

**Ride-Hailing to Rail Station in the Suburbs:
Can Subsidized Rides Enhance First-last Mile Access for the Carless?**

SUPPLEMENTARY INFORMATION

This document provides supplementary information to the main text about the GoMonrovia program, the data and measurements used in the study, and some findings about price elasticity of ridership. Most of the information presented in this document was directly extracted from the project report approved in June 2021 by the funding agency, that is, the Metrans Transportation Center through the United States Department of Transportation (Banerjee et al., 2021).

Background information about GoMonrovia was provided by the City of Monrovia (2019).

1. The GoMonrovia Program

Monrovia, California, incorporated in 1887, is a suburb of Los Angeles and the fourth oldest city in Los Angeles County. According to 2021 estimates, Monrovia's population is 38,479 (California Department of Finance) and the median annual household income is \$71,373 (Southern California Association of Governments [SCAG]). Its 35.5 square kilometers (13.74 square miles) of land area is largely comprised of single-family homes (both attached and detached), which make up 66.3% of the entire housing stock (California Department of Finance). The median existing home sale-price is \$685,000 (SCAG). Many households are car dependent, with 77.1% of the population driving alone to work and only 6% of households owning no car (SCAG). The Metro Gold (L) Line connected the city to the greater Los Angeles area in 2016.

Faced with population growth, a shortage of parking, and traffic congestion, the City of Monrovia launched a public-private partnership program named GoMonrovia to enhance transit mobility. The municipality partnered with two

TNCs, Lyft (an on-demand ride-hailing company) and Lime (a bike-sharing company), offering subsidized rides within designated geographic areas. This research is limited to the experiences and impacts of the Lyft partnership. In the Main Text and hereafter in this document, GoMonrovia refers to the Lyft component of the GoMonrovia program.

Before partnering with Lyft, the City of Monrovia had its own ride service, named DIAL-A-RIDE, which covered the entire city and its surrounding areas. The service was provided by a city-owned fleet of nine vehicles, each equipped with an ADA-approved wheelchair lift. The price for DIAL-A-RIDE was relatively low: \$1.00 per ride, \$0.75 for senior citizens and passengers with disabilities, and free for children under two years old. Reservation was required before using the service and hours of service were limited and closed on major holidays. Additionally, DIAL-A-RIDE provided a shuttle service between Old Town and Station Square (two hot spots in the city) on Friday & Saturday evenings. DIAL-A-RIDE served about 107 riders per day. After the GoMonrovia program was launched, the DIAL-A-RIDE service was restricted to disabled users, with others encouraged to switch to GoMonrovia.

To use GoMonrovia, riders can either use the Lyft application on their smartphone, after registering the GOMONROVIA “coupon” (promo code) or call a dedicated hotline if they do not have a smartphone (“concierge service”). Until the COVID-19 pandemic, three tiers of service were available for reservation: (1) “Classic” rides (\$5.00 per rider per trip in February 2020), where the trip is not shared by any other travelers; (2) “Shared” rides, where multiple travelers share the same vehicle, although they may have disparate trip origins or destinations (\$3.00); and (3) “Shared Metro / Downtown” rides (\$1.00), where multiple travelers share the same vehicle and all travelers are either picked up or dropped off by Monrovia’s Gold Line Metro station or its core downtown area, known as Old Town. The shared Metro / Downtown ride option was cheaper than a single bus trip in the area (\$1.75), and more convenient to users as it provided door-to-

door transportation. All shared ride options became unavailable with the onset of the COVID-19 pandemic in March 2020.

The program is funded by multiple sources. Monrovia receives roughly \$3 million in restricted Los Angeles County transportation funds on an annual basis, of which about \$1.8 million is reserved for ongoing capital projects/agreements, including one with the dial-a-ride operator. GoMonrovia's Lyft partnership is left with the remaining \$1.2 million. In addition, local return money is available in Los Angeles County. Los Angeles County has four voter-approved ½ cent sales tax measures for transportation: Prop A, Prop C, Measure R, and Measure M. LA Metro returns a portion of this funding to local municipalities each year in a process called local return dollars to be spent on transportation projects approved by LA Metro. After ongoing extensive discussions and negotiations with Metro's CEO, all transportation local return dollars are now eligible for use towards Lyft subsidies. This determination by Metro effectively opens Prop A, Prop C, Measure R and Measure M local return dollars for use in employing rideshare companies (such as Lyft) as a public transportation services provider.

