

Bundled Mobility Passes:  
A Framework for Partnership Between Public Transit and New Mobility Services

By

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**Abstract**

The emergence and proliferation of “new” mobility has the potential to fundamentally disrupt urban mobility in the 21<sup>st</sup> century. This includes bikesharing, carsharing, or on-demand vehicles that can be summoned from a smartphone through transportation network companies (TNCs) and microtransit. Competition provided by these services to public transit has often soured the relationship between public authorities and new mobility. However, in the absence of a blanket ban on these services, the public sector needs to find a way to coexist with newer mobility forms, while still upholding system-wide benefits and values of public transportation. One way to coexist is through publicly-guided regulation, but going further than this is to find mutually-beneficial forms of partnership. This thesis proposes bundled mobility passes between public transit, bikesharing, and TNCs, as a potential framework in which the popularity of new mobility can be tapped to strengthen public transit revenue and ridership while at the same time enabling public institutions to regulate these services more effectively. By bringing together stakeholders, the Superpass hopes to cement public transit’s place in urban mobility by making the transit pass more appealing. In particular, Chicago is used as a case study for this concept. Enclosed within are the results of an engagement process with employers and employees in the Chicago area, to whom surveys were administered to gauge preferences towards a hypothetical bundled “Superpass” offered by the Chicago Transit Authority (CTA). The surveys found widespread support among employers for such a pass. A discrete choice model was also made from the employee survey results to simulate the choices of employees under different pass scenarios. A scenario analysis found that from this Superpass, the CTA, bikeshare operator, and TNC operator can all at least increase either the number of passes they sell or the number of rides they provide to the market. The CTA, in particular, can potentially increase its pass holders by 6% to 35% and its revenue by 1% to 8% with a 30-day pass add-on bundle, and with a Metra Link-up add-on bundle it can increase pass holders by 11% to 36% and remain about revenue neutral. This thesis also presents an implementation framework for such a pass that could bring together the urban public transit system, the regional commuter rail, the bikeshare operator, the TNC operator, employers, and finally, employees, to ensure the success of this program.

Thesis Supervisor: Jinhua Zhao

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# Chapter 1 Introduction

## 1.1 Motivation

The emergence of new mobility has the potential to fundamentally change urban mobility. With the advent of smartphone and improved GPS technology, one can book rides in a stranger's car on-demand with a few taps on a phone, which would have been unthinkable just 10 years ago. This has no doubt led to changes in travel behavior and had system wide impacts. While it has definitely made urban mobility more convenient, it has also been proven to increase congestion in major cities. City governments and transit agencies, responsible for managing urban mobility, were taken by surprise with the initial popularity of transportation network companies (TNCs). Unprepared to regulate these new services, many cities and countries reacted negatively to the initial emergence of TNCs. Lawsuits went back and forth. The taxi industry was decimated. Eventually, TNCs won the right to operate in most cities and the public sector must now adapt its approach for this new reality.

Transportation policymakers across the US and the world are playing catch up to what has transpired while at the same time planning for the future of mobility. The question of how the public sector should deal with new mobility evokes visceral opinions from almost anyone familiar with the topic. On one hand, new mobility is making urban mobility more convenient for some, but on the other hand the policymakers must react to system-wide impacts and equity concerns.

This thesis has emerged as a response to a call from a transit agency that is searching, like many major transit agencies in the world, for a way to engage with new mobility that takes advantage of their appeal and convenience while remaining true to the core values of urban mobility that the agency must uphold. The Chicago Transit Authority (CTA) has seen a fall in bus ridership recently; one likely reason is the concurrent rise of new mobility services. This has led to a sometimes difficult relationship between TNCs and the public sector in Chicago. This thesis is an attempt to find a mutually beneficial way for collaboration between the two parties.

At the same time that US cities have been dealing with the rise of recent innovations in the transport sector, European cities have been experimenting with Mobility as a Service (MaaS). This concept refers to the bundling of access to public transit and other mobility services for a subscription fee.

Initial impacts of this concept have been promising but limited to small pilots. This thesis is an exploration of the application of MaaS to the Chicago context to investigate whether it can pave the way for more effective interaction between the public sector and new mobility.

## **1.2 Background on Chicago Mobility**

With a city population of about 2.7 million, Chicago is the third largest city in the United States and has the second most extensive public transit system. Surface transportation in Chicago is managed by the Chicago Department of Transportation (CDOT), while mass transit in the region falls under the umbrella of the Regional Transit Authority (RTA). The RTA, in turn, funds three transit agencies: the Chicago Transit Authority (CTA), Pace, and Metra. The CTA handles an average of 1.5 million weekday trips on its 8 rail lines and around 130 bus routes, mostly all within the City of Chicago. Pace operates more suburban bus routes and also provides paratransit and dial-a-ride services. Metra operates the commuter rail system, connecting Chicago with its surrounding suburbs. Figure 1-1 shows a system map of the CTA, Pace, and Metra network.

Figure 1-1: System Map of CTA, Pace, and Metra Network



The CTA fare payment system is called Ventra, which was launched in 2013. Soon thereafter, the Ventra mobile app was rolled out, which allows CTA users to load money into their Ventra accounts, track real-time arrival information on trains and buses, and purchase Metra tickets. In 2017, the Federal government provided a grant to integrate Divvy bikeshare with the Ventra app and its electronic payment system. Figure 1-2 shows a screenshot of the Ventra app.



Figure 1-2: The Ventra App



There are an array of transportation services in Chicago. These are briefly outlined in Table 1-1. A more detailed picture of the different mobility services in Chicago and their cost is presented in Chapter 3, along with more information particularly on the CTA fare structure and fare product use distribution.

Table 1-1: Mobility Operators in Chicago

Mobility Service	Operators
Rail Transit	CTA, Metra
Bus Transit	CTA, Pace
Water Transport	Chicago Water Taxi
Rideshare / Ridehail / TNC	Uber, Lyft, Via
Taxi E-Hail	Curb, Arro
Bikeshare	Divvy
Carshare	Zipcar, Getaround, Maven, Turo

### 1.3 Research approach

This thesis is based on three years of interaction with CTA officials and study of Chicago employer and employee preferences. It uses the following methods to arrive at its conclusions and findings.

- **Survey of employers:** A series of 122 transit benefits managers of different employers in Chicago were surveyed to get basic information on the benefits they provide, whether or not they would be interested in a bundled mobility pass, and which modes of transport they would like to see in those passes.
- **Stated preference survey of employees:** Then, a more extensive and in-depth survey was administered to employees across Chicago, most of who worked for companies that the CTA had an existing relationship with. This survey asked travel behavior and spending questions along with stated-preference conjoint questions to get relative preferences for different bundled pass configurations.
- **Discrete choice analysis of employee survey results:** The responses to the conjoint questions were used to model preference for bundled mobility passes using discrete choice analysis.
- **Stakeholder analysis:** Important stakeholders related to the Superpass were identified and their various objectives, constraints, and decision tasks were outlined.
- **Scenario testing:** The results of the choice model were used to simulate revenues and market shares under different Superpass scenarios. These different outcomes were then matched with the stakeholder analysis to lay out a framework for how to go about selecting configurations that might be acceptable to a broad range of stakeholders.

#### 1.4 Overview of the thesis

Chapter 2 reviews current examples of partnership between the public sector and new mobility and argues in favor of a pro-partnership mindset by the public sector. Chapter 3 presents a background on Mobility as a Service (MaaS) and argues for its implementation in Chicago through a public entity. Chapter 4 examines the case for launching an integrated mobility pass through employers. Chapter 5 presents the results of a stated preference survey of employees in Chicago and the development of a new “monthly bundled mobility pass” choice model based on the survey results, and Chapter 6 applies this model to different stakeholders. Finally, Chapter 7 concludes the thesis with a summary of key findings and a roadmap for future implementation and research. Table 1-2 summarizes the objectives of each section of this thesis.

Table 1-2: Overview of Thesis

Chapter	Section of Thesis	Objective
<b>The Case for Partnerships with New Mobility</b>	Role of State in Transportation	To set the motivations of the public sector as it decides on course of action to take with regards to changes in mobility landscape.
	Background on New Mobility	To establish domain knowledge on what is meant by “new mobility” what their impacts are.
	Public Sector Response to New Mobility	To inspire other transit agencies to get ideas on partnerships to pursue.
	The Case for Partnerships	To argue in favor of partnerships between the public sector and new mobility.

<b>The Case for Bundled Mobility Passes</b>	Literature on Product Bundling	To understand the economic rationale for bundling.
	Transit Passes and the CTA	To give an introduction to CTA fare policy with respect to its pass fare products.
	Mobility as a Service (MaaS)	To provide an overview of the MaaS concept and global examples.
	Application and Rationale for Chicago	To explain why MaaS might make sense in Chicago and why the public sector should lead it.
<b>The Case for Working with Employers</b>	Why Employers?	To explain the rationale for targeting employers with the Superpass.
	Literature on Employer-based TDM Programs	To provide examples of employer-based programs that can lead to favorable TDM results.
	Employer Engagement in Chicago	To give an overview of the current relationship between the CTA and employers in Chicago.
	Employer Survey and Results	To report the results of the employer survey and show the interest level in a bundled mobility pass.
	Revenue Model	To show how assumptions can be used on basic employee information to predict the revenue, passes sold, and impacts on different commuter groups as a result of offering the Superpass.
	Summary and Findings	To summarize the revenue model key findings and emphasize the importance of an employee survey.
<b>Bundled Mobility Pass Choice Model</b>	Employee Survey Overview	To describe the instrument used to collect the data that will go into the model
	General Results	To give an overview of the descriptive statistics and some basic cross-tabs of the survey responses
	Modeling Methodology	To describe how the model was structured and implemented
	Model Results	To know the factors that impact preference for pass choice from pass composition to personal traits and behavior.
<b>Applying Choice Model to Stakeholders</b>	Stakeholder Analysis	To get an understanding of the broad range of objectives, constraints, and decisions needed of all stakeholders involved so that a comprehensive Superpass can be designed.
	Model Application Methodology	To explain the methodology used in the scenario analysis that follows.

	Non-Metra Superpass Scenarios	To understand the varying impacts on different stakeholders under different Non-Metra Superpass configurations.
	Metra Superpass Scenarios	To understand the varying impacts on different stakeholders under different Metra Superpass configurations.
	Selecting the “Optimal” Bundle	To describe the process of balancing stakeholder interests to identify mutually acceptable Superpass configurations.
<b>Conclusion</b>	Key Findings	To summarize the salient points from each chapter in this thesis.
	Recommendations	To use what has been learned from this thesis to create actionable recommendations for any policymaker.
	Looking Towards Implementation	To give an outline of important considerations to keep in mind when implementing the Superpass.
	Future Research	To inspire future scholars to take this work further.

## Chapter 2 The Case for Partnerships with New Mobility

This chapter presents an overview of the new mobility landscape that has emerged and continues to change, and situates this change in the context of the fundamental role of public transportation. Specifically, this chapter:

- Describes the role of the public sector in ensuring mobility as a right;
- Outlines what is meant by “new mobility” and cites its known impacts;
- Presents an overview of regulations, partnerships and bans across the US in response to new mobility;
- Discusses why it is necessary for public agencies to think about partnerships if it can help them better serve the people.

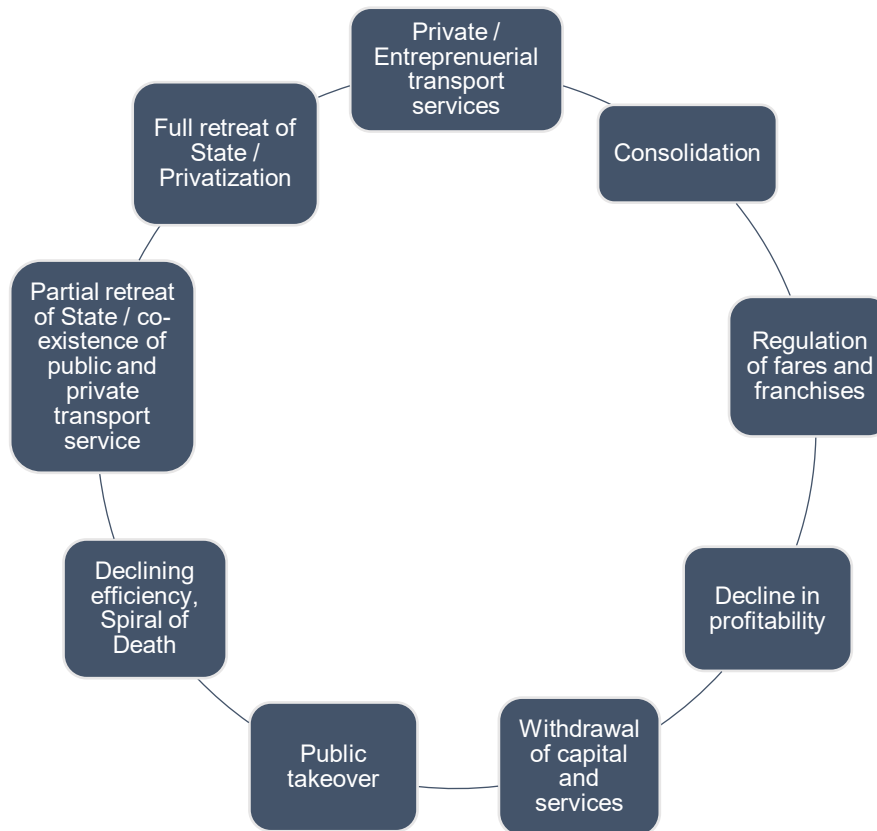
### 2.1 Role of the State in Transportation

One role ascribed to the State is to provide basic services to people who do not have means of purchasing these services on their own. What constitutes “basic services”, however, is debatable depending on where on the political spectrum you lie. Food, education, healthcare, housing, and increasingly even income are often the themes of such discussions because society has recognized them as basic human rights, but mobility is often left out. The concept of mobility as a right is not a universally held view. If it were true, then the government would be obligated to provide transportation to each and every person without the means of their own mobility, and it is clear this is often not the case in the United States. The reasons for why mobility should be considered a basic right ensured by the public are numerous and worthy of several volumes of dissertations. At a basic level, however, physical mobility allows a citizen to reach opportunities that can help them achieve their potential. It allows them to seek and attend employment opportunities, recreational activities, search for food and other basic needs, and overall enables them to contribute to nation-building. Once mobility as a right is accepted, and that it is the State’s duty to uphold this right, the discussion can move to how to ensure this right.

To ensure mobility for all people, the State can either enable mobility, regulate existing non-state mobility, or provide hybrid public-private mobility. The State enables mobility through the construction of roads, highways, and related ancillary services (e.g., gas pipelines, electricity, streetlights, etc.), and can directly provide a mobility service through public transit. The State regulates existing mobility to offset externalities through fees and rules and to keep it open to all through legislation (e.g., the Americans with Disabilities Act, Title VI of the Civil Rights Act, etc.). And finally, the State can use the help of the private sector for financing public infrastructure or for contracting out service that presumably leads to efficiency and service quality gains.

This thesis is concerned primarily with the third method (public-private partnership) but it also cannot ignore the importance of regulation. While often these are discussed separately, Figure 2-1 shows how the two activities are part of the same cycle of public and private involvement in public transit services (Gomez-Ibanez and Meyer, 1993). Though the cycle shown is in the context of public transit operations, it can be applied to all mobility services that provide fare-based services. Today's transportation situation in urban America, and in particular Chicago, could arguably be in two parts of this cycle. On one hand, it could be at the "Consolidation" phase. There are many new start-ups in the mobility space as described in the next section, and many are starting to acquire others to build national and global conglomerates. Regulation is starting to catch up, including in Chicago where TNC fees are imposed, which might indicate a move to the "regulation of fares and franchises" phase. However, another way to interpret this figure is to say that we are somewhere between the declining efficiency / "Spiral of Death" and co-existence of public and private transport phase. Some argue that the rise of new mobility is jump starting the "Spiral of Death", in which new services steal transit riders, which leads to declining ridership, revenue, and service cuts, which further lead to declining ridership and revenue. This makes it understandable why many public transit agencies are wary of taking anything other than an adversarial approach to new mobility as they enter the co-existence phase. Even more worrisome are those that suggest that TNCs and microtransit spell the end of public transit as we know it, hurtling us to the "full retreat of the State" phase. To prevent this from happening, with the assumption that the State should be involved with mobility to ensure it is provided for all, this thesis will go on to argue that smart partnerships could be used to remain in the co-existence phase and even help the public sector better fulfill its role in the mobility system as opposed to a progression onward to State retreat.

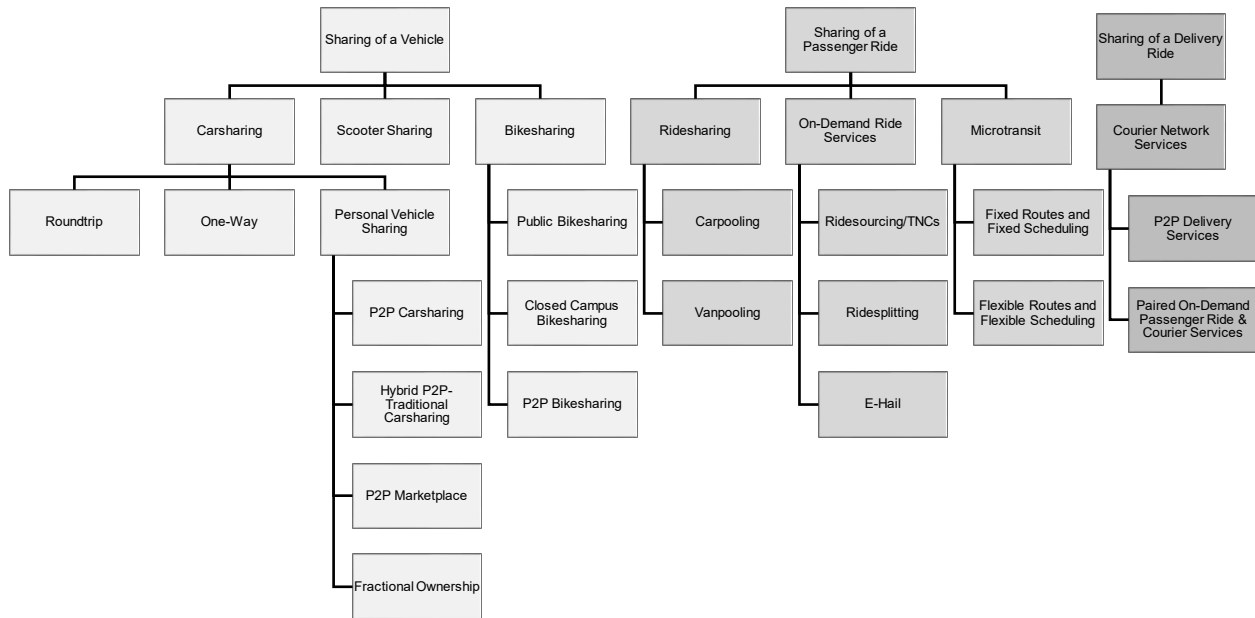
Figure 2-1: Cycle of Public and Private Involvement in Transit Bus Services (Adapted from Gomez-Ibanez and Meyer, 1993)



## 2.2 Background on New Mobility

Before delving into the complexity of partnerships between public transit and new mobility, a background understanding is needed on what exactly is meant by “new mobility.” Indeed, the term is often used in a broad sense without a clear definition. For example, many of the services it refers to are not really new at all, though it usually refers to a modern, tech-enabled rendition of the mobility service. Often, the term is really just a euphemism for transportation network companies (TNCs), which will be defined in this section. New mobility has also coincided with the sharing economy as it relates to the mobility industry. This is outlined in Figure 2-2. Overall, this section attempts to clear some of these definitions to set the scope of possibility when discussing bundled mobility products.

Figure 2-2: Overview of the New and Shared Mobility Ecosystem (Shaheen et al., 2017)



### 2.2.1 Bikesharing

Bikesharing is the short term access to a bicycle. Bikeshare systems are usually publicly-owned but can be operated by a private company. They usually comprise of docks throughout a service area from which users can check out and return bikes within stipulated time periods in return for a time-based fee or a membership. Bikesharing first emerged as early as the 1960s in the Netherlands, but has rapidly increased in popularity across Europe and North America in the past 10 to 12 years (DeMaio, 2003). Use of bikeshare has been shown to replace some walk and short transit trips (Martin and Shaheen, 2014). Recently, bikeshare has evolved towards “dockless” technology, where bikes can be left in any public space for the next rider to use. Dockless or “free-floating” systems have also begun to include electric-assist scooters. However, the unregulated proliferation of these services has led to some negative outcomes such as haphazard crowding of public spaces (ITDP, 2018).

Overall, bikesharing systems have shown promise of creating more multimodal lifestyles and making urban mobility more dynamic and active. There have been attempts at promoting the use of bikeshare for first- and last-mile connections to public transit through the placement of bikeshare stations at transit stations. They have also been included in many mobility bundles and partnerships outlined in Chapter 3. Given that bikeshare systems are often publicly owned, or at least operate with approval for use of public space, they lend themselves well to partnerships with public transit.



