might drop on their way)

• Would not have traveled

How many people accompany you (are with you excluding driver) in your usual rides on

Uber/Careem?

• I travel alone

• One more person

• Group of 3

• Group of 4

• Group of 5

How many members of your immediate household have started using ride sourcing services

like Uber/Careem?

• 1-3

• 4-6

• 7-9

• 10-12

• No one has started using

Whats your frequency of usage of Careem/Uber for 'Work' now, on a scale of 0 to 5?

0= Never used

5= Frequently used

Whats your frequency of usage of Careem/Uber for 'Leisure/Hangout' now, on a scale of 0 to 5?

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0= Never used
5= Frequently used

Whats your frequency of usage of Careem/Uber for 'Medical reasons/ Doctor appointments' on a scale of 0 to 5?
0= Never used
5= Frequently used

Whats your frequency of usage of Careem/Uber for 'Visiting Relatives' on a scale of 0 to 5?
0= Never used
5= Frequently used

Whats your frequency of usage of Careem/Uber for 'College/University' now, on a scale of 0 to 5
?
0= Never used
5= Frequently used

PUBLIC PREFERENCES

Do you prefer booking ride on Uber/Careem instead of waiting for public bus or private

car?
Agree
Disagree
Neutral

Do you think that ride-sourcing has positive social impacts (in terms of employment and

accessibility to transport)?
Agree
Disagree
Neutral

Do you think that ride-sourcing has positive environmental impacts (in terms of reducing

emissions/air pollution)?
Agree
Disagree
Neutral

Do you think that ride-sourcing plays significant role in reducing traffic congestion?
Agree
Disagree
Neutral

Are you somewhat dependent on Uber/Careem for your travelling?
Agree
Disagree
Neutral

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Have you taken a trip just because of the availability of car by Uber/Careem?
Agree
Disagree
Neutral

Have you experienced any savings in your money related to transportation? (Through Uber/Careem)
Agree
Disagree
Neutral

In your opinion what is the best suitable form of sustainable transportation in city, for everyone?
• Improved public transportation
• Improved ride sourcing services
• Using own cars/vehicles
• Unsure

Will you still purchase a new car in spite of ride sourcing (Uber and Careem)?
Agree
Disagree
Neutral

Do you travel more because of ride sourcing?
Agree
Disagree
Neutral

Do you drive less because of ride sourcing?
Agree
Disagree
Neutral
I don't drive

MODE FREQUENCY (WEEKLY)

What is your usual travelling destination on Careem/Uber? Choose all that apply.
• Work
• College/University
• Leisure/Hangout
• Doctor appointments
• Visit to relatives

How often you were taking public transportation for travelling weekly, BEFORE ride sourcing?
• Always (Daily)
• Often (4-5 days)

• Sometimes (2-3 days)
• Never (0 days)

How often do you take public transportation for travelling, AFTER ride sourcing?
• Always (Daily)
• Often (4-5 days)
• Sometimes (2-3 days)
• Never (0 days)

How often you were taking family car for travelling weekly, BEFORE ride sourcing?
• Always (Daily)
• Often (4-5 days)
• Sometimes (2-3 days)
• Never (0 days)

How often do you take family car for travelling, AFTER ride sourcing?
• Always (Daily)
• Often (4-5 days)
• Sometimes (2-3 days)
• Never (0 days)

How often you were taking rikshaw for travelling weekly, BEFORE ride sourcing?
• Always (Daily)
• Often (4-5 days)
• Sometimes (2-3 days)
• Never (0 days)

How often do you take rikshaw for travelling, AFTER ride sourcing?
• Always (Daily)
• Often (4-5 days)
• Sometimes (2-3 days)
• Never (0 days)

How often you were taking organization's staff van/student bus for travelling weekly,

BEFORE ride sourcing?
• Always (Daily)
• Often (4-5 days)
• Sometimes (2-3 days)
• Never (0 days)

How often do you take organization's staff van/student bus, AFTER ride sourcing?
• Always (Daily)
• Often (4-5 days)
• Sometimes (2-3 days)
• Never (0 days)

How often you were driving your own car for travelling weekly, BEFORE ride sourcing?
• Always (Daily)
• Often (4-5 days)
• Sometimes (2-3 days)

• Never (0 days)

How often do you drive your own car for travelling, AFTER ride sourcing?
• Always (Daily)
• Often (4-5 days)
• Sometimes (2-3 days)
• Never (0 days)

Appendix E

Questionnaire # 2: People Working for Ride Sourcing Services (Careem & Uber)

This form is to get an opinion and relevant information from drivers of ride sourcing services such as Careem and Uber. It includes questions like distance traveled on job daily in terms of average kilometers and petrol consumption. Please add your genuine, valuable comments to make this study possible.

Your age?
18 - 25
25 - 35
35 - 45
45 -65
66 or above

Gender?
Female
Male
Other:

For which service you're working?
Uber
Careem
Both

Since when you're working for Careem/Uber?
less than 6 months
more than 6 months
more than 1 year

How many hours you drive daily, on average?
1-4 hours
5-8 hours
9-12 hours
13-16 hours
17-20 hours
21-24 hours

How many day(s) you drive for Careem/Uber?
1
2
3
4
5

6
7

Before you began working for Careem/Uber as a driver, what was your profession?
This is the first job I am doing ever
Driver (somewhere else)
Office Job
Own business
Working abroad
Farmer
Labor
Student
Other:

Is driving for Careem/Uber your only job?
Yes
No

What is your monthly income from working as a Careem/Uber driver?
1,000 to 10,000
10,000 to 20,000
20,000 to 30,000
30,000 to 40,000
40,000 to 50,000
50,000 to 60,000
60,000 to 70,000
70,000 to 80,000
80,000 to 90,000
90,000 to 1,00,000
Above 1,00,000

What is the ownership status of car you're driving for Careem/Uber?
Own personal car
Own family car
Driving someone else's car
Taken car on rent
Other:

What's the nature of your car?
Only bought for driving (for ride-sourcing)
Already had this car, for family use
Already had this car, but it was free most of the times

Pick the fuel type?
Petrol
CNG

What is the kilometer average per liter of your car?

_____

How many rupees do you spend on fuel in your car per day?
100-500
500-1000
1000-1500
1500-2000
2000-2500
2500-3000
3000-3500
3500-4000
4000-4500
4500-5000
More than 5000

How many average kilometers you drive daily on job?

_____

What is the source of investment for the car which you are driving?
Self
Loan from bank
Loan from relatives
Third party (working for someone else)

What is your preferred reason of working for Careem/Uber?
Time flexibility
Good income
Unemployment
Option 4

Are you planning to invest in Uber/Careem, through a new car?
Yes
No
Maybe

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