The GoMonrovia program has been extremely popular among Monrovia's residents and visitors. From March 2018 when the program was first launched to February 2019, about 1,450 rides were completed every day through the program. GoMonrovia allowed the City to save nearly 70% on costs per passenger per ride compared to DIAL-A-RIDE – per the City's calculations, the average subsidy per passenger per ride went down from approximately \$19.70 per DIAL-A-RIDE trip to approximately \$5.80 per Lyft trip. Nevertheless due to high patronage the City adjusted the service area twice and the fare structure five times to remain within budget. At its inception, GoMonrovia included trips that either began or ended in Los Angeles County. Since 2020, though, the program's service area has been restricted to essentially Monrovia's city limits. In terms of fare, when the GoMonrovia program began, riders paid the same flat fee for all three service tiers (\$0.50). Since that time, five successive adjustments have led to

a differentiated pricing system. In February 2020, a Classic ride cost the most (\$5.00), a Shared ride the next most (\$3.00), and a Shared Metro / Downtown ride the least (\$0.50).

The Main Text focuses on examining the sociodemographic characteristics of first-last mile users of GoMonrovia and testing whether the program serves the mobility needs of transit-dependent individuals. After presenting the data sources and methods in more detail, this Supplementary Information document also includes results and their limitations of analyses designed to estimate price elasticities of ridership demand.

2. Data and Measurements

The analyses draw on a unique dataset comprising trip data provided by Lyft, sociodemographic data from the American Community Survey (ACS), and a survey.

Lyft's trip data

We signed a data sharing agreement with the City of Monrovia to access data about Lyft trips made under the GoMonrovia program. The data was collected and compiled by Lyft monthly. The dataset includes all trips made between March 2018 (i.e., the month of the program's inception) and February 2021 ($N = 1,139,860$ trips). Lyft's data provided information for each GoMonrovia trip about:

- Time period of the day at which the trip occurred (e.g., "late night")
- Method used to book the trip (i.e., "coupon" versus "concierge")
- Calendar day that the trip was booked (e.g., "Monday")
- Total price of the trip, amount paid by the rider, and amount subsidized by the City – the amount paid by the rider was used to infer the tier of serviced used (i.e., Classic ride, Shared ride, or Shared ride to/from the Downtown Area where the Metro station is located)

- Distance from origin to destination
- Starting and ending area

Note that the granularity of the starting and ending areas changed depending on the year of service. For trips made prior to 2020, the starting and ending areas were identified at the census tract level. For trips made in 2020 and 2021, these areas were identified at the census block group level. Considering that Monrovia encompasses 9 census tracts and 31 census block groups, trip data at the block group level offered greater variation and a more precise identification of trips possibly associated with the Metro station (those starting or ending in the block group where the station is located). Accordingly, our analyses focused on trips from 2020 and 2021 when assessing the evidence for GoMonrovia as a potential first-last mile mechanism. That said, we used the entire dataset, including trips made between March 2018 and December 2019, for analyzing monthly ridership trends in aggregate terms.

Finally, the major limitation of Lyft's trip data was that it did not record any characteristics of the riders using the service. For trips measured at the block group level, ACS data about sociodemographic, housing, and land use characteristics at the census block group level were used as proxies for the riders' characteristics. We collected survey data to enable individual-level analyses within a regression framework.

ACS data

We collected sociodemographic information on Monrovia neighborhoods, at the census block group level, from the 2017 ACS data that is publicly available on the U.S. Census Bureau's website. We collected data on the following sociodemographic and housing dimensions, omitting Monrovia's northernmost block group that has zero residents:

- Population density (people per residential-zoned acre)
- Median age of population

- Share of population aged 17 years and younger
- Share of population aged 65 years and older
- Share of population considered Hispanic
- Share of population considered Asian American, non-Hispanic
- Share of population considered White American alone, non-Hispanic
- Share of population considered Black American, non-Hispanic
- Share of population (aged 25 years and older) with at least a bachelor's degree
- Median household income (in 2018 USD)
- Share of households with zero personal vehicles
- Housing density (units per residential-zoned acre)
- Share of occupied units that are rented
- Share of occupied units that are detached single-family residential
- Share of units constructed pre-1940

For our cluster analysis, we utilized the “k-medians” methodology, which means that we generated cluster centroids based on medians of census block groups’ values along the variables listed above.