## 2.2.2 Ridesharing / Transportation Network Companies (TNCs)

Ridesharing is perhaps the most disruptive and controversial out of what can be called “new mobility”, and is central to this thesis. It is the on-demand hiring of a vehicle with a driver to conduct a trip. The vehicle is usually booked using a smartphone app and the price or a range for the price is shown for the given origin and destination before booking. The price is usually dynamic, based on demand and supply at a particular place and time. Users can usually select a regular ride, a premium ride, a larger vehicle, or a shared ride, and they are connected to a nearby driver who is seeking to provide rides for money. Ridesharing is perhaps a misnomer, because the name would suggest that the ride is shared with someone else going in the same direction. However, this is often not the case, and so other terms have been used to describe this service such as “ridesourcing”, “transportation network company” (TNC), “transportation network provider” (TNP), “ridehailing”, and “app-based ride/transportation service”, to name a few. “Ridesharing” traditionally has referred to carpooling or “slugging”—the sharing of rides in order to access high-occupancy vehicle or high-occupancy toll lanes. For the purposes of this thesis, however, these new on-demand services will be referred to as TNCs or ridesharing, to keep in line with general nomenclature used in the public domain.

The two biggest ridesharing players in the United States at present are Lyft and Uber. Lyft began as Zimride in 2007, which at the time was just a driver-passenger matching platform for long distance carpool trips. Lyft as it is known now was born in 2013 in San Francisco. Meanwhile, Uber began as UberCab in 2010 in San Francisco targeted towards higher-end users who wanted to summon black limo car ride with a smartphone app. As the same time, a third major competitor called SideCar emerged in mid-2012 but exited the market in 2015. Both Lyft and Uber launched the “shared” versions of their services with Lyft Line and UberPool in 2014. Recently, Uber has launched “Express Pool”, where riders are picked up and dropped off near their origin and destination so as to improve operational efficiency, somewhat similar to the concept of a “virtual” bus stop. Services similar to Uber and Lyft have since sprouted throughout the world (Shaheen, 2018a).

The taxi industry has been the hardest hit by TNCs out of all industries. They have responded by using what are called “e-hail” services to facilitate booking taxi rides using a smartphone app. These services include Arro, Bandwagon, Curb, Flywheel, Gett, Hailo, and iTaxi. However, due to the fact that taxi rates are still heavily regulated and much higher than TNC fares, they have continued to decline in popularity.

While surely making personal rides more convenient for users, TNCs in general has been shown to have concerning impacts on urban mobility. They have been shown to increase congestion and replace public transit trips. A 2017 report found that even after accounting for the replacement of taxicab trips, TNCs caused an increase of 600 million vehicle miles in New York City over a three year period (Schaller, 2017). It found that city-wide, TNCs, yellow cabs, and black cars increased their mileage by up to 19% in the period between 2013 and 2016. Overall, in 2015 and 2016, the growth in for-hire ride trips was greater than the growth in transit in New York City. Further, in San Francisco, a 2017 report found that TNCs account for 570,000 daily vehicle miles traveled (VMT) and contribute about 6.5% of the average citywide weekday VMT (SFCTA, 2017). Finally,

Table 2-1 shows that TNCs have had a switching effect away from public transit in several studies done on modes replaced by TNC use.

Table 2-1: Studies of Ridesourcing Modal Shift Impacts

<b>Study Authors Location Survey Year</b>	<b>Rayle et al. San Francisco, CA 2014</b>	<b>Henao Denver and Boulder, CO 2016</b>	<b>Clewlow and Mishra 7 U.S. Cities Two Phases (2014- 2016)</b>
<b>Drive</b>	7%	37%	39%
<b>Public Transit</b>	30%	22%	15%
<b>Taxi</b>	36%	10%	1%
<b>Bike or Walk</b>	9%	12%	23%
<b>Would not have made trip</b>	8%	12%	22%
<b>Other / Other ridesourcing</b>	10%	7%	–

Despite the above downsides to TNCs, there is no doubt that they have added to convenience of urban travel and that they are not going away soon. Both major US TNCs announced IPOs, with Lyft going public on March 18, 2019 and Uber on May 10. In the absence of an outright ban, public authorities and transit must find ways to effectively deal with TNCs and the mobility disruption they have unleashed. While many cities share an antagonistic relationship with TNCs, others have gone as far as to partner with them to solve mobility challenges. This thesis seeks to present a potential solution to at least lay a framework for a working relationship.

### 2.2.3 Microtransit

Another emergent new mobility phenomenon is microtransit, which shares similarities with TNCs. According to the US Department of Transportation (USDOT), it refers to privately-owned and on-demand vans and buses that operate on fixed or flexible routes and dynamic scheduling that carry people with similar origins and destinations. Often, they mirror routes already served by public buses but their appeal comes from being more technology-enabled, seat pre-booking, and having superior amenities. Microtransit has had mixed success in the United States. The first operators were Chariot and Bridj, which both started in 2014 but Bridj shut down in 2017. Chariot has since been acquired by Ford and is now called Ford Smart Mobility and operates 15-seater vehicles in 7 cities. Via, which started operations in 2013, is often cited as a successful example of microtransit because it is still in operation today. However, it toes the line between being a TNC and being considered microtransit, as its drivers are independent contractors who can decide to drive whenever they wish, there are no “routes”—riders are dynamically matched with each other in real time, and the vehicles used are generally SUVs and vans but not buses. However, riders do not receive door-to-door service and get picked up and dropped off at “virtual” bus stops. There have been few evaluation studies on the impacts of microtransit on user travel behavior. One study on a Bridj pilot project in Kansas City found that one-third of users had replaced a personal vehicle trip with their Bridj trip, one-third had replaced a public bus trip, and 22% percent had replaced a TNC trip (Shaheen, 2018b).

## 2.2.4 Carsharing

Carsharing can be defined as short-term access to an automobile. Usually a user must pay a membership fee to gain access to a fleet of vehicles, in addition to per mile or per hour costs. The earliest example of carsharing dates back to 1948 in Switzerland, and some of the earliest North American examples occurred in 1983 in San Francisco and Purdue University (Shaheen and Cohen, 2013). As of October 2016, there were about 15 million carshare members sharing about 160,000 vehicles in 46 countries, out of which 1.8 million members were in North America (Shaheen et al., 2018). Carsharing is traditionally associated with round-trip reservations, where the member must return the vehicle to the location from which he or she picked it up. Recent trends indicate the market is moving towards one-way carsharing, in which the member can drop the vehicle off at a location other than the one he or she rented it from. The proliferation of smartphones and social media profiles has also enabled peer-to-peer sharing of vehicles between individuals, where the carsharing company acts as a platform to facilitate the vehicle sharing economy (Shaheen and Cohen, 2013). Carsharing has been found to reduce the need for vehicle ownership by enabling easier access to a shared vehicle fleet. Round-trip carsharing has been found to reduce household average vehicle holdings from 0.47 to 0.24 (Martin et al., 2010). While previously carless households that obtain carsharing membership increase their vehicle-miles traveled (VMT) and greenhouse gas (GHG) emissions, this is outweighed by reductions due to car owners selling a vehicle or delaying a new purchase (Martin and Shaheen, 2011). Recognizing potential positive impacts of carsharing, cities across the world have welcomed carsharing organizations through parking allowances and other policies. Carsharing has been included as part of many mobility bundles and partnerships, as is shown in Chapter 3. The proven positive impacts of carsharing with respect to sustainable travel behavior would make them a potential candidate for partnerships with public transit.

## 2.3 Public Sector Response to New Mobility

Responses by the public sector to new mobility services have been varied, to say the least. They have ranged from large amounts of public subsidy for their operation to complete bans.

### 2.3.1 Regulations

New mobility, and in particular for-hire vehicles such as TNCs or microtransit, have been subjected to various regulations. These range from local to federal, and some regulations were made after the public sector was forced to react to the new player in the transportation scene.

For US Federal regulation, the primary two are the existing laws pertaining to Title VI of the Civil Rights Act and the Americans with Disabilities Act. While Title VI only applies to projects that take federal money, ADA compliance is still required, though not for all vehicles as long as some vehicles are wheelchair-accessible (Feignon et al., 2018).

State and local regulation, on the other hand, usually covers the following aspects for private transportation services open to the public (Feignon et al., 2018):

- Insurance requirements
- Permits and licensing

- Background checks of drivers of for-hire vehicles (e.g., fingerprinting)
- Per-ride fees
- Data sharing requirements
- Passenger privacy
- Vehicle size
- Use of curb space for parking and stopping

These regulations can apply to for-hire vehicle such as TNCs or microtransit, but also other services such as carsharing. For example, one-way carsharing services such as car2go operate with special parking permits from cities that allow users to leave the vehicles at any official parking spot. Other localized regulations include: ability to pick-up or drop-off at the city airport, special fees for pick-ups and drop-offs in certain areas (e.g., Navy Pier in Chicago), and marking of vehicles to show operating company or permit.

### 2.3.2 Partnerships

There have been numerous partnerships between transit agencies and new mobility, but the vast majority of these have been with TNCs. Even though public transit has partnered with private companies for providing service often in the past, TNCs provide the unique challenge of being only callable by a smartphone, not owning their vehicles, and having an unsteady supply of contracted drivers. US partnerships between public transit and TNCs have varied in their purpose, structure, and closeness of partnership. These partnerships are sometimes formal and sometimes informal, and sometimes they include public subsidy or an advertising/marketing component. Generally, the types of partnerships have been related to:

- First/Last mile connectivity: This refers to partnerships that enhance connectivity to or from transit stations and can be undertaken through special advertising or special fares and discounts.
- Paratransit: These partnerships involve TNCs helping with paratransit or Dial-A-Ride services for the disabled or elderly.
- Low density area: These partnerships are in areas where fixed route public transit is not effective due to low density and so TNCs can help provide mobility.
- Low-productivity route service: These partnerships explore replacing existing poorly performing fixed service transit with on-demand service to save public money.
- Late night service: This refers to when TNCs provide special service at night when public transit is not widespread.
- Guaranteed ride home programs: These partnerships allow for the reimbursement of TNC trips in guaranteed ride home programs, which are intended to provide mobility in the event of unexpected emergency situations such as illness, injury, or unanticipated break down of usual commute vehicle.
- Marketing partnerships: Some partnerships are simpler in nature and extend only to marketing—such as placement of advertisements inside transit stations or declaring a TNC as an “official” rideshare partner, even when no money changes hands.
- App integration: These integrations are a move towards publicly-led Mobility as a Service (as explained in Chapter 3), and involve the inclusion of various travel modes including TNCs in transit trip planning apps.

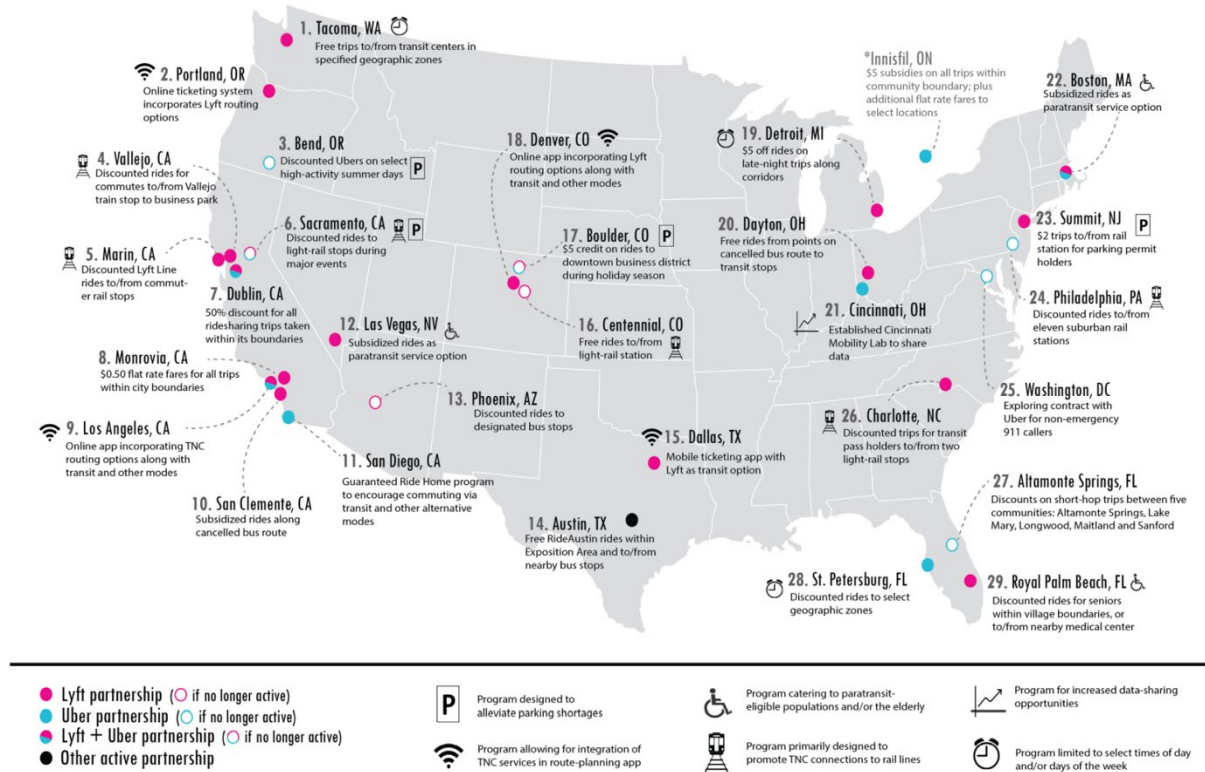
Table 2-2: Overview of Partnerships Between US Public Sector and New Mobility (Curtis et al., 2019; Schwieterman and Livingston, 2018)

Agency (City)	Partner Service	First-Last Mile	Para-transit	Late Night	Sub-urban Market	Marketing	Public Subsidy	App Integration	Duration
Santa Monica (BBB)	Lyft		•				•		July 2018 - present
Austin (CapMetro)	RideAustin	•					•		June 2018 – Dec 2018
Central Oregon (CET)	Uber			•		•			June 2017 – Sept 2017
Central Pennsylvania (CPTA)	Lyft, Uber		•				•		Mid 2017 - present
Denton Texas (DCTA)	Uber, Lyft	•			•		•		Oct 2016 - present
Richmond (GRTC)	UZURV and RoundTrip		•				•		Aug 2017 – Aug 2018
LA (LA Metro)	Via	•					•		Jan 2018 – Jan 2019
Livermore (LAVTA)	Lyft, Uber, DeSoto Cab Company	•			•		•		Jan 2017 – Jun 2019
Atlanta (MARTA)	Uber, Lyft	•				•			July 2015 - present
Boston (MBTA)	Uber, Lyft		•				•		Sep 2016 - present
NYC (NYCT)	Uber, NYC Taxi, For-Hire Vehicles		•				•		TBD
San Bernadino (Omnitrans)	Lyft, RIDE Taxi		•				•		July 2016 - present
Seattle (Pierce Transit)	Lyft	•		•	•		•		May 2018 – May 2019
Pinellas County FL (PSTA)	Uber, Lyft, various local taxi agencies	•	•	•			•		Feb 2016 - present
Sacramento (SacRT)	Uber, Lyft, Yellow Cab Company	•					•		Oct 2016 – Mar 2017
San Mateo County CA (SamTrans)	TBD	•					•		TBD
Philadelphia (SEPTA)	Uber	•			•	•			May 2016 – Sept 2016
Cincinnati (SORTA)	Uber				•	•			Mar 2016 – Mar 2017
Solano County CA (STA)	Lyft	•					•		May 2017 - present

Washington DC (WMATA)	Two local taxi companies		•				•		Sept 2017 - present
Chicago Region (Metra)	Uber					•			Dec 2016 - present
Outside Denver (Centennial)	Lyft	•					•		Aug 2016 -
Altamonte Springs FL	Uber	•					•		Mar 2016 -
San Diego (MTS)	Uber	•					•		Summer 2016
Dallas (DART)	Uber							•	Mar 2019 - present
LA (LA Metro)	Lyft, Zipcar							•	Jan 2016 - present
Innisfil, ON (City Govt.)	Uber						•		2017 - present
Denver (DDPW)	Lyft, car2go, taxi, B-cycle							•	Feb 2016 - present
Portland (TriMet)	Uber, car2go, Biketown							•	2017 - present
Monrovia CA (City Govt.)	Lyft						•		Mar 2018 - present

The following map of the US gives further details about some of the mentioned partnerships as well as additional ones.

Figure 2-3: Partnerships between US Cities and TNCs (Schwieterman and Livingston, 2018)



### 2.3.3 Bans

Several cities have banned TNCs altogether, often in response to what is seen as unfair competition for local taxi companies. These cities or countries include but are not limited to: Frankfurt, Barcelona, Budapest, Turkey, Denmark, Portugal, China, and Vancouver (Rhodes, 2017). Often, TNCs are banned at certain areas such as airports but operate in the rest of the city. These bans, however, are difficult to enforce because TNCs are often unmarked and they can continue to operate informally. Often TNCs were banned initially and after a legislative battle or after the formulation of regulations the bans were lifted.

### 2.3.4 Chicago's Response

Chicago has had an involved response to the rise of new mobility in the city. In particular, the Mayor commissioned a task force to examine future challenges and opportunities for transportation in Chicago and it submitted its report to the Mayor in March of 2019. This report is proactive with respect to new mobility and future challenges, though it remains to be seen how much of it will be implemented. The report recommends (City of Chicago, 2019):

- Implementing a VMT tax;
- Incentivizing businesses to provide transit benefits to employers;
- Creating a governance framework for uniform data sharing;
- Launching an autonomous vehicle pilot project;

- Ensuring new mobility is accessible to all;
- Ensuring that micromobility (scooter sharing, etc.) does not impede the public right of way;
- Launching a scooter sharing pilot in 2019;
- And finally, creating a Chief Mobility Officer to leverage partners to implement a unified mobility strategy.

TNC regulation in Chicago is governed by the Office of Business Affairs and Consumer Protection in the Mayor’s office. One of their key achievements is the implementation of a per-ride TNC fee equal to a \$0.02 per-trip license fee plus \$0.60 per-trip Chicago Ground Transportation Tax Rate. This is in addition to an annual \$10,000 license fee to operate in Chicago. The City imposes a special Ground Transportation Tax Rate of \$5.60 for trips ending or starting at either of the two city airports or at Navy Pier. The regulations mandate that the digital platform must be accessible to users who are visually impaired or hard of hearing. They also mandate special requirements such as asking a user to acknowledge when there is surge pricing taking place before they confirm a trip. Finally, in April 2019, Chicago became the first US city to publicly release the following TNC data:

1. Ride-hail vehicle information (make, model, year, total trips completed)
2. Registered drivers (city of residence, driver start month, total trips completed)
3. Trip data (pick-up and drop-off location by census tract, rounded up start and end time of trip, rounded up fare and tip by the nearest \$2.50, type of ride called)

### 2.3.5 Observations

Partnerships between cities or municipalities and TNCs have ranged from operational to just marketing, and from urban areas to suburban. Many of the partnerships in smaller towns involve public money used to subsidize trips, with the argument that it is cheaper for the city to do this than to develop a fixed route transit system in a low density environment. Most of the partnerships also appear to be related to first and last mile connectivity, but in the absence of detailed before and after survey results of the user’s travel behavior or a detailed study on ticket sales, it is difficult to ascertain whether first and last mile connections have led to a significant increase in ridership (i.e., switched otherwise car users to transit or induced transit trips). The partnerships, at the very least, would have increased the overall convenience for the user. Finally, Portland, LA, Denver, and Dallas are the four cities in which there is some sort of app integration with TNCs and other new mobility. However, there does not seem to be any joint fare product of a bundled pass as of yet. Further, there do not seem to be other innovative regulations in place such as: income-based subsidies for TNC trips, mandating only shared trips in parts of or the whole city, single fare system for TNCs and transit, requiring a minimum availability of TNCs in areas of the city, distance and congestion charging for trips, and charging for idling or circling time and distance (Freemark et al., 2019).

## 2.4 The Case for Partnerships

This chapter has presented an overview of recent disruptions in the mobility sector and public sector responses to them. The responses have been varied, which can leave a transit agency confused as to what path it should take with regards to new mobility. To put this decision in context, let us for a moment imagine the “do nothing” approach. TNCs and many new mobility



start-ups continue to receive copious amounts of venture capital money which has kept them afloat despite not once turning a profit since their inception. It appears that their approach is to hemorrhage money by paying drivers more than what is received through low fares in an attempt to establish TNCs as an integral part of the mobility system. This position is currently held by the personal vehicle, who TNCs claim they are fighting against, but also by public transit at least in major cities. Assuming for a moment that public transit is good for society and that personal vehicle use should be curbed in cities, the public sector should do all it can to ensure that in this almost artificial rise of TNCs is directed towards dislodging personal vehicle ownership rather than public transit from its place in the mobility system. And while today it is just TNCs that public transit is dealing with, in years to come autonomous vehicles have the potential to even more fundamentally disrupt the mobility system and pose an even greater threat to public transit as we know it. Thus, the public sector must begin to imbibe an approach of innovation that proactively directs current and future innovations towards making cities places that are desirable to live in for all.

