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Empirical Study Based on Online APP Cabs in India during  
COVID-19**

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**ABSTRACT**

*COVID-19 created a major transformation in our daily commuting from public transport to either personal transport or private cabs. The economic status of commuters determines whether switching from public to private mode of transport is a feasible option. The study explores the reasons behind the surge in online cab fares. Two probable reasons are COVID-19 and public transport shortage. The effects of weekends, dual shifts and infrastructure blockage were additionally controlled. The results indicate that the surge in cab fares is caused by the shortage of adequate public transport compared to the number of commuters. The dual shifts of jobs are effective in transferring transport demand from peak to slack period. Infrastructure blockage reduces the effectiveness of dual shifts of jobs in transferring transport demands. The findings contribute to the previous literature by highlighting the role of public transport importance for lower income section in developing countries.*

**Keywords:** *social distancing, technology, COVID-19, transport, online cab service, dual shifts*

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## Introduction

COVID-19 affected 151 countries across the world and WHO announced it as a pandemic on 11<sup>th</sup> June, 2021. India stands second position (44 million) after USA (104 million) in total number of COVID-19 patients affected as on 30<sup>th</sup> January, 2023 (worldometer, 2023). Most of the countries in the world France, Germany, USA, China and India imposed a nationwide lockdown to contain the spread of pandemic. Perceived risk from COVID-19 has caused many behavioral changes in the transport sector. In comparison to the developed countries context where most of the commuters reduced the travelling amount drastically, the developing countries context due to lack of inadequate infrastructure and nature of the jobs forced majority of the commuters to travel to sustain their livelihood even with fear of contacting the virus (Paul et al, 2022). According to Asian Development Bank report (2020) most of the developing countries have only 15-20 percent jobs that can be conducted remotely, therefore forcing majority of the people to travel. Besides reducing the frequency of travel and length of travel, COVID-19 has induced a major change in the travel modes of the commuters from public transport to private transport (Beck and Hansher, 2021; Kim et al, 2021 and Abdullallah et al, 2020). Surprisingly, in a countrywide analysis by Asian Development Bank found that in India commuters are still preferring to use public transport compared to driving in the recovery period from COVID-19 (ADB, 2020). In India out of every 1000 person only 23 people have cars and 128 have bikes as on 2018 (RTYB, 2018). For switching from communal transport to private transport, income of the commuter plays an essential role.

Empirically it has been observed that only the higher income group are successful in switching from public to private transport, the lower income groups still depend on public transport. Meena (2020), in a survey on the impact of COVID-19 on travel pattern in India found that only higher income (average monthly income more than Rs1 lakh) would switch to cars and the lower income group people (less than average monthly income Rs 50,000) are still dependent on public transport post-lockdown. The captive commuters who don't have options to switch to private mode would continue using public transport post-lockdown. This fact is empirically consistent for the lower income commuters in developed country context as well. Kim et al.(2021), in their study on South Korea found commuters those who belong to affluent locations are reducing their use of bus usage and switching to car usage after COVID-19, however those who belong to lower income are still dependent on public transport. Further, as per survey conducted in China, the propensity to switch from public transport to car is higher for the higher income groups (ADB, 2020). Although the impact of COVID-19 on modes of transport, travel patterns and trips have been widely studied but emphasis on lower-income sections who are forced to use public transport has not been explored to the best of our knowledge. The study at hand aims to fill this literature gap.

Hall et al (2017), in their study for metropolitan cities of USA found that online cab services like UBER acted as complement for usage of public transport by providing more flexibility to the fixed route of public transport and increases

the usage of public transport. Menna, 2021 in post-lockdown phase in a survey for Indian commuters found that 67 percent feels more anxiety and stress in travelling by public transport in fear of contacting virus and feel unsafe. Alternatively, online cabs like UBER and OLA can become a viable option for those commuters who are not able to afford the purchase of private vehicles but want to safeguard themselves from COVID-19. Paul et al. (2022), in their study found that the on demand services like UBER, taxi propensity of using increased after COVID-19 from 8 percentage to 11 percentage in Dhaka, Bangladesh. According to this demand for online cab services should increase and would lead to an increase in cab fares. However, the commuters whose income has shrunk post-lockdown would try to cut their expenditure on traveling on cab services which is more expensive than public transport, this would lead to a reduction in demand and online cab fare. The net effect would determine the effect of COVID-19 on online cab services and cab fares. This paper's contribution would be to measure the effect of public transport availability on online cab services usage like OLA and UBER in pre- and post-lockdown scenario. In this context, we study and examine the changes in pattern of online cab fare due to COVID-19 in Kolkata city, India.

Kolkata is one of the eight metro cities of India and 7<sup>th</sup> biggest city of India in area and population. As per the 2011 census the population of the city is 44 lakhs. However, the average annual salary is only 3.78 lakhs in comparison to the other four metros (Delhi, Mumbai and Bengaluru) where the annual salary is at least 4.78 lakhs (Economic Times, 2019). Having a lower income, most of the commuters depend on public transport than private individual transport for commuting. In a usual scenario around 60 lakh commuters travel daily from both within and around the greater Kolkata (Ananda Bazar Patrika, 2020). These commuters mainly depend on public transport like buses, metros, and local trains as their main mode of transport commute. After removal of lockdown in the initial period the local trains and metros were not operating. Henceforth, commuters had to depend on buses for public transport. Further, as the private buses were not operating in the first few days from 1<sup>st</sup>-3<sup>rd</sup> June, 2020. This created an additional public transport supply constraint in view of low-income status people who were commuting to sustain their livelihood. The shortage of public transport would create an increase in the demand for online cab-services and the cab fares. However, this increase in demand for online cab-services would be purely an instance caused by supply constraint and rather than commuter's behavioral change pattern for safe travel to avoid contacting SARS virus. For the former the increase in demand for online cab-services would be short lived and would reduce with adequate public transport supply, however in the latter there would be a long-run impact on the demand for online cab-services.