Survey data

We conducted an online survey, using a Google Form, in May 2021. All GoMonrovia users aged 18 years or older were eligible to participate in the survey. The link to the survey was shared with eligible participants using two main channels: 1) an email sent by Lyft to all registered Lyft users who have registered the GOMONROVIA promo code (reach: 15,000 accounts); 2) on the City’s social media (Facebook, Instagram, and Twitter) and Newsletter, called the “City Manager’s Update.” One reminder was sent by the City on their social media accounts. In total, 203 individuals responded to the survey. Over half of these individuals (130) responded through the link emailed by Lyft, while another quarter (54) responded via Facebook, Instagram, or Twitter. A small number (19) responded via the City’s newsletter.

Our survey methodology is equivalent to convenience sampling, that is, the set of GoMonrovia users who were motivated to respond may not, in aggregate, represent the overall GoMonrovia user community. Our small sample size suggests non-response bias. The low response rate may be explained by several factors. First, Lyft was our only point of contact with the entire population of interest, but Lyft agreed to send out invitations to participate only once, via email. Second, GoMonrovia users may have registered a secondary email address with their Lyft account and/or ignored the email from Lyft, assuming that it was promotional communication. Similarly, followers of the City's social media accounts and subscribers to the newsletter may not have read attentively all information received through these channels. Furthermore, the survey was rolled out amid the COVID-19 pandemic, so GoMonrovia users may have been especially unmotivated to answer questions about their travel behaviors and uses of the GoMonrovia service, at a time when both were severely disrupted. More generally, we may have been faced with the "shy respondent" effect which suggests that some socio-demographic factors are associated with preferring to stay away from surveys (Boyle et al., 2023). For example, our sample description by sociodemographic group (main text, **Table 2**) shows a rather low share of individuals aged 25 years or younger (7%), which aligns with Boyle et al.'s (2023) observation that shy respondents include a smaller share of young people than non-shy survey respondents. Nevertheless, the survey data enabled us to conduct targeted analyses of first-last mile use of the GoMonrovia program at the individual level, which were not possible using the other datasets supporting this study.

3. Estimating Price Elasticity of Ridership Demand

Note that all information presented in this section includes only rides fully within Monrovia's city limits to focus on the area that was common to all periods, independent of service area changes.

Descriptive Trends

Before the onset of the COVID-19 pandemic, Monrovia had adjusted the geofence twice and the fare structure five times. In no case had all service tiers experienced a price change simultaneously. **SI Table 1** below shows a chronological summary of GoMonrovia’s service area and fare structure changes.

SI Table 1 – GoMonrovia Program Changes since Inception

Month – Year	Price Shift	Classic Ride	Shared Ride	Shared Metro / Downtown Area	Service Area Change
Mar 2018*		\$0.50	\$0.50	\$0.50	
Sep 2018	#1	\$3.00	\$0.50	\$0.50	
Feb 2019	#2	\$3.50	\$1.00	\$0.50	
Apr 2019		\$3.50	\$1.00	\$0.50	#1 LA County removed**
Jun 2019	#3	\$5.00	\$2.50	\$0.50	#2 City of Bradbury removed
Nov 2019	#4	\$5.00	\$3.00	\$1.00	
Mar 2020***	#5	\$3.00	n/a	n/a	

Notes: *Inception of the program; **With the exception of City of Bradbury; ***Program adjustments due to the COVID-19 pandemic: all shared rides eliminated.