But why, if the threat is so large, would the public sector opt to partner with TNCs? With the new entrance of a player in the mobility market, the public sector has five choices before it. One is to do nothing, which was the approach many cities initially took. This, however, ignores the negative externalities of the service and also does nothing to capture any of its positive impacts. The public could go the other extreme and ban the service, like Vancouver has done. While this eliminates the negative externalities, it also eliminates any positive impact the service was having on the lives of the people who used it. The third option is to again be extreme and partner with the service with very few conditions, which is what cities like Monrovia and Innisfil have done. While this reaps potential positives of the service for the public sector, it also might ignore negative effects. The fourth option is for the public sector to regulate the service, which is essentially what most governments currently do. This approach attempts to limit negative externalities and keeps the service available to all, but it also misses out on reaping positive benefits for the public sector. Thus, the fifth and final option left is to both regulate and partner with the service. Theoretically, at least, this approach can both limit the negative externalities of the service while at the same time capturing some positive impact for the public sector.

The idea of partnering with new mobility might seem counterintuitive. However, to give a political analogy, in parliamentary democracies political adversaries sometimes band together in coalitions to defeat another force. The force to be defeated, in this case, could be single occupancy vehicles. Partnering can also be a way for public transit to fill gaps in its service. Going back to the discussion in the opening of this chapter, the public sector has an obligation to provide mobility for all within its jurisdiction, regardless of the people who live there or how densely developed that area is. Given the land use patterns of most US urban areas, there are large populations that live in densities cannot easily support mass, frequent transit. This can trigger the Spiral of Death that pushes transit agencies into decline. If done correctly, a partnership with TNCs could help fill these gaps in a more financially efficient way, and might even provide better service to the customer. This is perhaps why many of the partnerships between public agencies and TNCs in the US have been to provide paratransit services, which allow public transit to focus resources and improve service elsewhere. A well-designed partnership could change the adversarial narrative that has prevailed.

Many people are still not convinced by this argument, asserting that TNCs are illegal and an overall negative influence on cities. It is important to remember that TNCs and other innovative mobility services have gained in popularity because they are serving an unmet demand, though often they might be inducing their own demand. In mobility systems, “informal” services have always been tacitly allowed to exist by the State because they fill gaps left by public services. These “informal” services become formalized in the eyes of the State once they follow a set of regulations set to ensure safety, sustainability, and other metrics for a public service. But it is by design that regulation follows slightly behind innovation so that it does not stifle it. For example, regulation in many places has followed the emergence of the sharing and gig economy (e.g., Airbnb, Task Rabbit, Uber, etc.). Thus, with some regulation imposed, a co-existence can emerge between public transit and TNCs.

Rather than seeing new mobility as a threat that must be wiped out, another way to look at it is as an opportunity. TNCs are clearly popular. They use advanced technology with complex matching algorithms to move people from point to point. In many cases, public transit service is simply not competitive from a wait time, travel time, comfort, or even price perspective. It is clear that public transit is not providing all the trips that people are demanding and willing to pay for, but a partnership with TNCs could jointly serve all (or most) of a person’s trips. This could either be done through first / last mile trips like many of the partnerships mentioned in the previous section, or through joint fare products, which is the theme of this thesis. The next chapter goes into more detail about the rationale for why joint fare products should be used as a framework for partnership. It is an acknowledgement by a public transit agency that it cannot serve all mobility needs in all situations (e.g., late night service or neighborhood to neighborhood service), but that with the help of another mobility service, it can provide a citizen the means to get between points. Ultimately, this sort of innovative thinking that is open to partnerships can help the public sector better fulfill its duty of ensuring mobility as a right.

## Chapter 3 The Case for Bundled Mobility Passes

The previous chapter outlined the ways new mobility services and public transit agencies have partnered or could be partnering, and this chapter will focus on one type of possible partnership: bundling services using special passes and/or other fare policies. The Chicago Transit Authority (CTA) requested help to develop a framework for possible engagement with new mobility but did not specify how. This chapter presents a background and rationale for why the bundled mobility pass was selected as the proposal for the CTA. Specifically, this chapter:

- Presents literature on economic theories for commodity bundling;
- Relates commodity bundling to transit passes and gives an overview of fare policy at the CTA;
- Introduces Mobility as a Service (MaaS) and presents examples and trends;
- Finds a rationale for implementing MaaS in Chicago with a leading role for the public sector.

### 3.1 Literature on Product Bundling

While this thesis is concerned with bundled mobility products, there is already a body of literature on product bundling in general. Product bundling, also called commodity bundling, is the selling of two or more goods together for a single price. It is already used extensively in the telecommunications, healthcare, automobile, airline, and entertainment industry, to name just a few. For example, today one can purchase access to the vast library of media on Netflix or Spotify for a single monthly price. Similarly, computers can be bought with different memory, screen resolution, and pre-installed software for a single price. Bundling is also used in transportation. For example, the same airplane ticket can be bought for different prices that include varying add-ons such as checked-in baggage, seat selection, and priority boarding. Bundling is also used in public transit, with a transit pass being a type of bundle in itself. This section presents an overview of the literature to provide a rationale for bundling in general and its extension to mobility as a service (MaaS).

There are general benefits of bundling. For the consumer, or demand side, the main rationale is price discrimination, in that consumers can buy the products separately for a price or together for a different price, which gives a new price point and thus new opportunity for maximizing consumer surplus (Adams and Yellen, 1976). An example of this is the sale of highly priced individual sports game tickets and a discounted season pass ticket. Buying products in bundles also means lower search and transaction costs, and can also have an additive utility effect for the buyer if the products are complements. For the producer, or supply side, benefits of bundling include lower inventory holding costs, lower sorting costs, and greater economies of scope (Venkatesh and Mahajan, 2009).

The purely economic rationale for product bundling from the firm side is to extract the maximum profit by reducing consumer surplus (Adams and Yellen, 1976). Consumers have varying reservation prices (willingness to pay) for goods, and if they purchase a good for a price lower than their reservation price they gain consumer surplus. Consumers for whom the price of the good is higher than their reservation price will forgo the purchase. Given that reservation prices are heterogenous across individuals, a single bundle price seeks to entice consumers into buying who would not purchase the items separately but find it worth it to buy the bundle. The products are bundled with the hope that while a consumer might not have a high willingness to pay for a certain item, they might have such a high reservation price for another good in the bundle that makes the whole bundle worth it. In effect, they have purchased more items and paid more to the producer under the bundled scenario when they might have only purchased the highly desirable good without bundling. Bundling several products together for a single price can also help sellers overcome a practical issue of not knowing specific reservation prices of individual goods (Adams and Yellen, 1976). For example, a firm might have a better idea of how much consumers are willing to pay for their home entertainment and communications needs as a whole than the reservation prices for internet, cable, and a phone connection. However, Adams and Yellen (1976) also identify economic inefficiencies that can arise from bundling such as over- or undersupply and misallocation of goods to buyer groups.

There are three main approaches to bundling: pure components (no bundling), pure bundling (no individual sales), and mixed bundling (offering goods separately and as a bundle) (Adams and Yellen, 1976). The economic theory for which strategy to employ differs based on whether it is a monopolistic or competitive environment, the correlation between the reservation prices of the bundled goods, whether the goods are complements or substitutes, and on the marginal cost of bundling for the producers (Venkatesh and Mahajan, 2009). Public transit agencies might have a monopoly on public transit in a given city, but not on mobility. Correlation between the reservation prices can be positive, negative, or independent (uncorrelated) across consumers. For example, as the income of an individual increases, his or her reservation price for both cars and champagne might increase, indicating they are positively correlated. The reservation price for champagne and instant noodles in this case might be negatively correlated. An example of goods that are complements includes a car purchase with auto insurance, and an example of substitute goods are Coke and Pepsi. Venkatesh and Mahajan (2009) state that when a monopolist is offering two complements with a uniform (i.e., linear) demand, bundling is better for the producer if the complementarity is high and marginal costs are low. Likewise, if a monopolist offers two substitutes with a uniform demand, non-bundling (pure components) is preferred if they are strong substitutes and mixed bundling is preferred if they are weak substitutes. If substitutes are bundled,

then the optimal bundle price should be lower than the sum of the reservation prices of the individual components.

It would appear from this that bundling has no place in transportation through MaaS—after all, a taxi trip and a public transit trip can be considered substitute goods for an individual journey. However, Matyas and Kamargianni (2018a) argue that rather than viewing individual components of a MaaS bundle as substitutes of each other, they should be viewed as complements that together substitute personal vehicle ownership and use. It should be further noted that transportation modes are not perfect substitutes, as they can be used for different trip contexts based on time of day, weather, and whether the traveler is in a hurry. The classification of transportation provided through MaaS is one area where economic literature is not clear or extensive and this thesis seeks to contribute to.

There are further benefits of bundling that can be applied to a MaaS context. Bundling of popular products with lesser known products can give exposure to these underutilized goods, and make them be viewed with greater trust by buyers (Reinders et al., 2010). This can arguably lead to greater adoption of lesser known sustainable modes of transportation that are trying to enter the urban mobility market, if they are paired with popular anchor modes such as public transit and if there is a stated policy of promotion of shared mobility services from the public sector (Matyas and Kamargianni 2018a). Likewise, for those who view taxis or personal vehicles more favorably than trains and buses, the pairing of TNCs with public transit in a MaaS bundle may improve the desirability of public transit in their view. This thesis seeks to ascertain how true this hypothesis is. Finally, MaaS can provide the inherent benefit of assembly, in that the buyer no longer has to make multiple payments to different transport providers or use multiple phone applications to access different modes. This added benefit carries with it a positive utility, increasing the reservation price of a bundle beyond the sum of its individual components.

## **3.2 Transit Passes and the CTA**

### **3.2.1 Introduction to the Transit Pass**

In public transportation, the concept of a “transit pass” is also a bundle—it is a bundle of individual trips for a presumably discounted price. This can include a finite number of rides, such as the 10-ride Metra pass, or can include unlimited rides in a specific time frame such as a day, few days, a week, a month, or a semester. It can also include multiple modes such as bus and rail, as is the case in Chicago. Different fares can also be offered for different groups of users such as the elderly, disabled, students, youth, or military veterans. In Chicago, a weekly pass was first introduced in August 1922 for \$1.25 for travel within the city limits, and it was not until November 26, 1979 that the calendar monthly pass was launched for \$30 (“Chicago “L”.org: Fares,” n.d.).

The rationale for unlimited transit passes is to encourage regular use of mass transit so as to decongest roads, reduce pollution, and increase ridership to engender greater expansion of transit systems. They are a way to incentivize this societally beneficial behavior by converting public transit to a zero marginal cost option with the purchase of a period pass. They are also a way to increase producer surplus for the transit agency, as data has shown almost 50% of 30-day pass buyers in Chicago itself use their passes on trips for a total value less than the pass price. Thus, the

transit agency gains from riders “overpaying” for their trips in a month, without the commensurate costs of catering to those additional trips they paid for. Table 3-1 presents an overview of current monthly transit pass prices and compares them to the per-ride cost of major transit systems around the world. It shows that there exists a considerable range in the 30-day/monthly pass to single-ride fare ratio, with the majority of agencies pricing their pass to be between 40 and 50 single-rides.

Table 3-1: Overview of 30-day/Monthly Transit Pass Versus Single-Ride Costs Around the World

City	Base Per-Trip Rail Fare	30-Day (30) or Monthly (M) Pass Fare	Number of Single Rides Needed to Match Pass
Chicago (CTA)	\$2.50	\$105 (30)	42.0
New York City (MTA)	\$2.75	\$121 (30)	44.0
Los Angeles (LACMTA)	\$1.75	\$100 (30)	57.1
Washington D.C. (WMATA)	\$2 - \$6	\$135 <sup>1</sup> (M)	60.0
Boston (MBTA)	\$2.25	\$84.50 (M)	37.6
San Francisco (MUNI)	\$2.50	\$94 (M)	37.6
Toronto (TTC)	\$2.32 USD	\$113 USD (M)	48.7
Montreal (STM)	\$2.44 USD	\$63.7 USD (M)	26.1
London (TfL)	\$4.35 USD <sup>2</sup>	\$208.6 USD <sup>3</sup> (30)	48.0
Paris (RATP)	\$2.14 USD	\$85.52 USD (M)	40.0

### 3.2.2 Fare Policy at the CTA

The CTA offers various fare products to use its system. It has a base fare that can be paid either via a Ventra card or through a purchase of a one-time use ticket. This base fare has a ‘reduced’ and a ‘student’ rate as well. In addition to these per-use fare products, the CTA offers a host of pass products, including a 1, 3, 7, and 30-day pass. The fares are valid on CTA rail and bus, and there are also joint fare products that give access to Metra and Pace buses as well. Table 3-2 shows a full overview of the fare products that the CTA offers.

Table 3-2: CTA Fares

	Fare Product	Full Price	Reduced Price	Student Price
<b>Pay-As-You-Go Product</b>	‘L’ train fare	\$2.50	\$1.25	\$0.75
	Bus fare	\$2.25	\$1.10	\$0.75
	Transfer	\$0.25	\$0.15	\$0.15
<b>Pass Product</b>	1-Day CTA Pass	\$10	-	-
	3-Day CTA Pass	\$20	-	-

<sup>1</sup> WMATA has varying distance-based prices. \$135 gives system access for which individual trips would cost \$2.25

<sup>2</sup> For using Oyster or Contactless card between Zones 1 and 3

<sup>3</sup> For between Zones 1 and 3

	7-Day CTA Pass	\$28	-	-
	7-Day CTA Pass/Pace Pass	\$33	-	-
	30-Day CTA/Pace Pass	\$105	\$50	-
	Metra Link-Up Pass	\$55	-	-

Source: CTA

A customer riding the CTA is automatically charged the ‘full price’ rate unless they have applied and received a discounted or student account linked with their Ventra card. Children aged 7-11 and school-going students during open school hours receive reduced and student fares, respectively. Registered seniors aged 65 or older, people with disabilities, and active US military personnel ride for free. The 30-day pass is valid on both the CTA and Pace, and the Metra Link-Up is a CTA pass riders can add onto an existing Metra monthly pass, though it is only valid on weekdays on the CTA (6 to 9.30 am and 3.30 to 7 pm).

Prior to December 1998, the CTA 30-day pass was actually a monthly pass valid for calendar months, but improved technology allowed for greater flexibility prompting the switch to a 30-day pass. This also allowed the CTA to drop its pass price from \$88 for the monthly pass to \$75 for the 30-day pass in December 1998, when it also switched from weekly to 7-day passes. Prior to 2009, the CTA also offered a 2- and 5-day pass but eliminated them in an effort to simplify their pass offerings. The 1- and 3-day passes have been fixed at their current prices since 2013 (“Chicago “L”.org: Fares,” n.d.). The Link-Up pass is only valid for a calendar month to align with Metra’s calendar month passes. The Link-Up pass increased in price from \$39 to \$55 between 2012 and 2013. The CTA raised its 30-day pass price from \$75 to \$86 in 2009, and then up to \$100 in 2013, and finally up to the current \$105 in 2018. During this period, the per-ride cost on the train went up from \$2 to \$2.25 in 2009, stayed constant in 2013, and was raised to the current \$2.50 in 2018.

The changes in the price of fare products over the years have influenced the breakdown of products purchased, and thus revenue and ridership for the CTA. A key number to note is the number of single rides that would be necessary to make a 30-day or 7-day pass worth it. Table 3-3 and Table 3-4 show how this value has changed over the years.

Table 3-3: CTA Base Fare Versus 30-Day Pass Price Over The Years

Year	Single Train Ride Full Fare <sup>4</sup>	30-Day Pass Price	Number of Single Rides Needed to Match 30-day Pass
<b>Pre-2006</b>	\$1.75	\$75	42.9
<b>2006 change</b>	\$2.00	\$75	37.5
<b>2009 change</b>	\$2.25	\$86	38.2
<b>2013 change</b>	\$2.25	\$100	44.4
<b>2018 change</b>	\$2.50	\$105	42

<sup>4</sup> These fares assume payment through a transit card and not cash

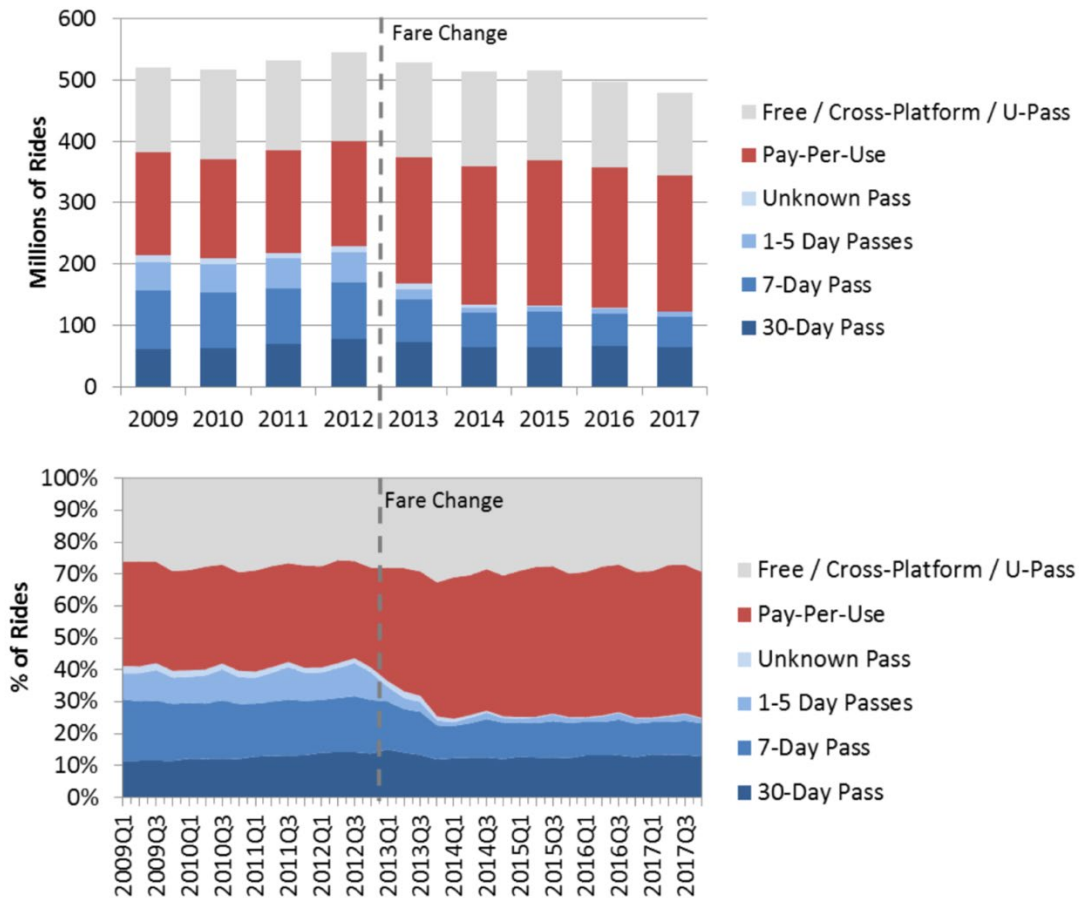
Table 3-4: CTA Base Fare Versus 7-Day Pass Price Over The Years

Year	Single Train Ride Full Fare	7-Day CTA Only Pass Price	Number of Single Rides Needed to Match 7-day Pass	Number of Single Rides Needed to Match 30-day Pass
Pre-2006	\$1.75	\$20	11.4	48.9
2006 change	\$2.00	\$20	10	42.9
2009 change	\$2.25	\$23	10.2	43.8
2013 change	\$2.25	\$28	12.4	53.2
2018 change	\$2.50	\$28	11.2	48.0

Note: To calculate the equivalent 30-day rides needed, the 7-day rides were multiplied by 4.29, which is 30 days divided by 7.

As the relative difference between the base fare and pass price has fluctuated over the years, so has the fare product purchasing behavior of CTA riders. People have tended to switch from pass products to pay per use products as passes have gotten relatively more expensive, and this is reflected in the CTA ridership and revenue numbers broken down by fare product type.

Figure 3-1: CTA Ridership by Tariff 2009-2017 (Stuntz, 2018)





After the 2013 hike in pass prices without a commensurate hike in base fare, there was a drop in pass usage for rides on the CTA in favor of pay-per-use rides. This was compounded by the rollout of the new Ventra system between August 2013 and July 2014, which made it easier for riders to fill money into their Ventra accounts using the Ventra app. This made using the CTA with pay-per-use (PPU) easier than before, as riders no longer had to interact with a ticket vending machine to refill money into their account. This made the utility associated with using a pass product instead of PPU relatively less desirable than before, though, of course there remain benefits of assembly. While the rollout of Ventra may have pushed some riders from using a pass to using PPU, there is the overall benefit of an improved customer experience and the likelihood of new customers being drawn into using the system due to easier fare payment options. However, overall CTA ridership fell 2.8% between 2013 and 2014 (attributed to severe winter weather), though it increased by a modest 0.4% between 2014-15 (CTA Annual Ridership Reports 2014 and 2015).