In Kolkata city, as per the central government guidelines a lockdown was imposed from 25<sup>th</sup> March which lasted till 31<sup>st</sup> May, 2020. The study uses balanced panel data on app cab fare daily basis for different time zones before and after the lockdown removal. Using the fixed effect methodology, the study aims to segregate the effect of COVID-19 from public transport shortage on the online cab fare.

The purpose of the study is to analyze the effect of lockdown restriction and public transport supply constraint on app-based cabs fare. The entire study is divided as follows. The literature survey on online cab service is explained in section II. The model and explanatory variables adopted in the study is explained in Section III. The result and analysis are explained in Section IV. Finally, the discussion is done in Section V and conclusion in Section VI.

## **Literature Review**

The online cab service and app-based cab service has garnered recent importance in the field of research (Luciano et al., 2023; Rizki et al., 2021). Cramer and Kruger, (2016) in their study has shown that app-based cab service like UBER is more efficient than a traditional yellow taxi in matching the commuters with the drivers with their technology. Henceforth, they both reduce the search costs of both commuters for cabs and cab drivers for potential riders. Further, Hall et al., (2017) in their study for metropolitan cities of USA empirically validated the fact that online cab services like UBER can act as complement for usage of public transport by providing more flexibility to the fixed route of public transport and increases the usage of public transport.

Usually the studies in online application-based cabs been mainly broadly divided into two categories: analyzing either the customer experience, studying their business model or predicting the use of app-based cab services like OLA or UBER. Studies (Nikam et.al, 2020; Kalla and Purohit, 2017) did a detailed analysis of the business model used especially of OLA. Alemi, F. et al., 2018 determined the factors that influences the commuters to use online cab-services like UBER. They found that the more educated and technology driven millennial generation are more prone to use UBER. Further, accessibility of a location by automobiles plays an important factor in using online cab-service. Empirical studies (Perea and Samarasinghe, 2021; Khuong and Dai, 2016; Soleh, Harini and Djamaludin, 2018) the major factors that determine the customer's satisfaction and customer loyalty for app-based cabs. Price of the app cab has been found to play an important and significant role on the customer's satisfaction (Perea and Samarasinghe, 2021; Khuong and Dai, 2016; Soleh, Harini and Djamaludin, 2018). A study on e-biking in Indonesia found that the condition of app-based drivers has become vulnerable after the COVID-19 (Rachmatwi et al., 2021). There is no study that shows the effect of public transport availability and dual shifts of jobs on app cab fare. The current study fills this gap in this literature using the online cab fare impacted by public transport, government policies like dual shifts and infrastructure blockage.

## **Methodology and Data**

The app cab fare in a locality for a particular time of the day depends on demand for cabs and availability of the online cabs in that locality at that point of

time as per demand-supply framework. Henceforth, during high demand for cabs compared to the availability of cabs usually a peak price loading occurs, which drastically surges the cab fares compared to the normal times (OLA, 2022). During the pandemic 2020 the government of India announced a nationwide lockdown (restriction in movement and all forms of activity) from 25<sup>th</sup> March, 2020 till 30<sup>th</sup> May, 2020 to prevent the rapid spread of COVID-19 disease among people. The restriction in movement issued by the government during lockdown and further the fear of spread of COVID-19 disease by contact lead to a social distancing and self-imposed containment in houses. Even after the removal of lockdown after 30<sup>th</sup> May, 2020 onwards the availability of both public transport and online cab services was highly reduced. On the other hand, the fear of being infected from COVID-19 increased the tendency of people to shift from public transport to online cab service. Both these factors would cause an increase in the demand for the online cab service.

In Kolkata, besides the online cab service the traditional yellow cab services are available. As these yellow cabs will be competitors for online cab service and based on their availability in an area would affect the online cab fares, the localities will itself play an important factor (Cramer and Kruger, 2016). The zones for this study could not be chosen randomly but restricted to as per availability of OLA and UBER service in the regions (Economic Times, 2020). If we consider only cross-section the analysis will suffer from cross-section bias, for example yellow cab services available would affect both the extent of lockdown on transport and fares. Similarly, considering time series data only can incorporate time series bias. Overtime exposure and familiarity to online cab service will increase the usage of online cab service (Alemi et al., 2018). To remove both cross-section and time series bias the study uses a fixed effect panel methodology (Baltagi, 2005). The following fixed effect model tries to capture the essence of the previous discussion and removes the cross-section and time series bias:

$$\begin{aligned}
 (pit) = & \alpha_0 + \text{Number of Active Cases } \beta_1 + \text{Lockdown}_{it} \beta_2 + \\
 & \text{Number of Active Cases} * \text{Lockdown}_{it} \beta_3 + \\
 & \text{Private Bus Operation } \beta_4 + \mu_i + \varphi_i(t) + \vartheta_{it}; \\
 & i = \text{distance zone}, t = \text{time of a day} \quad [1]
 \end{aligned}$$