SI Table 2 and **SI Table 3** show that a price increase for a given tier of service is consistently associated with reduced ridership for that tier the following month, thus suggesting a negative response of demand to pricing increases. This is most obvious for the third price shift in June 2019, when the cost of a Classic ride increased from \$3.50 to \$5.00 and the cost of a Shared ride increased from \$1.00 to \$2.50. Simultaneously, Classic ridership fell by 60.3% month-over-month (from 6,753 rides in May 2019 to 2,679 rides in June 2019) and Shared ridership fell by 61.8% (from 24,819 rides in May 2019 to 9,473 rides in June 2019). Ridership under the Shared Metro/Downtown Area tier, which did not experience a price change at that time, increased over the same period by 14.5% (from 14,645 rides in May 2019 to 16,772 rides in June 2019).

The Shared Metro/Downtown Area tier experienced only one price increase, in October 2019 (SI Table 1). Shared Metro/Downtown Area rides fell by 22.8%, from 19,467 rides in October 2019 to 15,024 rides in November 2019, (SI Table 2). An

ordinary measure of elasticity suggested that Shared Metro/Downtown Area rides were less elastic to price changes than other service tiers (SI Table 3).

SI Table 2 – Trip Frequencies by Price Tier

Month	Classic	Shared	Shared Metro / Downtown	Total	
Mar-18	4,535	0	0	4,535	
Apr-18	19,043	0	0	19,043	
May-18	30,917	0	0	30,917	
Jun-18	39,284	0	0	39,284	
Jul-18	50,891	0	0	50,892	
Aug-18	63,222	0	0	63,222	Price shift #1
Sep-18	9,165	48,194	0	57,359	
Oct-18	10,352	51,263	0	61,615	
Nov-18	9,605	50,260	0	59,865	
Dec-18	10,905	53,487	0	64,392	
Jan-19	9,818	57,984	0	67,802	Price shift #2
Feb-19	8,941	2,711	54,543	66,195	
Mar-19	10,548	29,142	34,428	74,118	
Apr-19*	6,263	24,056	13,895	44,214	
May-19	6,753	24,819	14,645	46,217	Price shift #3
Jun-19*	2,679	9,473	16,772	28,924	
Jul-19	2,615	8,496	18,849	29,960	
Aug-19	2,819	8,974	19,925	31,718	
Sep-19	2,806	8,480	18,167	29,453	
Oct-19	2,955	8,490	19,467	30,912	Price shift #4
Nov-19	2,684	6,496	15,024	24,204	
Dec-19	2,828	6,397	13,334	22,559	
Jan-20	2,846	6,426	14,261	23,533	
Feb-20	2,885	6,258	13,604	22,747	Price shift #5
Mar-20	14,155	0	0	14,155	
Apr-20	4,255	0	0	4,255	
May-20	4,618	0	0	4,618	
Jun-20	5,616	0	0	5,616	
Jul-20	5,334	0	0	5,334	
Aug-20	4,925	0	0	4,925	
Sep-20	5,125	0	0	5,125	
Oct-20	5,521	0	0	5,521	
Nov-20	4,848	0	0	4,848	
Dec-20	4,491	0	0	4,491	
Jan-21	4,182	0	0	4,182	
Feb-21	4,339	0	0	4,339	
Total	382,769	411,406	266,914	1,061,089	

Notes: *Service area change. Only rides within Monrovia's city limits are counted in this table.

Next, we utilize a time-series regression model to estimate the effects of price changes on GoMonrovia usage. In particular, we measure the extent to which such events predict future ridership levels, in line with the Granger test commonly employed in econometric research (Granger, 1969). The small sample sizes prevents us from conducting such an analysis by service tier. In addition to the sample size issue, the fact that the Shared Metro/Downtown Area tier experienced only one price increase makes it impossible to run a time-series regression model. Therefore, our regression model estimates the effects of a price change (to any tier) on aggregate GoMonrovia usage (all tiers included).