CTA ridership reports attribute the recent fall in ridership partly to increased competition from TNCs such as Uber and Lyft. This could provide an additional explanation for the trend of switching from pass use to PPU. The CTA 30-day pass is already highly priced, especially when compared to the “deep discounting” price regime common in the 1990s (Oram, 1990). The 2013 fare change required a rider to use the train at least 44 times in the month just to break even, and this number increases if the rider takes some bus trips instead of rail. Even at today’s 42 trip multiplier, assuming 20 working days and that the rider uses rail to reach work, that would require commuting roundtrip to work every single day using the CTA with two additional non-commute trips to break even with the price of a pass. With the advent of services such as Uber and Lyft, but also bikeshare and other forms of personal mobility, coupled with a growing trend of telecommuting (and increasingly, more part-time workers and paid time off), the monthly pass can begin to appear not worth it for more and more riders. Discretionary off-peak trips are now easier than ever to take using modes other than public transit, and commute trips at peak hours are becoming less necessary, which is precisely when transit is most time and cost effective. These factors can reduce the number of transit trips a rider would take in a month, which threaten their propensity to consider a pass product. Without having purchased a pass product, the rider is no longer anchored to public transit as the zero marginal cost option, leaving them more susceptible to using other modes that lead to a less sustainable lifestyle, cause more congestion, and hurt the public transit agency’s ridership and revenue. Thus, the CTA and all public transit agencies that offer passes must find new ways, through pricing structures or otherwise, of keeping riders using pass products or making up for the lost producer surplus from reduced pass sales.

### **3.3 Mobility as a Service (MaaS)**

#### **3.3.1 Overview**

The bundling or integration of mobility services for a subscription fee have in recent times been referred to as Mobility as a Service (MaaS), though there is no universally accepted definition yet. Much like in the way Amazon has become a one-stop shop for shopping needs and Netflix for television shows and movies, MaaS aims to create a one-stop shop for mobility needs in return for a subscription fee. A principle rationale behind this is to make the use of the growing number of disparate mobility services easier such that an individual can live without owning a personal vehicle, echoing the much-touted “access over ownership” paradigm that the transportation world

is often predicted to be heading towards. Although the term was first used in 2014 (Heikkilä, 2014), the general concept of an integrated mobility solution with public transit as the core and shared modes as non-competitive complements was already being used in the public domain as “combined mobility” in 2011 (UITP, 2011). The exact definition of combined mobility in 2011 stated that, “*carsharing, taxis and shared taxis, bicycle and bike-sharing, car-pooling, demand-responsive transport, car-rental, etc., are services that can complement the classic fixed line- and timetable-bound public transport services and, together with walking, they form a complete and coherent mobility solution*” (UITP, 2011).

Given the multitude of definitions in existence and the fast-changing nature of the industry, it is difficult to pinpoint the exact characteristics of MaaS. Sochor et al. (2018) attempts to bring together the different definitions of what MaaS is and to arrive at some common themes. These include: Integrated, on-demand, digital, personalized, multimodal, public and private, includes information, planning, booking, and payment, is user-oriented, and finally, emphasizes mobility over transport. Some of these are shown in a general schematic of potential uses of MaaS in Figure 3-2. These include routing, booking, payment, gamification, and service bundles. Gamification refers to the use of a points system to incentivize certain behaviors. Sochor et al. (2018) goes on to provide a topology for different levels of mobility integration to help decide what MaaS is and is not, as shown in Figure 3-3.

Figure 3-2: Schematic showing different potential uses of a MaaS platform

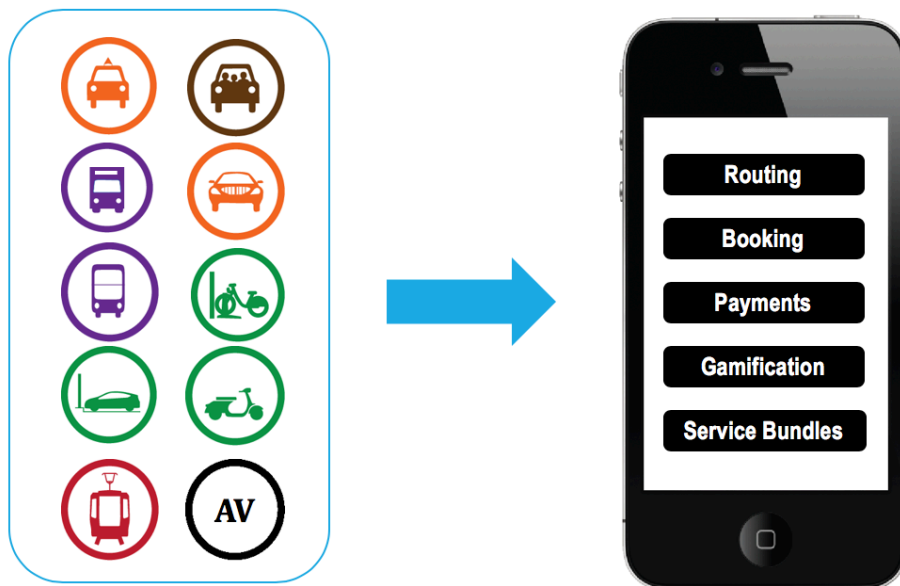


Figure 3-3: Overview of different levels of integration in MaaS



Source: (Sochor et al., 2018)

Sochor et al. (2018) describes four levels of integration above 0 integration for disparate services. In the diagram above, Lyft is shown as being of level 0, but with Lyft’s 2018 purchase of the bikeshare company Motivate, perhaps it can no longer be considered a single service. Level 1 refers to information integration to help plan trips and price them. Level 2 integration is a step up from level 1 with the key difference that trips can be directly booked from the app. A key US example of this would be “Transit” app. Level 2 companies would most likely gain revenue through commissions with the mobility providers they feature, and mobility providers gain from exposure, though they are also presented with their competition side by side. Sochor et al. (2018) further asserts that these companies will find it hard to make money unless they include non-transportation products that can be bought directly in-app, such as hotels, event tickets, or shopping. Level 3 integration is more comprehensive in nature where a single payment or contract of mobility service gives access to several options that can be expected to meet most mobility needs of the customer. Customers pay just one price and while they might have an idea of the retail costs of the separate modes offered in the bundle, the actual cost for these modes to be included on the MaaS platform is unknown to them. These “internal” prices of each mode would be the result of negotiations between the MaaS operator and the mobility service providers. Finally, level 4 MaaS includes the integration of incentives to nudge users towards more sustainable behavior to fulfill city or national goals. This includes using lower carbon-emitting or shared modes, or using services off-peak or on specific routes to alleviate congestion. However, the push to include such features on a MaaS platform would require a strong public transit agency or city government that is committed to setting and meeting such sustainability goals (Sochor et al., 2018).

### 3.3.2 Literature on Preferences and Impacts

There is a limited but growing body of literature on Mobility as a Service and bundled mobility products in general. This literature includes preferences of potential buyers of MaaS, predicted travel behavior impacts, and actual studies on MaaS deployments.

Matyas and Kamargianni (2018) used choice modeling to determine whether MaaS monthly bundles could be used to promote the use of more shared and sustainable modes of transport. They

surveyed 1000 Londoners between November 2016 and March 2017, first on their current travel behavior and spending and then accordingly provided stated preference (SP) questions. These SP questions presented various types of mobility bundles that included varying degrees of public transit, bikesharing, carsharing, and taxi for different prices. The study used multinomial logit (MNL) to model the preferences for two types of passes: a fixed plan pass where a pre-set combination of features was presented and a flexible pass where the respondent could customize the pass features and the price would dynamically update. The study found the inclusion of public transit to be the only positive utility mode in the bundles, and taxi, bikesharing, and carsharing (in order of ascending disutility) to have negative coefficients. However, this study was done in London, where the public transit network alone is probably good enough to meet people's travel needs without add-ons, and they did not present market segmentations of the model by age or other socio-demographics. It did have interaction terms, and thus found that previous bikeshare users and frequent taxi users were likely to gain positive utility from the inclusion of bikeshare membership and taxi miles in a bundle. The survey additionally found that 60% of respondents would try previously unused modes of transport if their MaaS plan included them. A methodology very similar to that of Matyas and Kamargianni (2018) will be used in this thesis.

Sochor et al. (2015) conducted before and after surveys of participants of the UbiGo initiative (Sweden) to assess its impact on users, which is described in the next subsection. It found that 93% of the respondents were satisfied with the service and 79% wanted to continue with it as it stood with a further 18% willing to continue given certain conditions. Respondents reported having more travel alternatives than before and being able to more easily track transport expenses. UbiGo was also used as a testing ground by the public transit agency to test out new initiatives, such as expanded zones and daily passes. It further found that 48% of respondents used private cars less than before as compared to 3% using them more, and 23% had a less positive attitude towards private cars versus 3% having a more positive attitude (Sochor et al., 2015). The gaps they found in the UbiGo coverage included day trips to nature areas that were outside of the carsharing service zone and would be too expensive to justify using a car rental. They also found that the density of carsharing lots was a key factor in people's satisfaction with the service, as people needed carsharing for non-commute trips such as shopping errands but found it difficult to find carshare availability in suburban neighborhoods.

A study for Nordic governments found that MaaS deployments across Nordic countries had the potential to reduce annual CO<sub>2</sub> emissions by 1.3 to 7.2% and annual vehicle kilometers traveled (VKT) by 3,595 to 24,558 million VKT/year (with the greatest reduction predicted at about 11% per year in Sweden) (Laine et al., 2018). They made these predictions by taking documented impacts of increased shared mobility use, and assuming an increased adoption rate due to the proliferation of MaaS. However, given the few actual deployments of MaaS it is difficult to arrive at accurate estimates for its impact on travel behavior.

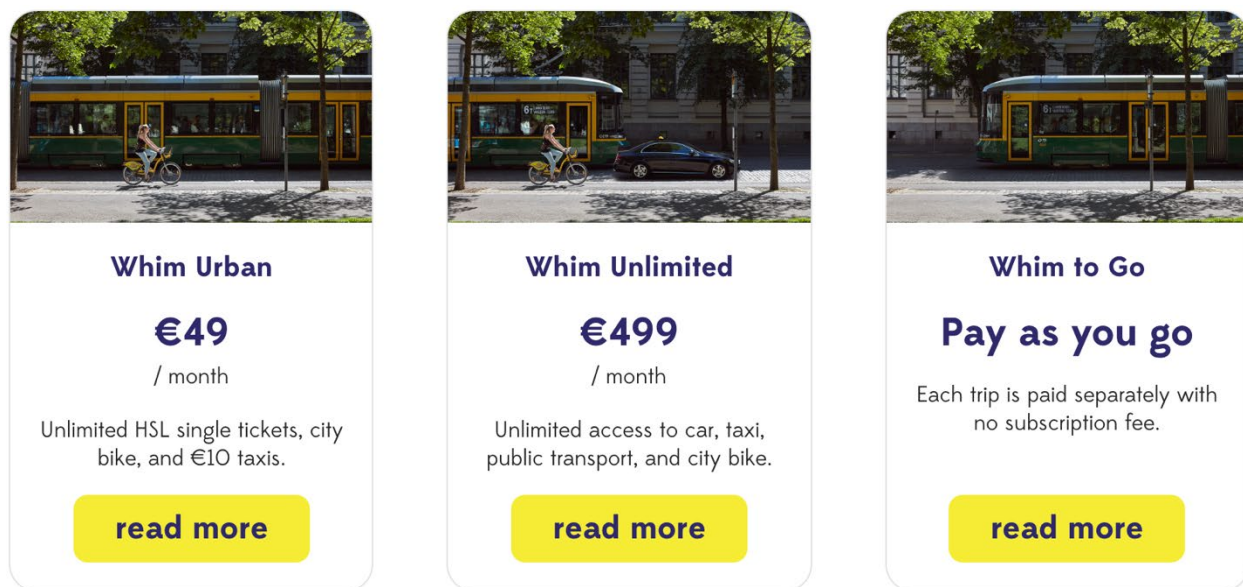
### 3.3.3 Salient Examples

Today's deployments of MaaS-like initiatives include self-described MaaS programs as well as what could be called simply mobility bundles or partnerships. The difference can be subtle, and arguably there is no difference at all. Broadly speaking, MaaS initiatives would seek to provide a complete suite of solutions to get the customer from point A to B, while mobility partnerships

could be ad-hoc arrangements for commercial reasons. Most deployments are in Europe and all contain public transit (except for the US TNC bundling/partnerships). A few salient examples are detailed here.

**Whim:** Whenever MaaS is mentioned, often the first example that comes to mind is Whim, which started in Helsinki, Finland in 2016 but has since expanded to Birmingham and Antwerp. It brands itself as an all-inclusive solution for urban mobility needs that allows the user to not worry about individual ticket purchases and is also eco-friendly. It offers three plans: Whim Urban, Whim Unlimited, and Whim To Go (which is not a subscription). In effect, it is pursuing a “mixed bundling” approach, as explained earlier. Whim Urban includes unlimited public transit and 30-minute bikeshare trips, as well as flat-fare 10 euro taxi rides that are under 5 kilometers. Whim Unlimited includes all the features of Whim Urban, except that taxi rides under 5 kilometers are completely free and 2 free hours of carsharing per day are also included. For context, a single ride on Helsinki’s public transit system costs 2.20 euros and a monthly pass costs 54.70 euros, meaning that the Whim Urban plan undercuts the transit pass price, even without the bikeshare and taxi add-ons. Screenshots of Whim’s pricing plans are shown in Figure 3-4.

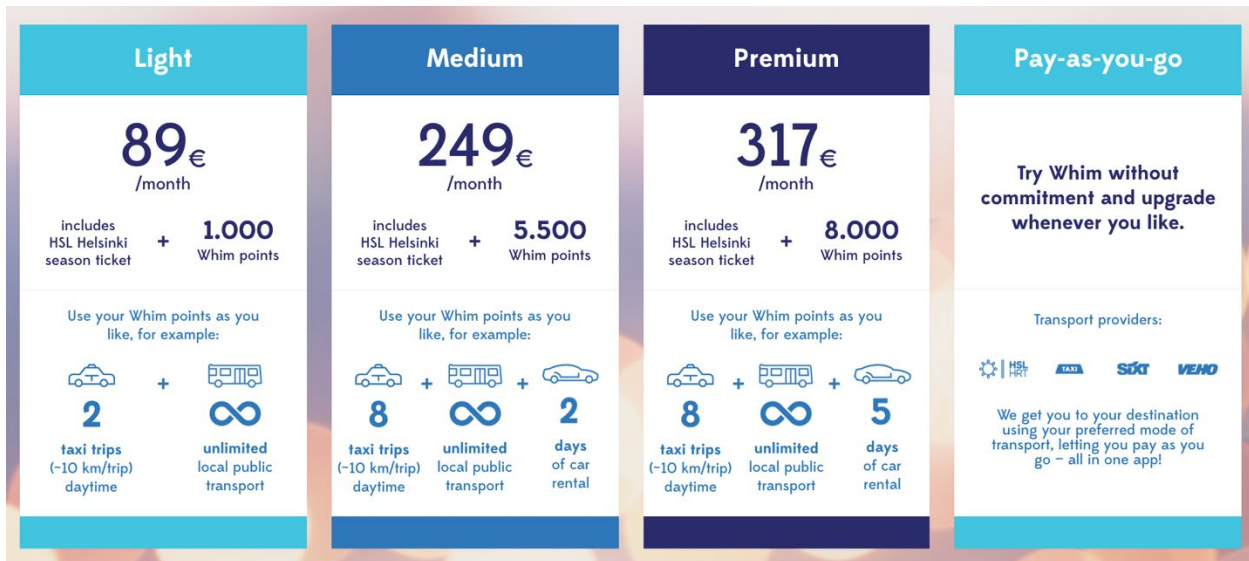
Figure 3-4: Whim’s subscription plans in Helsinki as of April 2019



Source: whimapp.com

In comparison, Figure 3-5 shows Whim’s pricing plans as of November 2016, around when the service started. It had three subscription plans in addition to its Pay-As-You-Go option, as opposed to only two today. The prices in 2016 were also more clustered together than today’s prices, where the unlimited plan costs 10 times the basic plan. It is likely that after several years of operation, Whim found two key market segments to target rather than the three below. This indicates that the market is comprised of basic riders and high-paying riders, who are likely subsidized by their employers.

Figure 3-5: Whim subscription plans in November 2016



Source: whimapp.com

**UbiGo:** This service started as a pilot service in 2013 in Gothenburg, Sweden, and offered public transit, taxi, bikesharing, car rental, and carsharing for the equivalent of \$162 USD in November 2014 dollars (Sochor et al., 2015). After the initial pilot, the service has been relaunched in Stockholm in 2019 in select households and neighborhoods, with plans of expanding back to Gothenburg and in other Swedish cities.

**Citymapper:** Citymapper, which started out as a trip planning application, announced its “Citymapper Pass” to be launched in London around April 2019. It will initially offer two weekly subscriptions: one for around 31 GBP which gives unlimited access to TfL’s Zone 1 and 2 (as opposed to TfL’s own 35 GBP rate for the same), and another for 39 GBP which adds on unlimited 30-minute rides on London’s bikeshare system and gives 2 free rides on Citymapper’s own ridehailing service (Kobie, 2019).

Figure 3-6: An advertisement for the Citymapper Pass

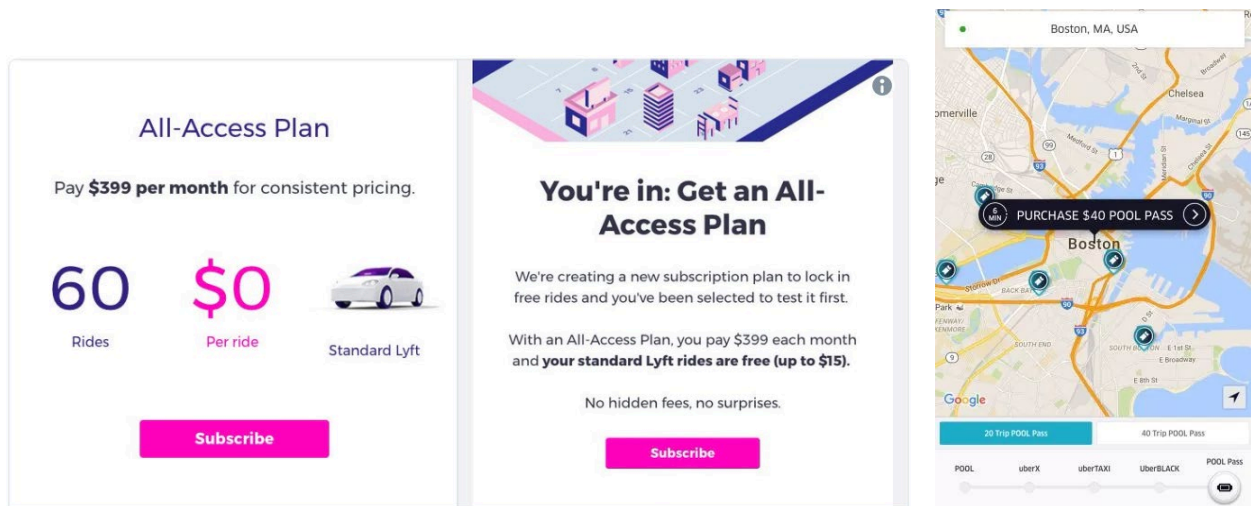


Source: (Citymapper, 2019)

**Via partnership with Mobike in DC:** Via, a shared ride-only TNC operating in several US cities, announced in April 2018 that it would be including access in its unlimited pass to Mobike, a dockless bikeshare start up. It was one of the first mainstream examples of multimodal bundling between a TNC and another service in the United States. However, due to city regulations Mobike pulled out of DC in July 2018, hence ending their partnership.

**TNC unlimited bundles in the United States:** There have been attempts at varying price points in cities across the US to offer unlimited TNC monthly passes. Via offers the ViaPass in its cities, in which it offers a “commuter” option for just free rides during weekdays and a “24/7” option for all days at any time. Uber and Lyft have also tried to offer unlimited passes. Lyft has tried offering different “All-Access” plans to different customers based on their spending habits. These can go up to \$399 upfront for 60 rides that month, each up to a cost of \$15 (Hawkins, 2018). Uber also tried offering upfront payments in return for a fixed number of flat-fare shared or non-shared rides in 2016 (Solomon, 2016). These subscriptions have been targeted and are by no means widespread nor open to the general public. It is unclear what the impacts of these passes have been, though it appears these companies have been using experimentation to find out rider reservation prices for different types of passes. Lyft’s CEO seemed to indicate that subscriptions were the way forward for Lyft (Hawkins, 2018). Some examples of these bundles are shown in Figure 3-7.

Figure 3-7: Examples of subscriptions and bundles tried by TNCs in the United States



Source: (Hawkins 2018, Solomon 2016)

### 3.3.4 Observations

Except for the US TNC bundles/subscriptions, all the MaaS-like initiatives have had unlimited public transit as a base product included. Most initiatives also seem to offer different price levels and types of bundles, in an attempt to price discriminate. Whenever on-demand services such as taxis or rideshare have been included, there has usually been a distance limit imposed on each ride, clearly to cut costs for the supplier. There have also been flat-fare offerings for on-demand services, so the customer would have to pay on top of their subscription for these rides but is

assured a consistent price, as is seen with Whim Urban and some US TNC passes. Finally, all the initiatives have been undertaken by third-party companies or applications, with little to no public agency involvement.