The dependent variable online cab fare ' $pit$ ' in a locality ' $i$ ' in any particular ' $t$ ' time of day would be dependent on many factors. The unobserved individual locality factors are captured by  $\mu_i$ ,  $\varphi_i(t)$  captures the trend of cab fare and  $\vartheta_{it}$  represent the random error term. Our primary interest lies in the coefficient of regression variable ' $Number of Active COVID - 19 Cases$ ' \*  $Lockdown$  which represents change in pattern in the travel behavior to maintain social distancing post lockdown. With an increase in COVID-19 active cases post-lockdown whether online demand for cab-services is increasing in fear of social distancing. The coefficient  $\beta_3$  represents the online cab fare affected by COVID-19 cases in a particular locality since it is in a more restricted area with less transports available visa-vi a less restricted area with more alternatives post-lockdown. Beside this our secondary interest is the coefficient  $\beta_4$  effect of private

bus operation dummy variable on cab fare. Hall et al., (2017) found that in metropolitan cities in USA online cab services intensity act as complements to the public transport services by increasing their usage. However, the lower income commuters would be mainly captive users who are dependent on public transport as it is a cheaper mode of transport, henceforth public transport would act as a substitute for private cabs. Therefore, whether the majority of the commuters are captive users would determine the net effect and relationship of public transport as a complement or substitute for online cab-services. Additionally, we also explore the effect of dual shift for government employees and weekends on the cab fare. The dual shift of government employees would allocate the demand between different times of the day and henceforth reduce pressure on demand for transport and reduce online cab services. Weekends would require only travelling for leisure purposes, henceforth after COVID-19 would lead to a major reduction in leisure travelling (Kim et al, 2021).

#### *The Temporal and Geographical Scope of the Study*

The initial period of COVID-19 before lockdown and after removal of lockdown in 2020 from 10<sup>th</sup> March, 2020-17<sup>th</sup> June, 2020 (with gaps) in Kolkata is the study period. WHO declared COVID-19 as a pandemic on 11<sup>th</sup> March, 2020. The first case of COVID-19 was recorded on 17<sup>th</sup> March, 2020 in Kolkata. After that there was an increasing trend of COVID-19 cases and keeping in view of curbing the spread of pandemic the central government imposed a nationwide lockdown from 25<sup>th</sup> March, 2020 – 31<sup>st</sup> May, 2020 like other developed countries France and Germany. During this lockdown period public transport and all forms of activities except movement for emergencies, were halted.

#### *Explanatory Variables*

The dependent variable APP cab fare is collected from primary data of online app (OLA and UBER) on daily basis from 10 March, 2020-17<sup>th</sup> June, 2020. Usually before commencing any ride the commuter is shown for these APP cabs the potential fare based on its current location and time, this potential fare has been considered for this study as the main dependent variable. We record the app cab fare on daily basis for different zones before and after COVID-19 lockdown removal. The authors recorded the necessary cab fare data from OLA and UBER online app for each zone, daily for different time periods. The entire cross-section was divided into seven zones, with ascending orders of distance required to be travelled respectively for each zone. The details of the different zones are provided in Table 1. Further, the app cab fare was collected on daily basis for three different time periods morning (8 a.m.-9:30 a.m.), afternoon (12:30 p.m-2p.m) and evening (5p.m-6:30 p.m.) to capture peak pricing of cab fare. As both OLA and UBER are prominent players for online cab services in Kolkata, henceforth for each zone both the app cabs fare were initially noted and then the average of the two fares for zone on a particular time was considered. As during the interim period (25<sup>th</sup> March, 2020-31<sup>st</sup> May, 2020) when the central government announced a complete

lockdown the service of online app cabs like OLA and UBER were not publicly available henceforth a balanced panel of 294 observations were collected. Hereafter, we will refer OLA and UBER as app cabs for the rest of the study.

**Table 1.** *Description of Zones of App Cab for Study*

Zones	Distance (in kms)
MAIDAN - PARK STREET	5
BOTANICAL GARDEN - BENIAPUKUR	7
BENGAL CHEMICAL - TOPSIA	9
LAKE TOWN - BOSEPUKUR	12
DAKHINESWAR - SANTOSH PUR	15
BELGHORIA - SHAKUNTALA PARK	18
JOKA - KAMALGACCHI MORE	21

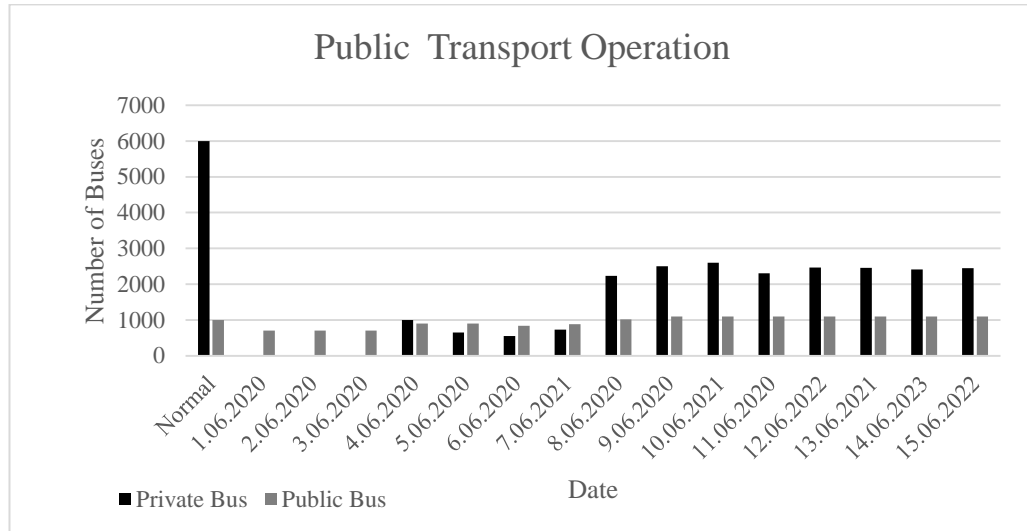
*Source:* Based on Authors Calculation of App Cab Fare Data.