Table 3 – Ordinary Estimates of Service Tiers' Elasticities of Demand

Observed Change	Price Shift 1	Price Shift 2	Price Shift 3	Price Shift 4	Price Shift 5
Ridership statistics					
Classic Ridership (gross)	unknown	-877	-4,074	n/a	n/a
Classic Ridership (percentage)	unknown	-8.9%	-60.3%	n/a	n/a
Shared Ridership (gross)	n/a	unknown	-15,346	-1,994	n/a
Shared Ridership (percentage)	n/a	unknown	-61.8%	-23.5%	n/a
Shared Metro / Downtown Ridership (gross)	n/a	n/a	n/a	-4,443	n/a
Shared Metro / Downtown Ridership (percentage)	n/a	n/a	n/a	-22.8%	n/a
Pricing statistics					
Classic Pricing (gross)	\$2.50	\$0.50	\$1.50	n/a	n/a
Classic Pricing (percentage)	600%	16.7%	42.9%	n/a	n/a
Shared Pricing (gross)	n/a	\$0.50	\$1.50	\$0.50	n/a
Shared Pricing (percentage)	n/a	100%	150%	20%	n/a
Shared Metro / Downtown Pricing (gross)	n/a	n/a	n/a	\$0.50	n/a
Shared Metro / Downtown Pricing (percentage)	n/a	n/a	n/a	100%	n/a
Elasticity measure*					
Classic Rides	n/a	0.53	1.41	n/a	n/a
Shared Rides	n/a	n/a	0.41	1.17	n/a
Shared Metro / Downtown Rides	n/a	n/a	n/a	0.23	n/a

Notes: *Elasticity of demand calculated as: (a) Change in ridership (percentage), divided by (b) Change in Pricing (percentage). Only rides within Monrovia's city limits are counted in this table.

Model Specification

The model's dependent variable is average daily ridership in a given month, where the ridership measure includes only trips that occurred fully within Monrovia. We isolate those trips to mitigate the confounding effects of service area changes, which have historically occurred at the same time as or proximate to pricing changes. We included a one-month lagged measure of our dependent variable as an explanatory factor based on the variable's large and positive autocorrelation and partial autocorrelation apparent over a one-month period. Longer lag periods did not exhibit significant autocorrelation or partial autocorrelation and therefore were excluded.

Regression Results

SI Table 4 below shows time-series regression modeling results. Three factors appear to have significant and negative effects on average daily ridership: (1) the COVID-19 outbreak in March 2020, estimated to have reduced average daily ridership within Monrovia by 334 trips; (2) the third round of adjustments to rider flat fees in June 2019, estimated to have reduced average daily ridership within Monrovia by 108 trips; and (3) the fourth round of adjustments to rider flat fees in November 2019, estimated to have reduced average daily ridership within Monrovia by 222 trips.

It is not surprising that our model identifies the third and fourth price shifts as more impactful on ridership than the first and second shifts. For one, the third shift was responsible for the largest price changes in terms of magnitude, with the cost of both a Classic ride and a Shared ride increased by \$1.50. Meanwhile, the fourth shift was the only one that raised the cost of a Shared Metro / Downtown ride. Between the third price shift and the COVID-19 pandemic, Shared Metro / Downtown rides were by far the most popular tier of service. They accounted for 63% of all rides the month before that fourth shift occurred, and they continued to comprise over 50% of all rides up until the pandemic.

SI Table 4 – Time-Series Regression Modeling Results

Explanatory factor	Estimated coefficient (t-statistic)
1-month lagged average daily trips	0.665*** (6.90)
1-month lagged COVID-19 start (Mar 2020)	-334.027*** (-5.44)
1-month lagged Price Shift 1	10.397 (0.17)
1-month lagged Price Shift 2	-83.546 (-1.22)
1-month lagged Price Shift 3	-108.060^ (-2.03)
1-month lagged Price Shift 4	-221.955*** (-4.23)
1-month lagged Price Shift 5	omitted (collinearity)
constant	358.667
# of observations	35
F-statistic	121.86
Prob > F	0.0000
Adjusted R-squared	0.9552

Notes: ^ for $p < 0.10$; * for $p > 0.05$; ** for $p < 0.01$; *** for $p < 0.001$

To conclude, use of GoMonrovia appeared sensitive to pricing changes, but the price effect was difficult to disentangle from other factors affecting ridership, such as changes in the service area boundaries or the COVID effect. Furthermore, small sample sizes made it impossible to estimate price elasticities of different service tiers. As a result, we cannot draw conclusions on the implications of price elasticities for first-last mile usage of the GoMonrovia program.

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