### 3.4 Application and Rationale for Chicago

This chapter has shown evidence of an economic rationale for product bundling, evidence that the CTA is facing difficulties in maintaining historical levels of pass purchase and use, and evidence that MaaS is a growing trend. However, a compelling argument is still needed as to whether MaaS is the right approach for Chicago, and even more importantly, whether the CTA (or any public agency for that matter) should be involved with its implementation.

#### 3.4.1 Chicago Mobility Market

The Chicago mobility market itself presents opportunities for MaaS. There have been many different mobility operators in the city for quite some time, which could call for some degree of organization. Table 3-5 gives an overview of the range of mobility services operating in the city. Several important considerations to keep in mind when thinking about creating a MaaS program for Chicago are the individual prices and service areas of the different mobility services in existence.

Table 3-5: Range of Mobility Services in Chicago

Service Name	Type of Mobility	Pricing (without concessions)
<b>CTA</b>	Public Transit (city rail and bus)	Single-ride fare \$2.50 for rail and \$2.25 for bus Unlimited 30-day pass for \$105 1-, 3-, 7-day, and student passes available
<b>Metra</b>	Public Transit (Commuter Rail)	Single-ride fares range between \$4 and \$9 10-ride pass fares range between \$38 and \$85.50 Monthly pass fares range between \$116 and \$261
<b>Pace</b>	Public Transit (Suburban bus)	\$2.00 per ride with Ventra card Pace-only 30-day pass for \$60
<b>Uber</b>	TNC	Base + service: \$3.64 City tax: \$0.65 Per min: \$0.28 Per mile: \$0.81
<b>Lyft</b>	TNC	Base + service: \$3.64 City tax: \$0.65 Per min: \$0.28 Per mile: \$0.81



<b>Via</b>	TNC/Microtransit	\$3.95 + fees when buying with pre-loaded “Ride Credit”, else \$2 surcharge Thursday and Friday 9pm-midnight \$4.75 per ride ViaPass: - 4-week “commuter” pass: \$189 - 1-week “all-access” pass: \$70
<b>Divvy</b>	Bikeshare	Day pass: \$15 for unlimited 3-hour trips Annual: \$99/year (equivalent to \$8.25 per month) for unlimited 45 min trips. Students get \$75/year (equivalent to \$6.25/month).
<b>Taxi</b>	Taxi	Base: \$3.25 Per mile: \$2.25 Per min: \$0.42 2 pax: +\$1, 3 pax: +\$1.50, 4 pax: +\$2
<b>Zipcar</b>	Carsharing	Membership: \$70/yr Rate: \$9-15/hr
<b>Maven</b>	Carsharing	Hourly/daily rates
<b>Getaround</b>	P2P Carsharing	No membership fee From \$5/hr
<b>Turo</b>	P2P Carsharing	Per day pricing scheme

Despite current friction between the City and TNCs, there have been previous partnerships between public transit and other mobility operators. For example, in 2009, the CTA partnered with IGO carshare to provide a single smartcard that gave access to the CTA as well as IGO vehicles parked at CTA stations. Metra in 2017 started a 3 year partnership with Uber where it gave Uber permission to advertise directly to Metra customers in an effort to boost first and last mile connections. In 2016, the CTA and Divvy won a joint bid for the Federal government’s “Mobility on Demand Sandbox” Project to fund the integration of Divvy in the Ventra app. These are just a few of the major partnerships that have taken place in the Chicagoland region between public transit and alternative mobility providers.

The existence of so many different mobility services in a city with a strong public transit backbone like Chicago presents the conditions necessary for MaaS. There are enough new mobility operators such that users can experience a tangible benefit from their collection onto a single platform, and public transit is extensive and frequent enough that it can be a reliable foundation for personal mobility. Further, this can allay fears of new mobility overrunning public transit use that might be present in contexts where public transit is not robust enough and is more susceptible to replacement.

### 3.4.2 Rationale for Public Sector Involvement

Though all MaaS initiatives thus far have been private-sector driven, this thesis argues that there is a strong case for the public sector to be heavily involved, if not create the actual MaaS platform. This can be radical idea for public transit agencies in the US who would be uncomfortable with the idea of working with those who they view as competitors. It can also be an uphill task for a public entity to bring together so many private players, as the procurement and bidding process

would likely be complex (Sochor et al., 2018). However, by getting involved with a market trend that is already taking place, the public sector can be better positioned to monitor, regulate, and nudge mobility trends in the city.

To understand the rationale behind public sector involvement in MaaS a change mindset is needed regarding the role of the public sector in urban mobility. While a public transit agency might view itself as a physical operator of trains and buses, the combination of the operating agency and the city government presents a much more holistic range of power and influence. In the current mobility governance structure, a transit agency's primary concern is making trains and buses run on time, whereas the city government, usually represented by its department of transportation (DOT), is concerned with the regulation of street space and mobility in general. But beyond these functions of the transit agency and the city DOT lies a larger function of the public sector—to guarantee mobility for all city dwellers. At the heart of this is the concept of mobility as a right, which currently manifests itself through laws for public transport to prevent discrimination on the basis of physical ability, race, and income. However, when the public transit network has gaps either on a spatial or temporal basis, this idea of 'mobility as a right' is violated. To accept that public transport does not provide all mobility needs for the city population in itself might be difficult for a transit agency to accept. Even harder to agree on is how to fill those gaps. This is where mobility as a service can be a solution. The combination of the flexibility and on-demand nature of new mobility services with fixed-route public transit service on a single platform can create a system that makes "mobility as a right" a closer reality. The governance of such a combination, however, should be handled by the public sector so that it can place itself at the center of such an initiative. In this way, it can position itself as the "guarantor of mobility" in the city, where if someone wishes to travel between two locations, the government can source that service, either through its own transit service or through a partnership with another operator.

While the idea of guaranteeing mobility in the city can be a guiding rationale for public sector control of MaaS initiatives, there are other concrete reasons for public regulation of new mobility services through MaaS. As has been argued before by Block-Schacter (2009), the traditional transit pass does not fully capture the range of mobility needs and demands of city-dwellers today. As more options proliferate, people are likely to become more multimodal and will search for other modes of travel to supplement their transit use, but this might make them more unlikely to purchase a monthly transit pass. There is a segment of the population in this space who are willing to live without a car but are also willing to pay for better service at times and places that public transit does not serve them well. They also might be increasingly mode agnostic. Thus, rather than allowing these customers to be pulled away from transit enough that the monthly pass becomes unviable, transit agencies must be proactive in creating a way for their pass to be a core component of citizen mobility, accepting that it will be supplemented by other modes. A publicly-controlled MaaS platform can be one way to accomplish this.

Further, Chapter 2 showed that there is a trend of acquisitions of new mobility companies by TNCs as they seek to themselves become one-stop shops for mobility. As they engage in this race for acquisitions and price war, there is the danger of monopolization. A private monopoly forming in the on-demand transport space, especially after publicly-regulated taxi services have been largely diminished in many cities, could expose travelers to steep price increases and poorer service. Large mobility conglomerates can also become harder to regulate down the line as they wield stronger

political influence resulting from public dependence. The public sector should thus be concerned with the formation of monopolies and should act to prevent it. One way to accomplish this is to foster competition and encourage alternatives. A MaaS platform that is publicly governed can show these alternatives alongside the dominant players in the market who might not otherwise get as much exposure as better-funded venture capital-backed or public companies.

A third reason for public involvement in MaaS is to prevent the arbitrage of transit pass sales. Citymapper announced on February 20<sup>th</sup>, 2019 the “Citymapper Pass”, essentially a MaaS-like service that combined public transit, bikeshare, and rideshare in London (Heikkilä, 2014). However, it decided to sell Transport for London’s (TfL) weekly transit pass for £31 a week, undercutting the retail price of £35.10 by £4.10. This means that users would get unlimited rides for just £31 a week, while Citymapper would pay TfL just for the rides that people take, until of course the traveler reaches the maximum of £35.10 worth of rides in the week. Thus, Citymapper could potentially lose a maximum of £4.10 per buyer, but it presumably hopes to make up for that loss with people who travel less than £31 in the week and with profits gained from other components of the pass (Hern, 2019). Also, the Citymapper Pass requires an upfront payment worth 4 weeks of the pass, perhaps an indication that it is targeting higher income individuals who would not mind fronting so much money, even if it means they might travel less than the value they pay.

One might wonder, however, why this sort of pass would be objectionable to a transit agency. After all, the agency still gets full payment for rides taken in its network and people might be induced to travel more due to the lower price they pay for the pass. However, more people being drawn to a privately-owned bundled mobility pass reduces the public agency’s direct contact with its customers, thereby limiting the development of its relationship and brand with the people and the ability to nudge them towards sustainable modes. It also limits the range of possibility for how the MaaS platform can be used to maintain system optimality, for which the public agency is the primary governor. A simple example of this could be the targeted nudging towards other modes in the event of a train breakdown. A private company’s bottom line is profitability (and Citymapper is not yet profitable), and thus any private MaaS operator will be inclined to push its users to use the components of the bundle that would give it more profit. It is therefore in Citymapper’s interest to have its users travel on public transit less, as they benefit from under-use of the transit pass. Thus, level 4 integration in MaaS, or the alignment of societal goals, can never be possible if incentives are not aligned to encourage the use of sustainable modes. Further, it is clear that this arbitrage of the pass is an attempt to capture market share while hemorrhaging venture-capital money, with the hope of either becoming profitable through marginal revenue on a large volume of sales or through becoming a powerful enough company so policies can be influenced in their favor. This is precisely what has happened with Uber and Airbnb in several cities across the world (Hern, 2019). Thus, public transit agencies should be wary of the discounted use of their transit passes to capture market share by private MaaS operators who might later become more difficult to manage. Finally, there is the question of capture of the public transit agency’s producer surplus by the third-party operator. This would not be much of a problem in the London context because they cap fares at a daily and weekly rate, and so unless the user has purchased a pass beforehand and travels less than the pass amount, the agency is unlikely to capture surplus from “under” traveling. However, in cities such as Chicago that do not have a capping system and where about half of monthly pass users travel less than the pass value, producer surplus is a major issue. This

would mean, of course, that the third party seller who undercuts the transit agency's pass price is taking on more risk of losing money on customers if they are paying the transit agency on a per-ride basis. However, the third party could mitigate this risk by targeting traveler groups who are unlikely to use the pass more than the value (such as pre-paid tax-advantaged payroll deduction benefits users, as CTA data has shown) and thereby capture that producer surplus that previously went to the transit agency. Thus, it is in the public agency's interest to be proactive about being the governor of a MaaS platform in their city to ensure socially-beneficial MaaS outcomes.

## Chapter 4 The Case for Working with Employers

The transit agency-employer relationship was a common theme throughout this study and not without good reason. While this chapter describes the potential for engagement between the CTA and employers, the next chapter will describe the engagement with individual employees of companies. Specifically, this chapter:

- Discusses the reasons for placing employers and employees at the center of the Superpass project;
- Outlines existing literature on employer-based transit pass and benefits programs;
- Presents an overview of the Chicago context with respect to agency-employer engagement;
- Presents the results of a survey of benefits and human resources managers at select employers in Chicago;
- Presents a model to predict revenue and pass sale impacts of a Superpass on a given company; and
- Reports overall findings from the employer engagement exercise.

### 4.1 Why employers?

A significant motivation behind this project was to target employers and launch the Superpass through them. This was intentional. A more general approach could have been taken with the idea that one day such a pass would be launched to the public-at-large. In fact, this might have even made the study easier, especially when facing difficulties with survey distribution and data collection. Nevertheless, there are numerous reasons for why targeting employers with a tailored pass product carries with it inherent benefits and sets up the program for greater longevity.

Employers often act as a middle man between the government and people. The biggest example of this is healthcare, which is often tied to the employer in the United States. With respect to

transportation, they enable employees to reserve their pre-tax income for use on public transit, vanpooling, or parking, and can even be a point of sale for transit passes. Increasingly, large employers are using third party companies such as WageWorks and Edenred to handle health and transportation benefits, placing yet another middle-man between people and the state. This creates a greater separation between transit agencies and the people they serve and inhibits their ability to more directly target customers with new initiatives. By working directly with employers, transit agencies can interface closer to their customers and offer new initiatives directly to them.

As transit agencies try new fare product innovations and incentive programs, the burden of managing these programs also increases. Big data in transportation gives insights that allow for more tailored and individualized products, but the increased complexity itself might be a disincentive for transit agencies to pursue such initiatives. By working with employers, who presumably would know their employees better than transit agencies, not only can better insights be gained to create tailored products but also the burden of managing, marketing, and troubleshooting such products can be shared with employee management. This provides an easy way for transit agencies to reach thousands of existing and potential riders by only having to interface with some (presumably larger) employers and not having to increase program management resources by a commensurate amount.

Further, and perhaps the most important reason for targeting employers, is that they present an opportunity to align incentives so that everyone is working for the success of the program. In other words, it is a win-win-win situation for employees, employers, and transit agencies. Tax incentives for both employers and employees is a major contributing factor. Since the 1993 addition of the IRS code 132(f), employees can use designated untaxed income for transit, vanpool, parking, and until recently, biking expenses. This can save them up to 40% on their commuting expenses, depending on their income bracket. If more employees use their pre-tax salary for these expenses, there is less overall taxable payroll for the firm, which saves the employers on the 6.2% payroll tax they must pay on salaries. Employers can also pay for employee commuting expenses directly and can save on tax expenses as well, though this has been recently changed. The idea behind these tax exemptions is that the cost of using transit or vanpool is lowered for employees which would induce a mode shift away from SOV, and the payroll tax burden for the employer is also lowered which would engender their support in encouraging sustainable travel.

With more people using transit at a company through pre-tax benefits, more employees save money on expenses, and employers benefit from a reduced payroll tax burden, reduced demand to provide expensive parking, better employer-employee relations, help in achieving internal sustainability targets, and finally, improved company image. The transit agency benefits because they not only get more revenue from higher participation in transit benefits, but also more steady revenue which can help in their financial planning. Increased participation in federal pre-tax benefits is also a way to have the cost of using local transit subsidized by the federal government, thereby releasing pressure on underfunded transit agencies to provide larger fare subsidies and allowing them to focus more on improving service. This shared incentive by all three parties to increase participation in transit benefits presents an opportunity to efficiently increase transit ridership but also save money for the government, employers, and employees at the same time. Changing the dynamic from one of the government trying to externally dictate how people should

spend their money to one where there is intrinsic motivation for the program's success by employers can ensure longevity of the program.

Finally, targeting employers makes for a cleaner way to study behavior. By limiting the study to several specific employers, some random variation in the study population can be controlled. For example, the respondents would have similar morning commute destinations, they would have similar work hours, similar type of work, and are in the same transit benefits framework which would impact their travel behavior. This allows for a clearer comparison between different potential Superpasses for the given population.

## **4.2 Literature on Employer-Based TDM programs**

In many ways, this project built on work previously done at MIT regarding the study of travel behavior by employee populations. Block-Schachter (2009) studied bundled mobility passes that might better capture inherent multimodal behavior by commuters, Kamfonik (2013) analyzed the MBTA Corporate Pass program, Gates (2015) examined and critiqued the design of employer-based commuter benefits programs for large companies in Cambridge, and Rosenfield (2018) investigated how employer-led “nudges” and incentives could encourage mode shifts among employees in Greater Boston. This section presents an overview of studies in the larger academic community on employer-based transportation demand management (TDM) programs and their impacts.

As explained in greater detail earlier, employers play an important role in influencing the travel choices of employees, and by extension, the travel patterns at the city and regional level. For this reason, there are several federal and state government-mandated transportation demand management (TDM) programs for employers and employees aimed at inducing more sustainable commute modes. TDM encompasses all actions aimed at influencing the demand for various transportation modes rather than supply. These initiatives were first introduced in the 1970s in response to rising oil prices and gradually evolved to take their current form of pre-tax deductions for transit and vanpool expenses by 1993 due to a change in US federal tax laws. As of January 1<sup>st</sup>, 2018, the maximum an employee could reserve pre-tax for transportation was \$260. However, it should be noted that the 2017 Tax Cuts and Jobs Act eliminated corporate tax deductions for money spent by employers to subsidize their employees' transit, parking, vanpooling and bicycling. The \$20 bicycling expenses deduction for employees was also eliminated (Dawson, 2018).

Financial incentives such as being able to designate pre-tax commuting expenses are just one type of employer-based TDM technique. Broadly speaking, the other three types of TDM strategies used by employers include “employer or institutional support”, “provision of transportation services”, and “alternative work arrangements” (TCRP, 2010). The TCRP report also notes that TDM strategies are rarely implemented in isolation, but rather as part of a multi-pronged approach. The implementation of several initiatives has an amplifying effect in nudging sustainable travel behavior. An overview of TDM actions often used by employers are given in Table 4-1.

Table 4-1: Overview of TDM Measures Used by Employers

<b>Financial Incentives or Disincentives</b>	<b>Employer or Institutional Support Actions</b>	<b>Provision of Transportation Services</b>	<b>Alternative Work Arrangements</b>
<b>Transit Subsidies</b>	Transportation Coordinators	Shuttle Bus Services	Flexible Work Hours
<b>Vanpool Subsidies</b>	Transportation Management Association	Contract Transit Service	Staggered Work Hours
<b>Parking Cash-out</b>	On-Site Transit Information and Pass Sales	Vanpool Formation Assistance	Compressed Work Week
	Rideshare Matching Services	Use of Company Vehicles	Telecommuting
	Guaranteed Ride Home	Bicycle Loan Programs	
	Preferential Parking for HOV	Carshare or Bikeshare membership	

Source: TCRP, 2010

The TCRP 2010 report evaluated 82 employer TDM programs in the US and quantified the vehicle trip reduction attributable to each type of intervention. It found an overall 17% reduction from all actions. High availability of transit caused the largest reduction of 26%, which was followed by restricted parking (24%), parking fees (24%), provision of transportation services (22%), modal subsidies (19.5%), and telecommuting (16.5% reduction).

A TCRP report from 2005 aggregated surveys of commuter benefits programs in the US to ascertain their impacts. They found that in general, participating companies saw a 10 percent increase in transit ridership, though this number ranged dramatically from 5% to 140% and was based on data ranging from the early-1990s to the mid-2000s. They found that the largest percent increases were in areas that did not have much transit available and hence the starting mode share was low. The new transit users were found to most likely have been previous drivers. Interestingly, they also found that in many cases, there was not a great increase in number of new transit users indicating that the benefits of the program were serving existing transit users. However, it notes other benefits of this, such as greater retention of existing transit users, increased transit use by existing users, and increased convenience and satisfaction with transit in general. Further, the provision of commuter benefits alongside other programs such as carpooling and work-from-home would demonstrate a reduction in driving to work although not a commensurate increase in transit as these employees use these other programs (TCRP, 2005).

### 4.3 Employer Engagement in Chicago

While federal employer-based TDM programs are in place on paper, their success in a particular city often depends the relationship between employers and local transit agencies. For example, out of the CTA's total revenue of \$487.8 million in 2017, \$54 million or 11% came from the pre-paid benefits (PPB) program in Chicago (CTA Ventra). This can be compared to the 28% of the



MBTA's \$596 million revenue that came from their Corporate Pass Program in 2015 (Stuntz, 2018). Of course, these numbers do not reflect employee passes bought through third party providers, which is estimated to be an additional 3-8% for the MBTA by Kamfonik (2013). This same estimate is unknown for Chicago, but 86% of Ventra benefits monthly pass accounts are administered by third parties, meaning that these companies are purchasing passes from the CTA and reselling them. This implies a large presence of third-party benefits managers in Chicago. The 86% is comprised of 51% from WageWorks, 30% from Edenred, and 4% from the Regional Transit Authority (RTA) (CTA Ventra). What this also means is that a mere 14% of all pre-paid benefits 30-day passes are sold by the CTA directly to employers and their employees, which could explain why a much smaller proportion of their revenue comes from pre-paid benefits as compared to the MBTA (though it is worth noting that the MBTA has a contract with Edenred for the sale of its corporate passes). Given all the aforementioned benefits of strengthening employer transit benefits programs, this is an area the CTA would surely want to focus on in time to come.

The Metropolitan Planning Council (MPC) in Chicago has recently begun an initiative called 'Transit Means Business', in which it leverages the symbiotic relationship between transit and business growth to encourage large businesses to advocate for greater transit use among their employees. Its report highlights the fact that business often decide on their firm location based on transit connectivity and investments in an area, and hence there is a direct link between transit investment and job and economic growth. Among the many case studies detailed are those of McDonald's and Illinois Medical District, two large employers targeted in this study. The MPC study explains the importance of transit proximity, provision of additional benefits such as transit pass and bikeshare membership subsidy by employers, and the non-provision of parking as key factors in increasing transit mode share for companies (Metropolitan Planning Council, 2018)

Given all of these salient features of employer-based transit benefits programs, it was decided that an employer-based survey focused on transportation benefit policies and interest in bundled pass products be launched in Chicago. We especially wanted to target large employers, but as mentioned, the vast majority of the larger companies handle their benefits through third parties, who refuse to share their client data with the CTA. Thus, only the 14% companies that handle their benefits directly with the CTA could be targeted, the process through which is described in the next section.