The other major explanatory variables for this study are the number of active COVID-19 cases in Kolkata. The West Bengal Government has been updating the number of active cases of COVID-19 in Kolkata daily on its COVID-19 website. We collected data on the daily active cases in Kolkata from this website. We included a lockdown dummy to consider the reduction of public transport availability after the uplift of restrictions on movement from 31<sup>st</sup> May, 2020 onwards in comparison to the pre COVID-19 period.

In the usual scenario most of the commuters in Kolkata city depend on the private buses which are almost six times in number compared to the government buses. The metros and local trains also provide vital modes of public transport, but during the initial period of lockdown removal these modes were not operating. Henceforth, the ordinary commuter had to depend mainly on buses for commuting to their desired location. However, in order to bargain for a fare hike in respect of increase in cost the private bus owners initially refused to resume the bus services between 1<sup>st</sup> June, 2020-3<sup>rd</sup> June, 2020 even after the lockdown removal from 1<sup>st</sup> June, 2020. Although, the private buses resumed in service from 3<sup>rd</sup> June, 2020 but they were operating only 30 percent of their usual full capacity as is evident from Figure 1. We include a dummy variable for private buses operating with operation period as one and otherwise zero. This allows to capture the massive supply constraint of public transport created by private buses being not operational from 25<sup>th</sup> March, 2020 to 3<sup>rd</sup> June, 2020.



**Figure 1.** Access to Public Transport Availability before and after Lockdown Removal



Source: Assorted issues of Anandabazar Patrika, 2020.

With respect to the public transport supply constraint the commuters were facing, the West Bengal Government introduced a dual shift for government job employees, to reallocate the demand of public transport from peak to slack period. In order to capture this dual shift, we use a dummy variable whose value equals one for time period 11<sup>th</sup> June, 2020 onwards and zero otherwise. We also include a dummy variable to differentiate the travel behavior between weekdays and weekend, with weekends equals to one and zero otherwise.

As is evident from Table 2 the average APP cab fare in Kolkata increased by 5 percent after the upliftment of lockdown in comparison to the before COVID-19, when availability of transports was normal. Before lockdown removal there was approximately 85 percent times private buses were operating in comparison to after upliftment of lockdown when only 71 percent times the private buses are operating.

However, as visible from Figure 1 that there was a mass reduction in the number of buses operating and only 30 percent of the normal scenario were available for the commuters. There are more additional weekends that have been considered in the sample data after lockdown removal. We also observe that before lockdown there was no dual shift and post lockdown removal there is approximately 50 percent observations when the government employees had a choice for dual shift to perform their duties.

**Table 2.** Comparison of Average APP Cab Fare before and after Lockdown

	<b>Before Lockdown Removal</b>	<b>After Removal of Lockdown</b>
<b>Average Cab Fare</b>	304 (77)	319 (85)
<b>Private Bus Operation Dummy Private Bus operation=1, otherwise=0</b>	0.857 (0.351)	0.714 (0.453)
<b>Weekends Dummy Weekends=1, Weekday=0</b>	0.143 (0.351)	0.286 (0.453)
<b>Dual Shift of Government Jobs Dummy Dual Shift=1, otherwise=0</b>	0 (0)	0.429 (0.497)
<b>Number of active COVID-19 cases</b>	132	1450
<b>Observations</b>	147	147

Source: Based on Authors Calculation of App Cab Fare Data. The standard errors are mentioned in parenthesis.

## Results and Analysis

The results of the study in hand are being presented in this section both graphically and analytically.

### Graphical Analysis

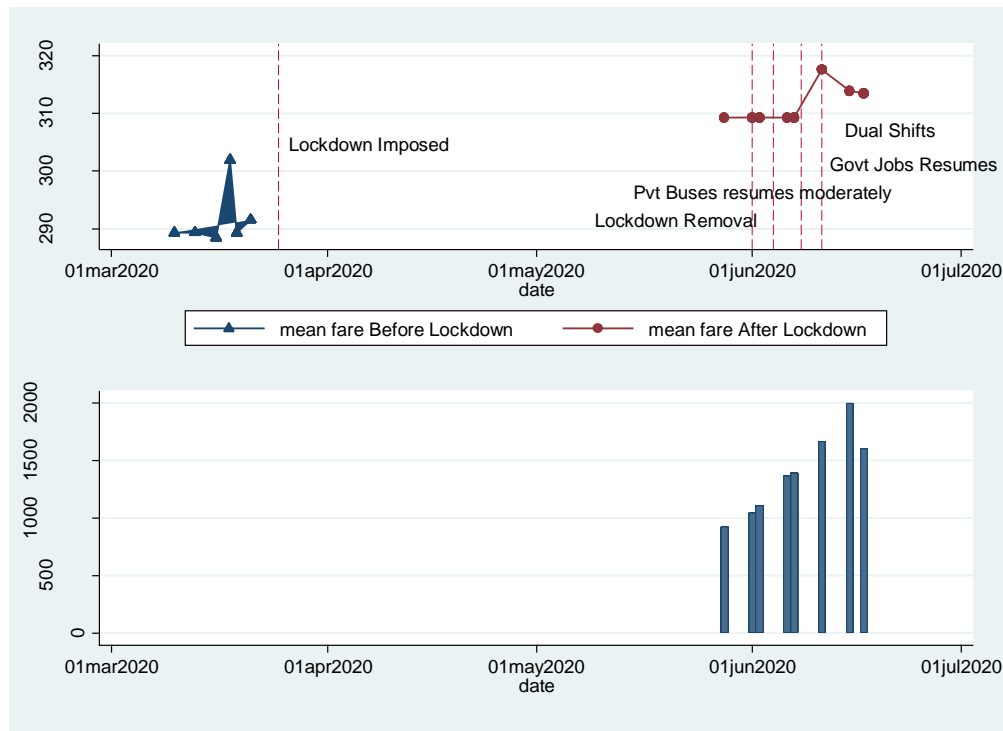
Figure 2 presents a graphical representation of the average app cab fare before lockdown was imposed and after the removal of COVID-19 lockdown in 2020. In the first panel and number active COVID-19 cases in the second panel. As the regular cab services were not available from 25<sup>th</sup> March, 2020-31<sup>st</sup> May, 2020 during the central lockdown, henceforth there is a gap in the data. As is evident that there is a discrete jump in the average app cab fare to Rs 319 from Rs302 after the removal of lockdown in comparison to the before lockdown. Interestingly it is observed that in the pre-lockdown stage there is a surge in the demand for APP cab, which is getting translated in the cab fare respectively, this is coinciding with the first positive case of COVID-19 diagnosed in Kolkata on 16<sup>th</sup> March, 2020. Further, the volatility in the fare has increased after the COVID-19 in comparison to the normal period before imposition of the lockdown.

The second panel depicts on daily basis the number of active COVID-19 cases in Kolkata. There has been an increasing trend in the COVID-19 cases after the removal of lockdown. Although, before imposition of the lockdown Kolkata already have been affected by few COVID-19 cases but due to range of scale it is not depicted visually.

The vertical lines represent different structural breaks that occurred to depict their effect on the cab fare. The first and foremost structural break was the imposition of nation-wide lockdown on all modes of transport and activities from 25<sup>th</sup> March, 2020. The second structural break in the form of removal of lockdown

from 1<sup>st</sup> June, 2020 is included. The third line depicts the partial availability of private bus transport beside the government buses in Kolkata from 4<sup>th</sup> June, 2020. Although, in Kolkata most of the commuters rely on the private buses in comparison to the West Bengal Government buses, only thirty percent of the regular private buses were operating to bargain for a hike in bus fare. The next structural break was in the form reintroducing work from office of government employees from 8<sup>th</sup> June, 2020. Lastly, the government employees were allowed to operate in dual shifts to ease the commute problem after removal of the lockdown from 11<sup>th</sup> June, 2020.

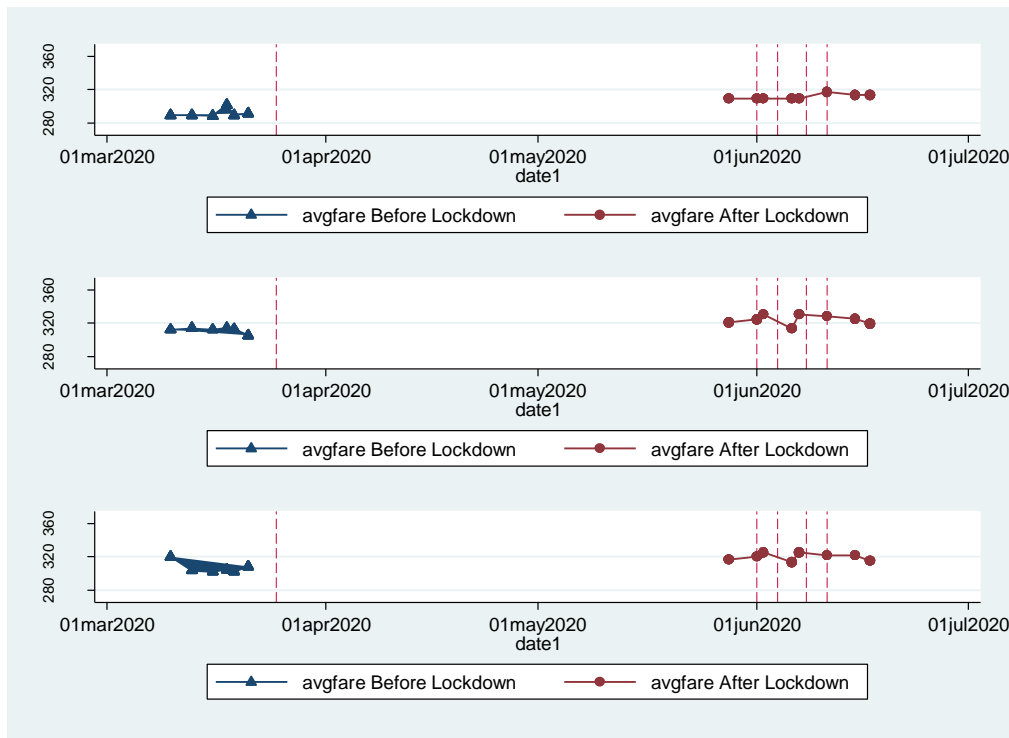
**Figure 2.** Comparison of APP Cab Fare before Imposition and after Lockdown Removal



Source: Based on Corona Bulletin of West Bengal Government and Authors Calculation of App Cab Fare Data of OLA and UBER.

Figure 3, graphically represents the average APP cab fare during the different time zones namely morning, afternoon and evening on daily basis before the imposition of lockdown and after the initial removal of lockdown in Kolkata. Usually, the demand for transport varies between office hours (peak period) and non-office hours (slack period). Further, with a supply constraint of public transport in the form of private buses this would directly translate to demand for APP cabs. Here, the morning and evening are the peak office hours and afternoon represents the slack period.

**Figure 3.** Comparison of APP Cab Fare during Different Time Periods of the Day



Source: Based on Authors Calculation of App Cab Fare Data of OLA and UBER.