## **4.4 Employer Survey and Results**

### **4.4.1 Rationale and Overview**

The first step towards launching a "Superpass" through employers was to better understand employer needs, current commuter benefits setup and penetration, and preferences towards such a pass. Based on this information, companies can be identified with whom to potentially pilot a new pass product. Thus, in the summer of 2017, a survey was developed and launched to certain employers in the Chicagoland region as an initial probe to identify potential pilot companies for the Superpass. These were companies that already purchase monthly transit passes directly from the CTA's Ventra account system. The surveys were sent to the contact that the CTA had for the company, who was usually their transit benefits manager or someone in human resources. In total,

the survey was sent to 615 companies and 143 completed responses were received. The survey asked questions pertaining to the following:

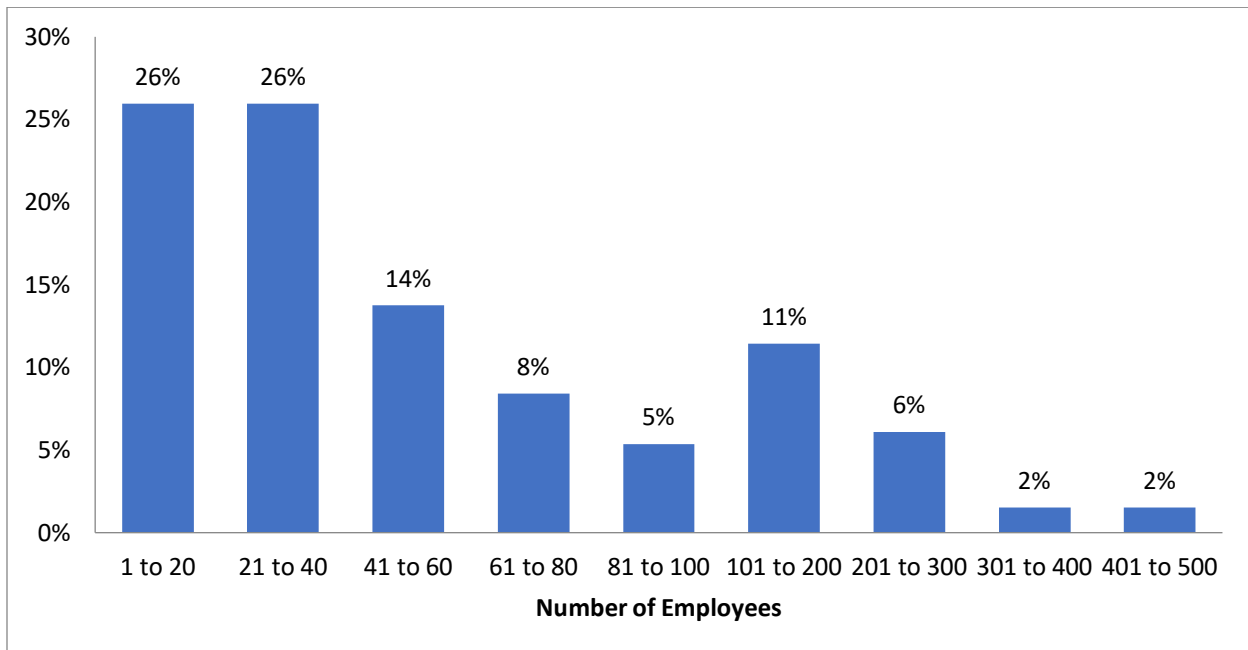
- Overall mode share of the employees;
- Parking supply and demand situation;
- Types of commuting perks the company offers its employees;
- How the company administers commuter benefit money;
- Information on company-provided shuttles, if applicable;
- Whether or not the company is interested in bundled mobility passes that include the CTA monthly pass;
- If they are interested, their ranked preferences of which modes of transportation to include in the bundle; and
- If they are not interested, why not.

#### 4.4.2 Results

A selection of key results of the survey follow.

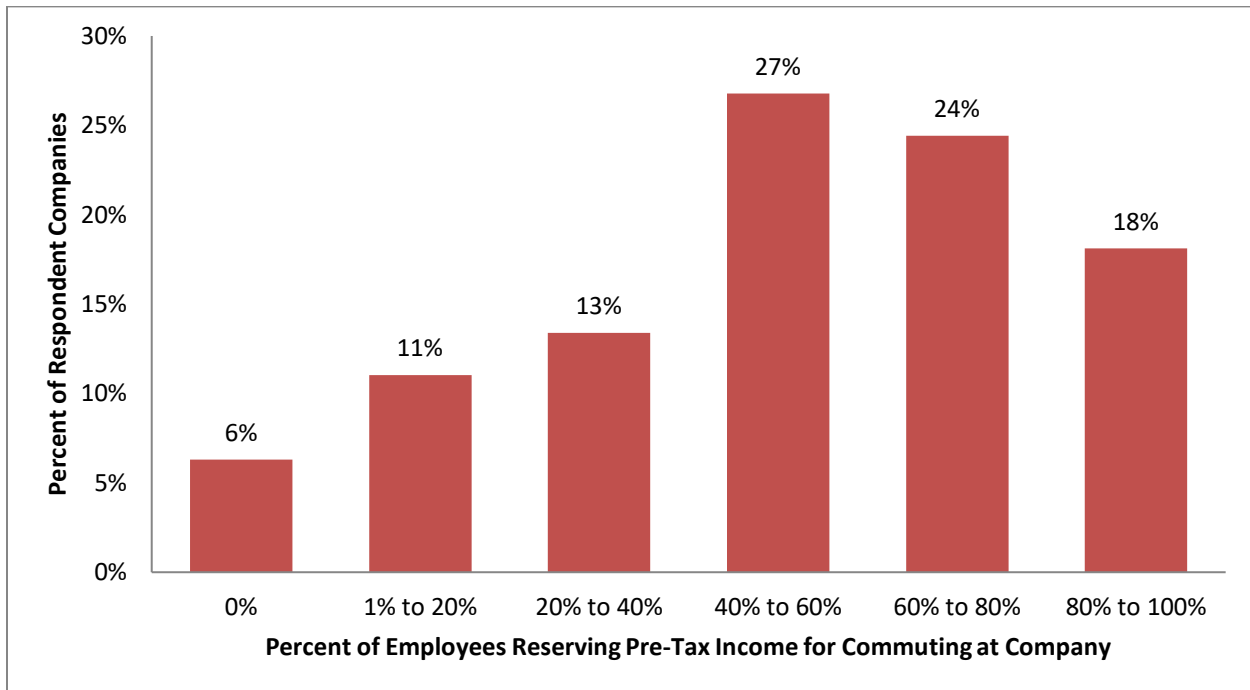
First, as seen in Figure 4-1, the survey was completed by a larger proportion of smaller companies as compared to larger ones. This is likely because larger companies mostly handle their benefits through third party companies rather than directly with the CTA. In some later figures, the company size by employees is grouped into the following four categories to have about equal representation per grouping: 1 to 20 employees (34 companies), 21 to 40 employees (34 companies), 41 to 100 employees (36 companies), 101 to 500 employees (27 companies).

Figure 4-1: Number of Employees at Respondent Company Largest Location (n=131)



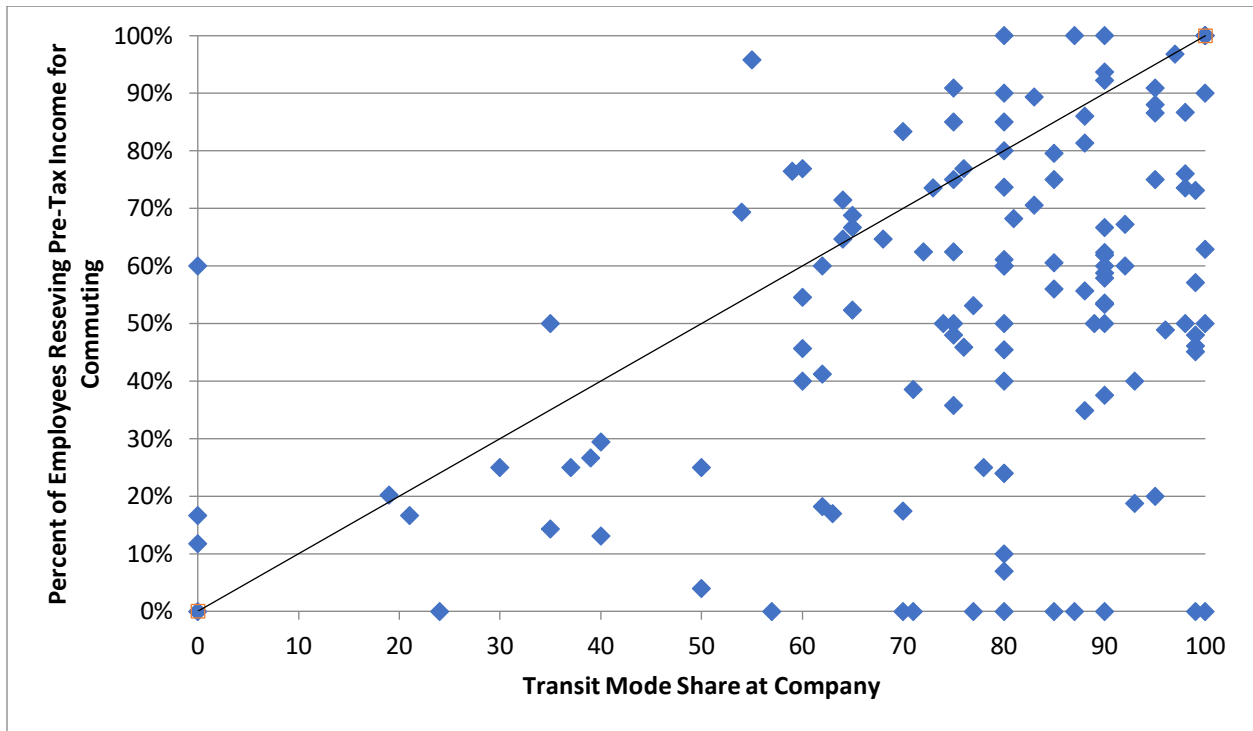
Respondent companies were also asked how many of their employees reserve pre-tax income for commute expenses. The distribution is shown in Figure 4-2, which shows that 30% of the respondents said under 40% of their employees participate in pre-tax benefits. The overall average participation rate across all the respondent companies was 53%.

Figure 4-2: Percent of Employees Reserving Pre-Tax Income for Commuting



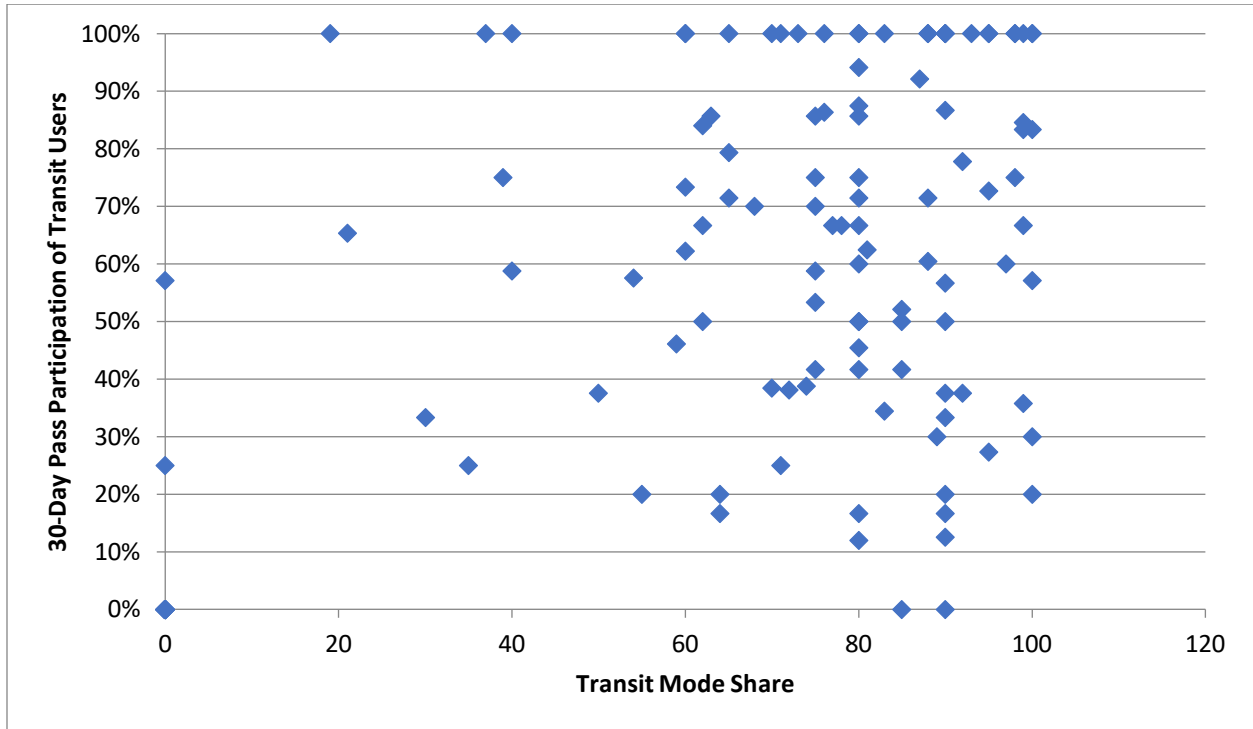
Then, the transit mode share at the company was compared with the percentage of employees that reserve pre-tax income for commuting (when offered by the company) as shown in Figure 4-3. Ideally, each person that commutes by transit participates in commuter benefits. This not only provides the individual and employer with tax benefits, but it further anchors them into using transit. On a broader scale, more people paying less for transit through federal tax incentives relieves some pressure on local agencies to keep fares low by using the help of this federal program. Hence, it is in the long-term interest of any transit agency to promote participation in pre-tax benefits programs. Even car commuters can use pre-tax benefits for parking, and so the data points would be expected to at least be above the  $y = x$  line. However, there are a large number of companies below this 1:1 ratio, meaning more people in these companies travel by transit than reserve pre-tax income. One cluster of these sorts of companies can be seen where companies with an already high transit mode share, who probably just need more awareness and marketing to get employees to participate in the pre-tax program. The other target group are companies that exhibit a low transit mode share as well as a low pre-tax reserving rate. With these companies the CTA would not only hope to increase the benefits participation rate, but also achieve an increase in transit mode share and transit pass sales.

Figure 4-3: Reported Transit Mode Share vs. Percent of Employees Reserving Pre-Tax Income for Commuting



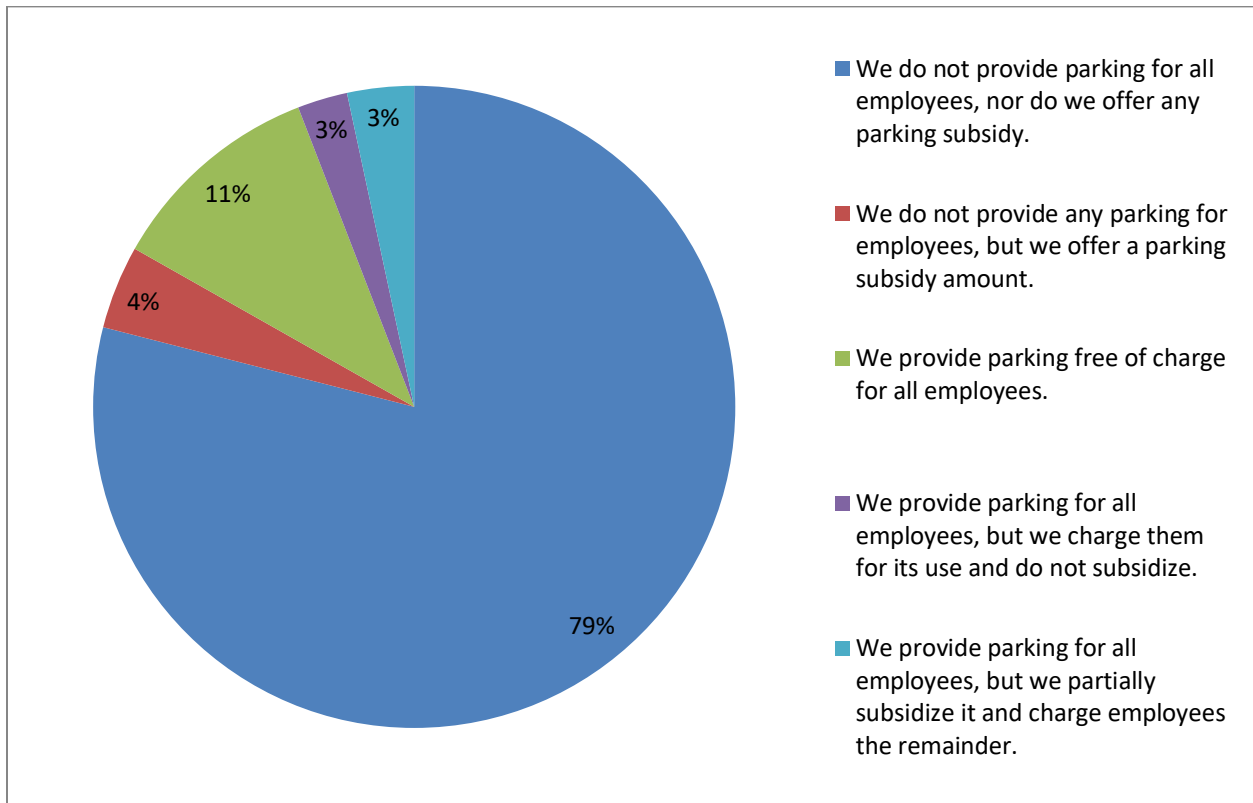
Next, the transit mode share of a company is compared with the CTA 30-day pass participation rate at that company in Figure 4-4. The 30-day participation rate was found from the percent of employees who buy 30-day passes through the employer out of all employees who load money into their Ventra account (again, through the employer). Barring some outliers likely due to noisy data, there is a general positive trend. However, many companies show a high (greater than 70%) transit mode share and yet there is a low pass participation rate. A caveat for some of the low numbers could be employees who purchase a 30-day pass separately from their employer. Nevertheless, it can be assumed that people who commute using transit have a financial incentive to purchase an unlimited transit pass because they have high transit use, but also to eliminate the need to constantly fill money in the Ventra transit account. However, due to multimodality of individuals, telecommuting, and a host of other reasons, primary transit commuters may still not purchase a monthly pass. Any transit agency, the CTA included, would want to push as many transit commuters into an unlimited pass so that they become the zero marginal cost option, which could induce more non-commute trips to take place on transit. Thus, a bundled pass that makes transit passes more attractive could potentially move the high transit mode share companies towards a higher 30-day pass participation rate.

Figure 4-4: Reported Transit Mode Share vs. Percent of Employees Who Load Money into Ventra Who Use the 30-Day CTA Pass



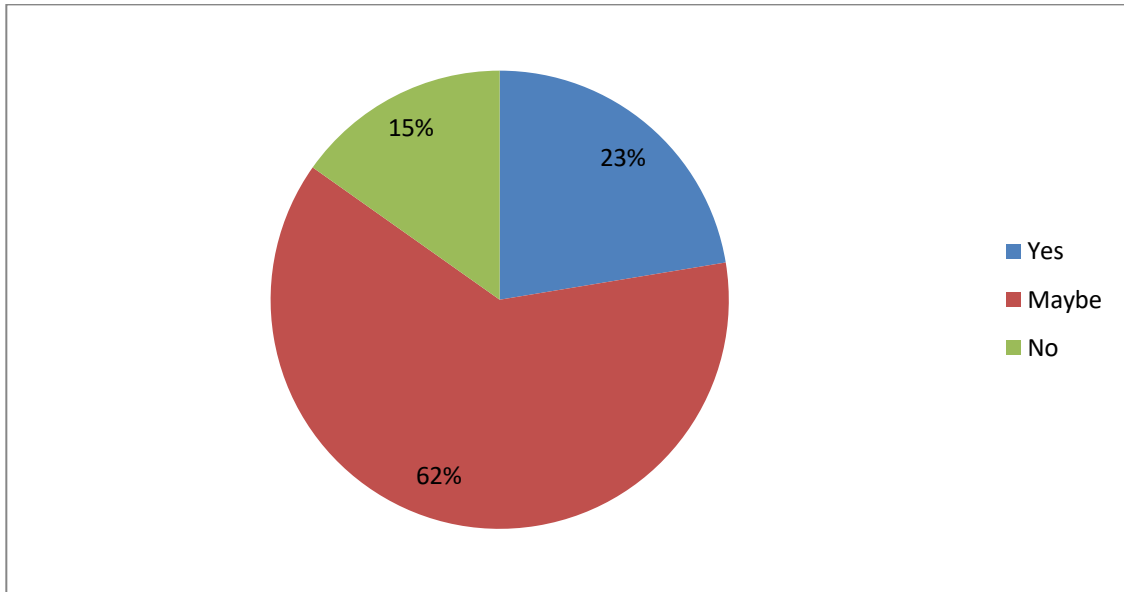
The need to reduce parking pressure can be a major motivating factor for employers to introduce TDM measures. Figure 4-5 gives an overview of how respondent companies provide parking for their employees, if at all. The 21% share that provide space or subsidy for parking would be key a target for the Superpass in an attempt to unbundle parking provision from employment centers. One insight that is not shown is that companies with 100+ employees were more likely to own or lease parking spaces, which further lends them to being a good candidate for a targeted TDM strategy.