Few observations are worth noting from the above graphical representation of the daily average APP cab fare for various time zones of the day. Firstly, irrespective of the time of the day there has been a hike in average cab fare in the post lockdown removal stage compared to the pre-lockdown stage, however the hike is significant mostly during the morning period. Further, after the introduction of the dual shifts for the government jobs employees there has been a shift in the demand from afternoon commute to morning commute. This can be explained by the fact that usually the government jobs employees have relaxed office hours compared to the private job employees and were not penalized for late entry during this period. However, due to the introduction of dual shifts a considerable section of these government employees needs to start their shift from 9 am and the other section started their shift from 12 pm. As a result, after the introduction of the dual shifts the demand for morning commute increased and evening commute decreased, as some of the government employees had already completed their shifts during the afternoon at 2:30 p.m. and left for the day. Henceforth, there is a surge in the morning cab fare and reduction in the evening cab fare after 11<sup>th</sup> June, 2020. This indicates a reallocation of demand for transport between various time zones of the day.

*Effect of COVID-19 and Public Transport Availability in Cab Search Behavior*

The existing literature on transport has found a shift in preferences from public to private mode of transport for the commuters after COVID-19 in many countries. Empirical studies (Paul et al, 2022; Meena, 2020) found that low-income commuters from developing countries are still dependent on public transport, besides choosing cycling or walking to sustain their livelihood. Due to lack of real time travel data of private transport like personal cars, bikes or bicycles in this study, we consider the demand for APP cabs as a proxy for preferences for a private mode of transport. Interestingly, Paul et.al, 2022 found that the demand for online cab services and taxis increased in our neighboring country Bangladesh post COVID-19. The objective of the study is to analyze whether online cab-service post COVID-19 is used by commuters as a safer mode of transport or forced as a compulsion due to lack of adequate public transport. In case of former there would be an increase in demand for online cab services even after controlling for public transport availability, whereas in the latter case the demand for online cab services would reduce after controlling for public transport availability. In Kolkata city approximately 60 lakh commuters depend on mainly private buses compared to public buses, which are less in numbers. However, private buses were plying only 30 percent in capacity during the study period. Further, other modes of public transport like local trains and metros were not available for the public commuters during the study period to restrict the spread of virus. Henceforth, this allows us to consider the travel choice of commuters under public transport constraint.

In Table 3 comparing columns 1 and 2 we find that there is a significant effect of number of COVID-19 active cases and lockdown on the cab fare initially. The coefficient from the interaction of COVID-19 active cases and lockdown removal dummy indicates that if there is an additional increase of COVID-19 active cases by 100 then the online cab fare would increase by Rs 1 in the post lockdown removal period. However, column2 depicts the driving force behind the demand for online cab is not social distancing in fear of COVID-19 but insufficient public transport availability as captured by the private bus operation dummy. If the private buses are operational, then it leads to an additional Rs 4 reduction in cab fares as the private buses are substitutes for private cabs. It is driven mainly by the evening rush hours when there is a huge shortage of buses compared to the demand (Ananda Bazar Patrika, 2020). The provision of private buses causes an additional Rs12 reduction in cab fares. As is evident from column three, four and five respectively that during the weekend people are demanding less cabs compared to the weekdays when they have the compulsion to travel to jobs. In weekends in comparison to weekdays there may be less traveling required due to which the cab fare reduces by Rs3-Rs 5.

**Table 3. Driving Force Behind Surge of Cab Fare After Lockdown Removal**

	Column1	Column2	Column3	Column4	Column5
	All Day	All Day	Morning (8-9:30 a.m.)	Afternoon (12:30 p.m- 2 p.m.)	Evening (5 p.m- 6:30 p.m.)
Number of Active COVID-19 Cases	0.013** (0.005)	0.008 (0.006)	0.017 (0.013)	0.009 (.009)	0.0007 (0.0081)
Lockdown Removal Dummy	15.636** (-5.158)	6.567 (7.016)	15.323 (16.776)	12.222 (9.791)	-7.843 (8.966)
Active Cases*Lockdown Removal	-0.014** (0.005)	-0.004 (0.008)	-0.018 (0.018)	-0.006 (0.010)	0.013 (0.010)
Private Bus Operation Dummy	-	-4.329* (2.175)	2.043 (2.537)	-2.390 (3.974)	-12.640** (2.648)
Weekend	-2.087** (0.927)	-0.634 (1.708)	-3.340* (1.614)	-3.857** (0.860)	5.295** (1.473)
Trend Effect	Controlled	Controlled	Controlled	Controlled	Controlled
Observations	294	294	98	98	98
Methodology	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect

Note: \*\*, \* Significant at 5% and 10 % confidence level respectively. The robust standard errors are mentioned in parenthesis.

Henceforth, the above results indicate that post lockdown removal commuters are preferring cabs not as a choice for social distancing but due to compulsion from lack of public transport availability. Especially during peak periods (evening and morning) when the public transport is limited, then the impact on cab fare is significant. Further, at the weekends when traveling is not compulsory, there is a significant reduction in the cab fares.

However, till now we have ignored commuter ability to choose the timing of travel to conduct jobs. In the following section we will study the effect of the introduction of dual shifts for government employees to conduct jobs on online cab service usage.

#### *Effect of Dual Shift of Government Jobs in Shifting Transport Demand*

Keeping in view that the public transport availability especially private buses were operating only 30 percent of their full capacity, the Government of West Bengal introduced a dual shift for the government employees from 11<sup>th</sup> June, 2020. The morning shift allowed employees to function between 9 a.m.-2:30p.m., and the afternoon shift operated between 12p.m.-5:30p.m. (Ananda bazar Patrika, 2020). The purpose of the dual shift was to reallocate the demand for transport of the commuters and reduce the burden on public transport. The result of the analysis of dual shift on APP cab demand is provided in the following Table 4.

**Table 4.** *Effect of Dual Shift Introduction on Peak Price Loading of APP Cab Fare*

	Column1	Column2	Column3	Column4	Column5
	All Day	All Day	Morning (8-9:30 a.m.)	Afternoon (12:30 p.m- 2 p.m.)	Evening (5 p.m-6:30 p.m.)
Number of Active COVID-19 Cases	0.008 (0.006)	0.008 (0.005)	0.018 (0.012)	0.007 (0.009)	0.001 (0.008)
Lockdown Removal Dummy	6.567 (7.016)	3.519 (6.127)	18.595 (12.971)	0.453 (8.032)	-8.491 (9.685)
Active Cases*Lockdown Removal	-0.004 (0.008)	-0.001 (0.007)	-0.021 (0.014)	0.004 (0.009)	0.013 (0.010)
Private Buses Operation Dummy	-4.329* (2.175)	-3.908 (2.281)	1.591 (2.820)	-0.764 (4.280)	-12.551** (2.802)
Weekend	-0.634 (1.708)	-1.859 (1.708)	-2.024 (2.679)	-8.588** (1.581)	5.034* (2.082)
Dual Shift of Government Jobs Dummy	-	-2.938 2.307	3.154 (5.027)	-11.342** (2.597)	-0.625 (1.910)
Trend Effect	Controlled	Controlled	Controlled	Controlled	Controlled
Observations	294	294	98	98	98
Methodology	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect

Note: \*\* Significant at 5% \* Significant at 10% confidence level. The standard errors are mentioned in parenthesis.

Comparing column 1 and column 2 of Table 4, we observe that after incorporating the dual shift dummy for government jobs employees the private buses are no longer acting as a driving force behind app cab fare determination. In other words, the dependency on private bus operation has been considerably reduced for afternoon commuters. Post introduction of dual shift for the government jobs the cab fare reduced by Rs 11 for an average afternoon cab commuter, which translates to 3 percentage reduction of the cab fare compared to base fare. However, the evening rush hours cab preference and henceforth fare is still affected by private bus operations. When private buses are operational visa vi not operational then the cab fare reduces by a significant Rs 12. This is because in the evening a smaller number of private buses especially were operational than in the morning. This shows that the state government was successful in transferring some of the demand from peak period to off -peak period by introducing the dual shift for the government job employees.

The study till now has considered regional uniformity in public transport access. However, usually not all sections of the city have similar access to public transport. Keeping this in view we use a natural shock Tala Bridge closure for reconstruction in Kolkata that created additional barriers for commuters to access the public transport. In the following section we study the effect of infrastructure blockage on the cab fare.

*Effect of Infrastructure Blockage on Transport Demand*

Infrastructural blockage creates a major problem in commuting and accessing public transport. In a city not every location may have similar access to public transport during pandemic. Alemi et al., 2018 found that usage of online cab services depends on regional accessibility by cars. In this study we use a natural infrastructural shock of Tala bridge closure in north Kolkata on account of reconstruction purpose between February, 2020-September, 2022 to study the impact of infrastructure blockage on transport demand of online cabs services. The commuters in northern parts of Kolkata had been severely affected by the closure of Tala Bridge from February, 2020 and suffered from public transport availability (Ananda Bazar Patrika, 2020). In the usual normal circumstances commuters in northern Kolkata depended on local train and metro for commuting regularly after closure of Tala Bridge for reconstruction. However, after removal of lockdown due to metro and local trains not being operational the commuters in this section of the city became dependent on either buses or private modes of transport for regular commuting. In the following section we segregate the zones of study into those affected by Tala Bridge closure (treatment) and those who were not affected by Tala Bridge closure (control). In our sample three zones were affected by Tala bridge closure, and the rest four zones were not affected by Tala bridge closure (Refer to Appendix). The result of the analysis is summarized in Table 5.

**Table 5. Effect of Tala Bridge Inaccessibility and Dual Shift on APP Cab Fare**

	Tala Bridge Affected Zones			Tala Bridge Not Affected Zones		
	Coulmn1	Coulmn2	Coulmn3	Coulmn4	Coulmn5	Coulmn6
	Morning (8-9:30 a.m.)	Afternoon (12:30 p.m-2 p.m.)	Evening (5 p.m- 6:30 p.m.)	Morning (8-9:30 a.m.)	Afternoon (12:30 p.m-2 p.m.)	Evening (5 p.m- 6:30 p.m.)
Number of Active COVID-19 Cases	0.002 (0.010)	0.003 ( 0.009)	0.003 (0.010)	0.013 ** (0.006)	0.012 * (0.007)	0.013* (0.007)
Lockdown Removal Dummy	-6.868 ( 12.683)	-3.486 (10.645)	-3.545 (10.625)	13.427 ** (4.356 )	8.948 (7.435)	8.817 (7.404)
Active Cases*Lockdown Removal	0.010 (0.013)	0.007 (0.012)	0.007 (0.012)	-0.011 ** (0.005)	-0.007 (0.008)	-0.007 (0.008)
Private Buses Operation Dummy	-9.373** (3.115)	-8.810** (3.370)	-7.995* (4.294)	-1.924 (1.320)	-2.670 * (1.425)	-0.842 (2.209)
Dual Shift of Government Jobs Dummy	-	1.505 (3.014)	0.077 (5.078)	-	-1.993 (1.877)	-5.199** (1.504)
Weekend Dummy	-	-	-1.086 (3.426)	-	-	-2.439 (1.753)
Trend Effect	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Observations	126	126	126	168	168	168
Methodology	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect

Note: \*\*Significant at 5%; \*Significant at 10% confidence level. The standard errors are mentioned in parenthesis.