Figure 4-5: How Respondent Organization Handles Parking for Employees



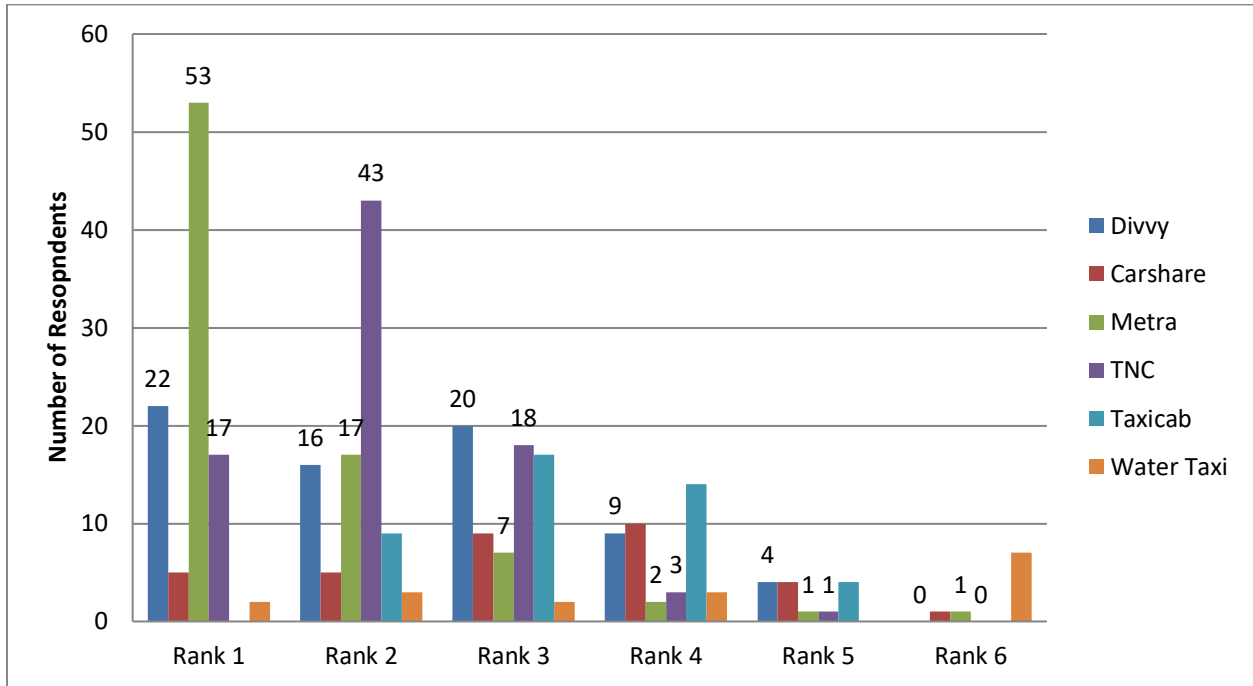
After getting all the preceding background information on companies, the survey finally asked respondents if they would be interested in a bundled mobility pass offered by the CTA. Figure 4-6 shows that the vast majority (84%) of respondent companies were interested in some sort of bundled pass. The 15% not interested in the bundle were then asked to state their reason for not being interested. They were often companies already in the Loop that stated that they already had a high transit and walk mode share and did not think this pass would benefit them from a TDM perspective.

Figure 4-6: Respondent Company Interest in Bundled Pass



Companies that responded “Yes” or “Maybe” to the prospect of a bundled pass were then asked to rank the modes they would like to see included in the pass. Figure 4-7 shows that respondents chose Metra as the top rank 1 option by far, with TNCs being the top second ranked option, followed by Divvy as the top third ranked option. Taxicabs were the fourth top ranked option, though the inclusion of TNCs might negate the need for taxi inclusion. There was also some interest in carsharing as being part of the mobility bundle, which theoretically might be easier to include in a bundled pass than other private mobility providers. Indeed, third-party benefits providers such as Edenred already have partnerships with carshare companies in their corporate benefits offerings indicating that there is some demand for it among companies.

Figure 4-7: Ranked Interest in Different Modes in Mobility Bundle



The way companies responded can be further examined to see if certain types of companies are more likely to be interested in a bundled pass. Figure 4-8 then shows that a bundled pass is more than twice as likely to receive a “Yes” response pass interest from larger (101-500 employees) companies (44%) as opposed to smaller companies. The ratio of “Yes” to “Maybe” responses was also much higher among these larger companies. This finding could be because larger companies have more costs and benefits that result from the way their employees commute to work (parking pressure, carbon footprint, payroll and corporate tax benefits, etc.). Thus, they are more likely to have an institutionalized way of dealing with TDM measures and have more capacity to try out a new measure such as the bundled pass. This further builds the argument for the CTA to target larger companies with the pass to ensure a greater chance of mutual interest. Figure 4-9 then shows interest in the pass idea by whether the respondent company provides or subsidizes parking. Companies that provide some parking are slightly more likely to be interested in the pass idea as compared to other companies, though this might be correlated with the fact that larger companies are more likely to provide parking and also more likely to offer institutionalized TDM measures.



Figure 4-8: Respondent Company Interest in Bundled Pass By Company Size

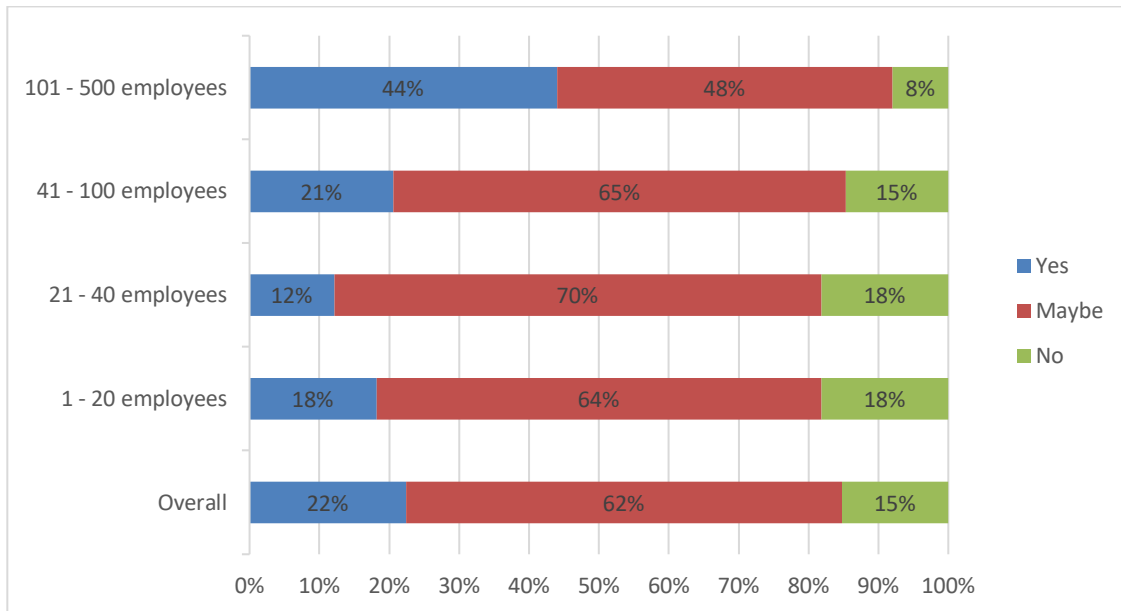
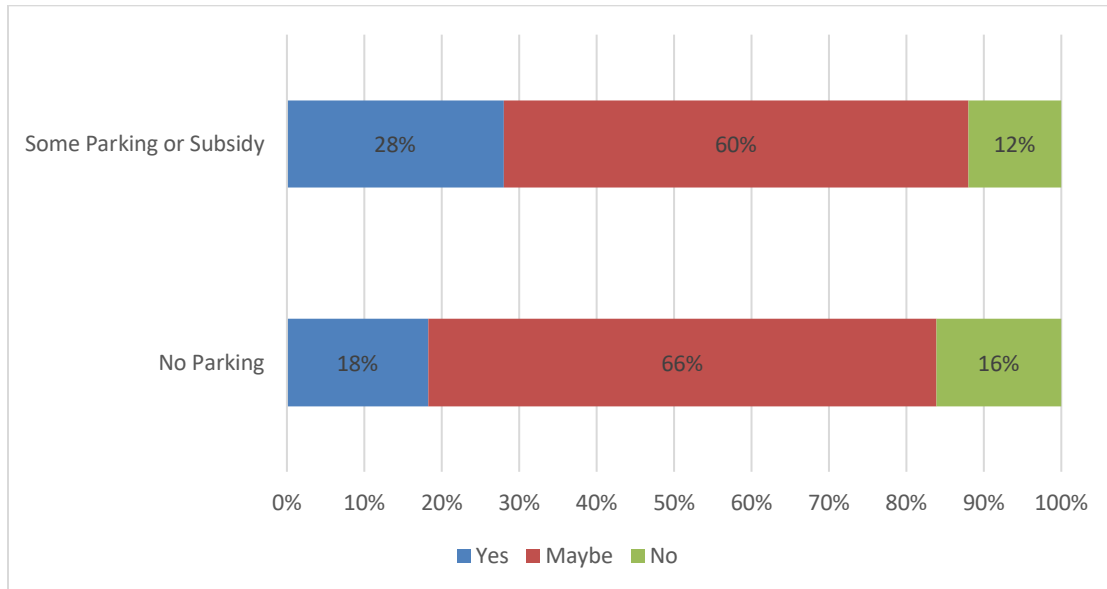


Figure 4-9: Respondent Company Interest in Bundled Pass by Whether Company Provides Parking Spaces or Subsidy



The employer survey results demonstrated interest in bundled pass products among respondent companies. Some insights from the survey are as follows:

- There are many companies where there is a high transit commute mode share but a lower than expected participation rate in pre-tax benefits or in purchases of the 30-day pass. Among these companies where the employees already have a transit-oriented lifestyle for

commuting, a bundled mobility pass can help achieve twin goals of more pre-tax benefits participation and more 30-day passes sold. These are goals for the CTA because they relieve pressure to keep fares low through a federal subsidy, and also anchor people into using transit on a deeper level. Greater participation in pre-tax benefits might lead to greater incidence of 30-day pass autoloads, and more purchases of the 30-day pass can lead to more non-commute trips with the CTA.

- The results showed that larger companies are more likely to exhibit interest in a bundled mobility pass. From the CTA's perspective, they would also be better targets because they present greater potential for gain for the agency.
- Metra, TNCs, and Divvy were the most popular modes of transport for inclusion in a mobility bundle. The interest in Metra is significant given that there already exists the Metra Link-up pass that users can purchase from Metra and yet there is an overwhelmingly high interest in it. This could be because people like the idea of CTA and Metra joining hands, and would like any mobility pass to be centered on the integration of these two modes. However, current demand for the CTA Metra Link-up is low, as only around 3000 such passes are sold each month by Metra as compared to the average 86,000 monthly passes it sells each month. The Link-up pass has restrictions of when it can be used and also has increased dramatically in price from \$39 in 2012 to \$55 today. Further, the Link-up pass can only be purchased if a Metra monthly pass has been bought, which can often be expensive and leaves out high Metra pay-per-use riders who would be willing to pay for a CTA pass as well. Finally, there might be low awareness about the existence of the Link-up pass.
- The interest in Divvy is also significant, as the mode is only feasible during appropriate biking weather and its use is limited by the rider's physical ability. Yet, there is high interest in the mode and it would also be an easy mode for the CTA to include in a pass given that the Divvy is owned by CDOT.

#### 4.4.3 Identifying Companies of Interest

From these results, companies were identified that would be ideal to pilot with using the following criteria:

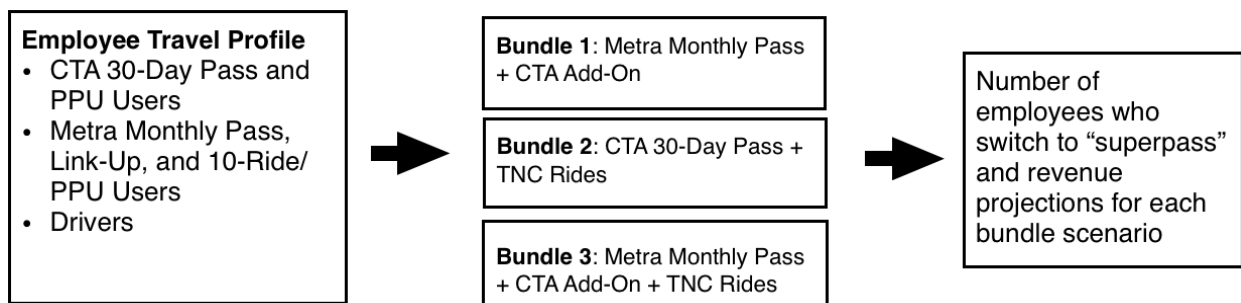
1. Interest in bundle: The first criteria, of course, was whether or not they responded with a "Yes" or "Maybe" when asked if they were interested in "providing its employees with a bundle that includes CTA use and other mobility options".
2. Public transit mode share: Then, companies were examined where the public transit mode share was already high, understanding the fact that if a company is in a suburban location without much transit access, an unlimited public transit pass would probably not be popular no matter how attractive we made it.
3. Percentage of employees reserving pre-tax income for commuting: If this value is high then it would be a smoother transition to the Superpass, and if it is low then that presents an opportunity to increase it.
4. Discrepancy between public transit mode share and percent of employees doing pre-tax benefits: Ideally, the CTA would want everyone using public transit to commute to enroll in pre-tax benefits, as the autoloading nature of it could make users more regular, or at least ensure more assured revenue to transit agencies.

5. Parking situation: Parking costs is a key incentive for companies to introduce TDM measures to reduce parking demand, and hence could engender their support for the Superpass. If a company currently owns or leases parking spots but feels there is a shortage, they would have an incentive to make more people use public transit, and if the company does not currently own parking but is thinking of purchasing parking in the future, then the public sector has an incentive to act to avoid that eventuality.
6. Breakdown of 30-day pass vs. PAYG use: If a high number of PAYG transit commuters is observed, this pass provides an opportunity to entice some of them to buy up into a 30-day pass, for all the societal benefits associated with increased pass sales as outlined in previous chapters.
7. Size of company: Finally, larger companies present a special opportunity for a potential pilot because that would give a more varied population and thus more insights into pass preferences and impacts, as the CTA considers whether the Superpass is a good option of city-wide rollout.

After applying the above criteria, five companies were selected as potential candidates. However, it is important to note that these surveys were filled out by a single individual at each company, and thus their results do not necessarily accurately reflect the ground reality or preferences of the employees at the company. Thus, more than these five companies were eventually targeted in further efforts with our “Employee” survey, as explained in the next chapter.

#### 4.5 Revenue Model

While in principle the idea of offering a mobility bundle to employees seemed amenable to the CTA, there were concerns on the revenue implications. The employer survey demonstrated the potential target markets for such a pass, but did not reveal much about how the math would work out for a given bundle. Thus, a revenue model was created that uses a series of assumptions to calculate a range for the number of a given pass expected to be bought, and by which types of employees. The revenue modeling exercise was important in identifying what unknowns exist when it comes to predicting user purchasing behavior for mobility bundles. The basic methodology was to take a company employee travel profile (and thus make assumptions about their spending on transportation), test how many of these employees would buy each of three different types of bundles using various assumptions and models, and thus calculate passes sold and revenue projections under different revenue sharing scenarios between the players involved: the CTA, Metra, and TNC operators. This methodology can be summarized as follows:



*Example: Rush University Medical Center*

The revenue model submitted to the CTA used the Rush University Medical Center as a case study. They had filled out the employer survey and thus basic modal split information on their estimated 9000 employees was available. Rush is also located close to two CTA rail lines and a frequent bus corridor and yet saw a 70% drive alone mode share, and thus was selected as a an example with great potential for increased CTA revenue.

#### 4.5.1 Employee Travel Profile

Employees were first divided into commuter-type segments by their primary mode and calculated how much each segment spends on the transportation modes offered in our bundle. This spending is then compared with the price of the offered bundles 1-3 that contain those same modes. Table 4-2 shows the employee mode share at Rush, as reported in the employer survey they completed.

Table 4-2: Rush University Medical Center Mode Split

<b>Mode</b>	<b>Total Employees</b>	<b>Total %</b>
<b>Drive Alone</b>	6,300	70%
<b>CTA Overall</b>	1,350	15%
<b>Metra</b>	450	5%
<b>Pace</b>	450	5%
<b>Bike<sup>5</sup></b>	90	1%
<b>Walk<sup>1</sup></b>	90	1%
<b>Carpool/Vanpool<sup>6</sup></b>	90	1%
<b>TNC/Taxi<sup>1</sup></b>	90	1%
<b>Other</b>	90	1%
<b>Total Employees</b>	9000	100%

*Source: Survey completed by Rush transportation benefits manager*

From this, the fare product breakdown of the CTA and Metra commuters was then assumed to follow the breakdown observed in the general population, and thus their spending on public transportation could be estimated. Assumptions were made regarding the number of TNC rides each user segment probably takes. This was done by dividing the users into urban and suburban residents, and used results of a 2017 CTA rider survey to assume TNC use of urban residents, and findings of Clewlow and Mishra (2017) to assume suburban TNC use. Drivers were divided into probable urban and suburban residents, and accordingly assumptions were made about their TNC, CTA, and Metra spending. Thus, having made estimates regarding each commuter group's spending on the CTA, Metra, and TNCs, their spending habits could be compared with each of three proposed bundles.

#### 4.5.2 Bundles to Test on each Commuter Group

<sup>5</sup> Those who primarily bike, walk, or take TNC/Taxi to work are unlikely to purchase a public transit pass product, let alone a Superpass, and are also left out.

<sup>6</sup> Those who carpool/vanpool are likely to behave similarly as those who Drive Alone (and might be even more likely to purchase the pass), but given that they were such a small group they have been left out to be conservative.

The following three bundles were used in the model to forecast revenue and sales implications of different configurations of a Superpass.

1. **Bundle 1: CTA + Metra.** This is a cheaper Link-Up pass except without the current time restrictions, which is currently priced at \$55 for a CTA 30-day pass add-on to an existing Metra monthly pass. It is tested at \$15 as an add-on to any Metra monthly pass, but also conduct a sensitivity analysis increasing this price up to \$55.
2. **Bundle 2: CTA + TNC.** Includes an unlimited CTA 30-day pass and some shared TNC rides (UberPOOL/LyftLine) that are up to 5 miles in trip distance. For now, the bundle that is tested includes 10 such rides, and the pass is priced at \$135.
3. **Bundle 3: CTA + Metra + TNC.** This pass would include the CTA pass add-on to a Metra monthly pass for \$15, and an additional 10 shared TNC rides. Thus, it would amount to \$45 on top of an existing Metra monthly zone pass.

#### 4.5.3 Estimating Superpass Purchases by Each Commuter Group

Once establishing how different employees travel and spend on travel and have decided on bundle offerings, the number of commuters who might purchase the new Superpass was calculated and calculated the aggregate revenue implications. The number of people who switch from their current discrete spending on individual modes to spending on a pass was estimated using a variety of estimation methods depending on the case, which are summarized in Table 4-3 and explained in further detail below.