As we move across from column 1 to column 6 the effect of Tala Bridge closure and dual shift gets reflected. Few observations are evident from the above Table 5. Firstly, comparing the column 1 and Column 3 of Table 5 we find that in the infrastructure blockage is creating a major dependency on private bus operation, henceforth private bus operation reduces the fare by Rs 9 in the treatment zones whereas in the control zones it reduces the cab fare by Rs 2 only. This is because with infrastructure blockage the public transport availability gets affected and the private cabs can surge their fare on such an occasion. Further, the dual shift of the government jobs has an opposite impact on the treatment zones in comparison to the control zones with respect to private bus operation. After the dual shift introduction, a private bus operation in comparison to non-operation increases the surge of cab fares in the affected areas. However, in the non-affected areas it is successful in transferring public transport demand and reducing the fares. A potential reason may be that due to infrastructure blockage public bus accessibility is constrained reducing the ability to transfer the demand on transport successfully. Lastly, we find that in comparison to the treatment areas the control zones the number of COVID-19 cases does influence surging the APP cab fares. A potential reason for this maybe the easy accessibility by cars increases usage of the online cab-service leading to an increase in cab-fare.

## **Discussion**

The purpose of the study was to empirically study in a developing country context where the commuters belonging to the lower income group can't afford private cars, potentiality of the online cab -service becoming a viable option after COVID-19. The study tried to analyze impacts of COVID-19 and constraint of public transport on online cabs travel choice translating to their fare using potential trip information for Kolkata city, India. We used potential trip fares of cabs before and after the removal of lockdown on account of COVID-19 across various locations of the city. We used a fixed effect panel methodology for capturing the attributes of the longitudinal data and to control unobserved location disturbances. We also tried to capture the dual shift of jobs and infrastructure blockage on cabs fares.

The modeling outcomes demonstrated the public transport supply constraint being a dominant factor for the app cab fare determination rather than the shift in preference for individual transport due to fear from COVID-19. The key findings are summarized below (i) public transport availability especially private bus transport particularly plays an important role in online cab fare determination. (ii) dual shifts of jobs are successful in reducing pressure on transport demand and reallocating transport demand between various times of the day (iii) Preference for social-distancing to avoid COVID-19 in the form of personal transport than collective transport is more feasible in scenarios with no infrastructure problem, causing less surge in fares. (iv) Infrastructure blockage reduces the effectiveness of dual shifts for jobs in reallocating transport demand and usage of online cab

services. (v) Fare is reduced substantially during weekends and with dual shifts of jobs.

This study indicates that although social distancing is essential to curb the spread of pandemic, lower income status commuters depend on the public transport availability for commuting. There is high proportion of captive users in Kolkata. Especially, in developing countries like India where people depend mainly on public transport for commuting imposition of social distancing rule without adequate provision of public transport would be a failure and would only lead to harassment for the ordinary commuters. Henceforth, planning of adequate availability of public transport along with social distancing imposition would be effective to curb the pandemic. This is similar to the strategy proposed by Asian Development Bank to encourage use of public transport by adding to the current and new as a long term sustainable solution to urban transport problem in a developing country context ADB (2020; 2022). Further, dual shifts of jobs are an effective policy measure which the government can impose to transfer the demand for transport and prevention of spread of pandemics. Also, this study gives a measure of the benefit an ordinary commuter gains from private bus operations. Approximately Rs5 in reduction of cab fare occurs in general due to operation of private buses in comparison to non-operating this can be used as a tool to set the benchmark of hike in fares for private buses by the government while negotiating with the owners of private bus.

## **Conclusion**

This study is the first to try to evaluate the impact public transport on online cab services in a developing country context post COVID-19, especially for the low-income commuters who mainly depend on public transport. It also tries to highlight the public transport supply constraint after the initial removal of lockdown of COVID-19. Although these studies reveal the effectiveness of public transport in low-income countries where people are restricted by income to avail public transport, it suffers from some limitations. The first limitation is that actual transport travel trip data of cabs and private and public buses is not used in this study, due to lack of availability. The second limitation is that the number of actual public transport buses availability could not be considered due to lack of official availability of the data. The third limitation of the study is that it cannot capture the effect of other modes of transport like cycling, bikes and walking which have gained in importance after pandemic will have effect on the online cab fare.

The study shows that even for a metropolitan city like Kolkata with good accessibility where most commuters are captive user's limited by income online cab services are substitute to public transport, contrary to the findings of Hall et al., (2017). Metros like Bangalore and Mumbai where commuters have higher income and public transport like local trains or metros acts as lifeline of the cities the online cab services can act as complements to public transit. However, it needs to be studied separately and as an area of future potential research.

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**Appendix**

**A1. Segregating Zones Affected Due to Tala Bridge Closure**

<b>Zones</b>	<b>Distance (in kms)</b>	<b>Tala Bridge Closure</b>
MAIDAN - PARK STREET	5	Unaffected
BOTANICAL GARDEN - BENIAPUKUR	7	Unaffected
BENGAL CHEMICAL - TOPSIA	9	Unaffected
LAKE TOWN - BOSEPUKUR	12	Affected
DAKHINESWAR - SANTOSHPUR	15	Affected
BELGHORIA - SHAKUNTALA PARK	18	Affected
JOKA - KAMALGACCHI MORE	21	Unaffected