Table 4-3: Methods Used to Calculate Switching to Superpass for Different Commuter Groups

User Group	Method for Calculating Switch		
	Switch under Bundle 1: CTA + Metra	Switch under Bundle 2: CTA + TNC	Switch under Bundle 3: CTA + Metra + TNC
<b>CTA 30-day pass users</b>	Zero switch	Pass Choice Model	Zero switch
<b>CTA PPU users</b>	Zero switch	PPU Choice Model	Zero switch
<b>Metra Monthly Pass (no Link-Up) users</b>	Pass Choice Model	Zero switch	Pass Choice Model
<b>Metra Link-Up users</b>	All switch	Zero switch	Pass Choice Model
<b>Metra 10-ride users</b>	PPU Choice Model	Zero switch	PPU Choice Model
<b>Drive Alone Commuters</b>	Cross-price elasticity	Cross-price elasticity	Cross-price elasticity

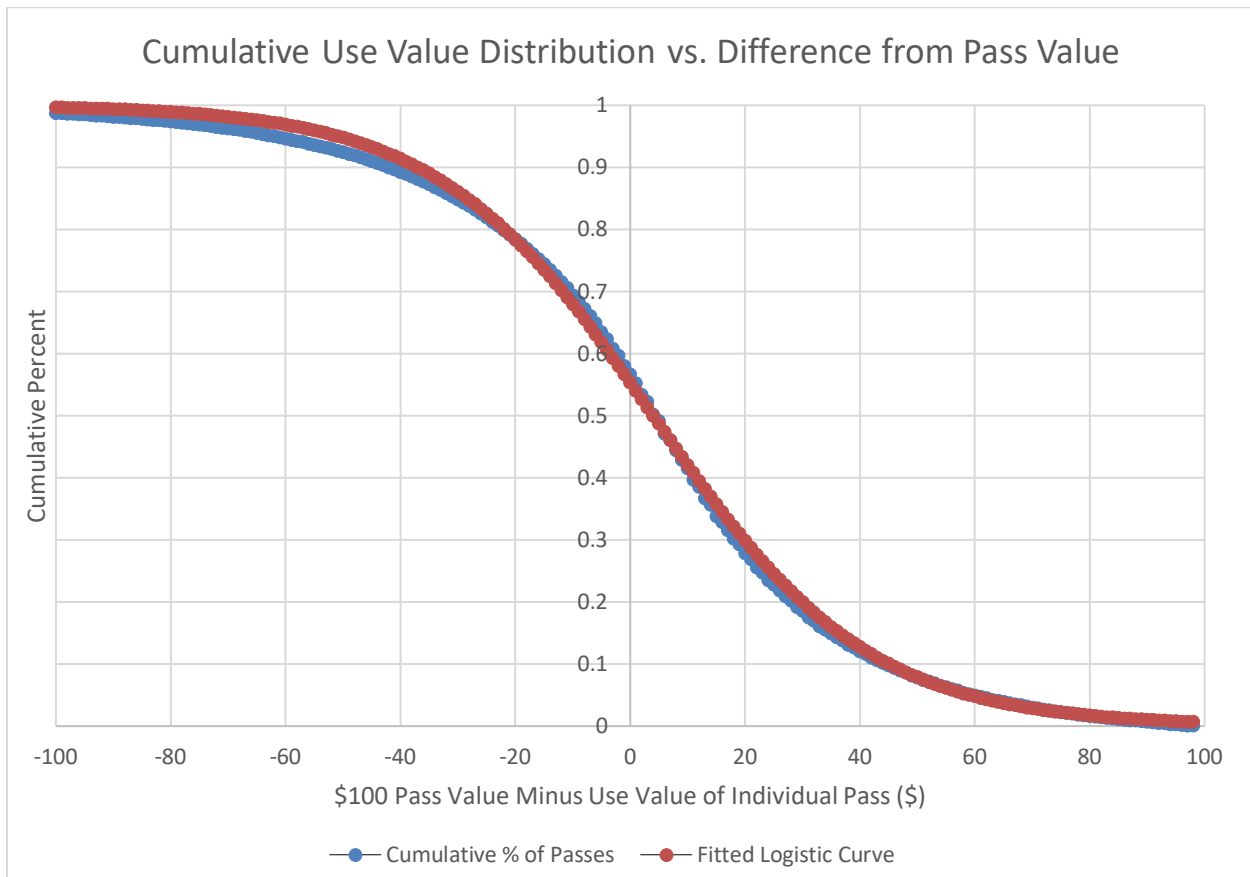
In Table 4-3, zero switch, all switch, pass choice model, PPU choice model, and cross price elasticity are referenced, and each of these will now be discussed.

Zero Switch: A zero new purchase rate was assumed for certain user groups and certain passes. This was assumed when the user group probably did not use the modes offered in the bundle enough for a pass to be worth it. For example, CTA users who would never use Metra would have no reason to purchase Bundles 1 or 3 which are offered on top of a Metra full price pass. Similarly, many Metra users would not purchase bundle 2 which is a full price CTA pass with TNCs, when they could just buy a less expensive Link-Up pass to gain access to the CTA.

All Switch: This was assumed for Metra Link-Up users under the bundle 1 scenario, because bundle 1 is effectively a cheaper Link-Up pass.

Pass Choice Model: Using data from the general population’s current spending behavior of CTA 30-day passes shown in Figure 4-10, it was clear that many people still purchase pass products even though they might spend less than the value of the pass on rides. This behavior was modeled and applied to commuters who currently held a CTA or Metra monthly pass, as they are assumed to behave like other pass holders. The data used was the use-value distribution of the CTA 30-day passes in October of 2016 and is shown below, with a transformation done on the x-axis to indicate the difference between the customer’s use value of their pass and the actual value of the 30-day pass (\$100 for the time during which the data were assembled).

Figure 4-10: Cumulative Use Value Distribution vs. Difference from Pass Value for CTA Rider Population



The red curve is a fitted logistic curve, the equation of which was then applied to CTA and Metra pass holders at Rush. This graph was interpreted as providing information on how likely it was for an individual who had a 30-day pass to be using it more or less than its value, and by how much. This was used to estimate their likelihood of purchasing an add-on to their 30-day pass based on how much the pass would cost versus how much they currently spend on the modes included in the pass. To model the relationship shown in this graph, the following logistic curve equation was used:

$$y = \frac{1}{1 + \alpha^{x - \kappa - C}}$$

where y is the percent of users expected to be holding a pass at a certain difference between their use value and the price of a pass;

$\alpha$  is the factor used for the fitted logistic curve, and  $\alpha = 1.055$ ;

x is the difference between an individual's transportation spending and a pass price (pass price minus use value);

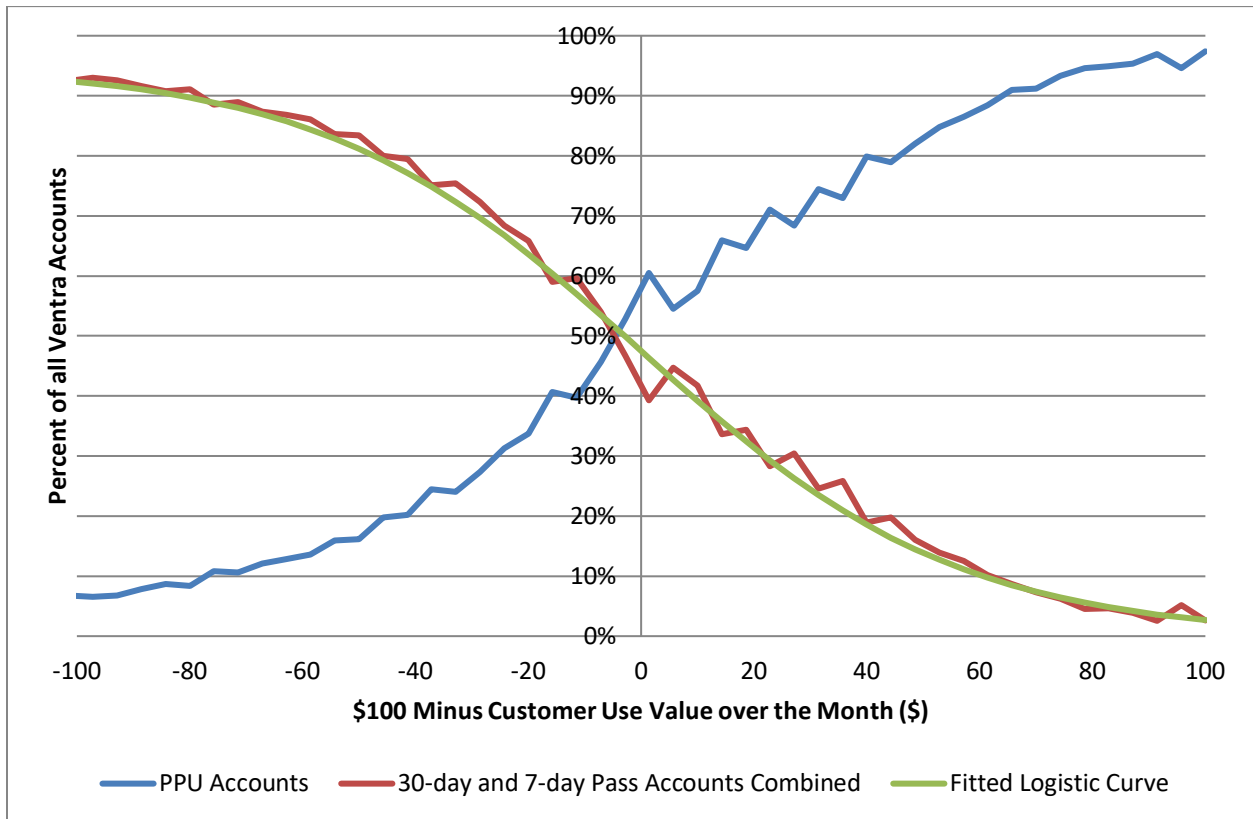
$\kappa$  is a variable to represent increased or reduced value a user might extract from a pass product (i.e., convenience of a pass);

and C is a constant applied to shift the curve to better fit the data, and equals 4.

This equation was used with the input for x being the difference between a commuter's estimated spending on the modes included in each bundled Superpass and the proposed Superpass price. One could also think of it as providing insight into what percent of pass holders are willing to pay for a pass even if they use it for less than the pass' price. The distribution that is seen in the graph is indicative of the fact that pass holders value the convenience of holding a pass differently, and this distribution was applied to Metra Monthly pass holders in Bundles 1 and 3, and to CTA 30-day pass holders in Bundle 2..

PPU (Pay Per Use) Choice Model: A graph was created that shows all users' Ventra account use value and the percent of these travelers using different fare products at each use value. This graph was used to estimate for a certain use value versus the cost of pass product, what was the user's likelihood of using a pass or a pay-per-use fare product. Similar to what was done with the pass choice model, the x-axis was transformed to make it show the difference between an individual's use value and the value of a pass product (in this case the \$100 30-day CTA pass). This was used to determine—for a certain difference between an individual's spending and the price of a pass—how likely they would be to use a pass versus a PPU fare product. The graph is shown in Figure 4-11.

Figure 4-11: Distribution of CTA Pass and PPU Accounts by Difference in Use Value from Pass Price (Oct 2016 CTA Ventra Data)



The following piecewise function was used to model the above graph to calculate propensities to purchase a pass:

$$y = \frac{0.95}{1 + \alpha^{x - \kappa}}$$

where  $y$  is the percent of users expected to be using a pass at a certain use value versus their pass price;

$\alpha$  is the factor used for the fitted logistic curve, and  $\alpha = 1.036$ ;

$x$  is the difference between an individual's transportation spending and a pass price (pass price minus use value);

and  $\kappa$  is a variable to represent increased or reduced value a user might extract from a pass product (i.e., convenience of a pass).

This method was applied to Metra 10-ride users in Bundles 1 and 3, and to CTA PPU users in Bundle 2.

Cross Price Elasticity: Cross-price elasticities were used to estimate how many drivers would buy the Superpass by using cross-price elasticities of car use/ownership and transit fares as a proxy. Using these price elasticities, one can estimate what percent of drivers would switch to the pass



with a 1% decrease in the price as compared to the current retail price of the pass components. Studies have shown that car ownership with respect to the cost of public transit has a cross-elasticity of 0.1 to 0.3. Dargay and Hanly (1999)<sup>7</sup> showed that car use with respect to public transit cost was 0.3. A CTA study<sup>8</sup> also showed that bus and rail in the peak hour have a ridership price elasticity of -0.3 and -0.1, respectively. All of these elasticities appear to range between 0.1 and 0.3. Keeping in mind that for this pilot we are largely concerned with short-term impacts, the lower end of this range was used to estimate the elasticity of driving to work with respect to the discounts offered through the Superpass. These are shown in Table 4-4, Table 4-5, and Table 4-6. A higher elasticity was assumed for those residing in the closer-in Metra Zones A and B, as it is posited that they would be more likely to shift away from car use than someone living in the far suburban Zone H. A larger elasticity was also estimated for those who use TNCs frequently, as they would be more likely to avail themselves of the discount and purchase a Superpass. The Bundle 3 elasticities were adjusted based on Bundle 1 to reflect the fact that those living in outer zones were less likely to use TNCs for their travel and thus less likely to purchase the Bundle 3 Superpass as compared to Bundle 1. The more conservative elasticities have been assumed given that 70% of Rush employees drive to work, and so slight adjustments in these values would have a relatively large impact on revenue projections.

Table 4-4: Assumed Driving Cross-Price Elasticity with Pass Price by Metra Fare Zone Residence (CTA + Metra Bundle)

	A-A	A-B	A-C	A-D	A-E	A-F	A-G	A-H
<b>Cross-price elasticity (% driving mode shift from 1% decrease in Link-Up price)</b>	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1

The cross-price elasticity was applied to the percent change in price between the current Link-Up pass price and the new Superpass.

Table 4-5: Cross Price Elasticity of Driving with Respect to Pass Price by Number of TNC rides Taken Per Month (CTA + TNC Bundle)

	Number of TNC Rides						
	0.0	0.5	1.0	2.5	4.0	10.0	25.0
<b>Cross-price elasticity (% driving mode shift from 1% decrease in Superpass price vis a vis retail price of CTA + up to 10 TNC rides)</b>	-0.10	-0.10	-0.10	-0.10	-0.10	-0.20	-0.20

The cross-price elasticity rates were applied to the percent difference between the Superpass price and the retail price of a CTA pass and the number of TNC rides the individual uses (for those using

<sup>7</sup> Joyce Dargay and Mark Hanly (1999), Bus Fare Elasticities. ESRC Transport Studies Unit, University College London

<sup>8</sup> Litman, Todd. (2004). Transit Price Elasticities and Cross - Elasticities. Journal of Public Transportation. 7. 10.5038/2375-0901.7.2.3. Page 9.

over 10 rides a month, the Superpass price was only compared to how much they spend on the first 10 TNC rides).

Table 4-6: Driving Cross Price Elasticity with Respect to Pass Price by Metra Fare Zone Residence (CTA + Metra + TNC Bundle)

	A-A	A-B	A-C	A-D	A-E	A-F	A-G	A-H
<b>Cross-price elasticity (% mode shift from 1% decrease in Superpass price vis a vis retail price of Link-Up + 10 TNC rides)</b>	-0.20	-0.20	-0.10	-0.05	-0.05	-0.05	-0.05	-0.05

The cross-price elasticity rates were applied to the percent difference between the Superpass price and the retail price of a CTA pass, a Metra zone pass, and 10 TNC rides (given that the Superpass we tested has 10 rides in it).

#### 4.5.4 Results

The net monthly revenue impact figures for a hypothetical Superpass to be offered to Rush IMD employees are presented in Table 4-7 and represent the sum of the CTA, Metra and TNC (if applicable) revenue. This includes revenue lost from transit users substituting pay-per-use fare products for the Superpass, revenue gained from transit users switching into the superpass, and revenue gained from drivers purchasing the Superpass. For TNCs, it includes revenue from new pass ride purchases (\$3 per trip initially assumed), revenue lost from the discount applied to existing TNC rides taken by users (also \$3 per trip for up to 10 rides assuming a \$6 retail price), and for now ignores additional revenue from an induced demand effect (i.e., additional “full cost” new TNC rides purchased beyond the number included in the Superpass that the user was not purchasing before).

Table 4-7: Revenue and Pass Sale Implications of Different Bundle Configurations

	<b>Bundle 1: CTA + Metra</b>	<b>Bundle 2: CTA + TNC</b>	<b>Bundle 3: CTA + Metra + TNC</b>
<b>Overall Revenue Implications</b>	+\$21,443	+\$7,412	+\$23,490
<b>CTA Revenue</b>	+ \$418 for CTA	+ \$5,791 for CTA	- \$17 for CTA
<b>Metra Revenue</b>	+ \$21,025 for Metra	N/A	+ \$19,605 for Metra
<b>TNC Revenue</b>	N/A	+ \$1,620 for TNC	+ \$3,902 for TNC
<b>Pass Sales Implications</b>	+323 Net increase in CTA passes (58% increase)	+181 Net increase in CTA passes (34% increase)	+145 Net increase in CTA passes (26% increase)

In Bundles 1 and 2 we see that the CTA has an overall positive net revenue, and in Bundle 3 it is just about revenue neutral. Metra stands to gain a lot from this Superpass, as indeed almost all the revenue gains are to the commuter rail agency. These estimates assume no revenue sharing and are calculated solely based on the change in revenue from the operator’s fare product sales, but it is expected that in the implementation of the Superpass there would be a new revenue sharing agreement between the two transit agencies. In any case, the revenue numbers for the CTA when

compared to the amount of money the agency likely currently earns from the 9000 employees at Rush Medical Center is insignificant. However, there is a large percent increase in the number of 30-day passes purchased by the employees, and this suggests that the Superpass will generate significant new CTA ridership independent of whether or not Metra revenue sharing is negotiated. For Bundle 1, the percent increase over the current number of 30-day pass holders is 58%, for Bundle 2 it is 34%, and for Bundle 3 it is a 26% increase.

Overall, Bundle 3 is estimated to generate the most absolute revenue at about \$23,490 additional revenue per month, to be shared among the CTA, Metra, and the TNC operator. Without revenue sharing, the CTA would gain the most in Bundle 2 where it must simply share revenue with the TNC operator, but the absolute revenue generated from the Superpass is the lowest out of the 3 scenarios. \$15 was used as the CTA add on price in Bundles 1 and 3 because it resulted in the most number of passes being sold. Though the CTA could earn slightly more revenue if they had the add-on price higher at around \$20 or \$30, the added revenue would be very small compared to the benefits of greater pass sales and increased ridership.

Most of the revenue in Bundles 1 and 3 comes from drivers purchasing the Superpass, which carries with it the added benefit of a likely mode shift. While more revenue is earned from the drivers switching to the Superpass, in Bundles 1 and 2 there is a greater increase in new 30-day CTA passes sold among transit users than among drivers. Transit users are substituting their pay-per-use travel for a pass given the new discounts that are offered to them through the Superpass. However, this does not generate much increase in revenue because these users are replacing some of their existing pay-per-use transit spending for the Superpass.

Finally, *pre-tax discounts on these passes were not included in the calculations*, because it is assumed that employees already have access to this option and we do not know how many are taking advantage of it. Further, the estimated 5% Pace mode share was not included because they would likely behave like CTA users, who are estimated to have a zero shift in Bundles 1 and 3. PlusBus users would buy Bundle 1, especially if the CTA add-on price falls below \$30, but they likely make up just 1% of Metra users and would not have an impact on the numbers. Finally, these results are only for Rush University Medical Center, which only represents a fraction of all commuters in the Chicago region. Further, given that it is a hospital, the workers likely have irregular hours outside of traditional commute times for which public transit has been optimized. Thus, it is likely that a bundled pass that has on-demand rides as a component are more appealing to these sorts of workers who need to travel late at night than other types of commuters. Thus, the results of this revenue model should be qualified by the fact that they are only for one type of employment establishment that exists in a certain geographic context, and to get generalizable results for a wider range of employers and employees would require a more robust data collection and analysis effort. Data collection could be in the form of stated preference surveys, but to avoid the inherent error involved with survey-based data, an experimental pilot can be launched where user pass purchasing behavior is monitored and linked to their current spending, residence location, and sociodemographic and socioeconomic indicators.

## 4.6 Summary and Findings

This chapter first introduced the idea and rationale behind targeting employers with a bundled mobility pass and then went on to present selected literature on employer-based TDM initiatives in the United States. The chapter then gave an overview of the current situation with CTA-employer engagement, and the basic results of an employer survey we launched in 2017 with 143 employers in Chicago. Finally, the chapter presented the findings of a revenue model that used reasoned assumptions to predict the pass sales and revenue implications of trying various Superpass configurations on a particular employer.

The revenue model found that if discounts are offered when different modes are combined into a single fare product, revenue can be gained from commuters, though much of this gain is for Metra as more monthly Metra passes are sold. More importantly, however, hundreds of additional commuters can be brought into the CTA 30-day pass, which carries with it benefits beyond revenue, including significant ridership gains. Another key takeaway from this model is that for Bundles 1 and 3, integrating CTA and Metra monthly passes (through a reduced Link-Up price) produces significant overall revenue gains. Thus, the CTA must consider offering such integrated pass products with a revenue sharing agreement with Metra.

The fact that the revenue impact for the CTA appears small or even negative should not deter the agency from embarking on pilot experiments with new fare products that integrate additional modes. Introducing attractive fare products can be a way of bringing together partners who want a share of the new revenue, which can pave the way for future collaborations that can result in a more seamless transportation experience for Chicagoans. These joint bundles touch upon untapped potential revenue that should be taken advantage of by public transit authorities before private players get further involved.

The revenue model used conservative assumptions in the absence of more detailed data. For example, it assumed no contribution from the employer nor did it take into account the pre-tax tax relief, which would reduce the cost of the pass seen by employees further inducing more purchases. One can imagine a scenario where the CTA matches a discount on the pass in return for a contribution by the employer which would further reduce the cost of the pass for employees. Of course, models would need to be run in which the CTA estimates how much of the surplus it gets from people overpaying for passes it can afford to give up in return for the inducement of more pass users and thus more ridership.

To improve on the assumptions made in the model, we proposed to the CTA that a more detailed survey be conducted on individual employees of companies. We proposed using stated preference questions to get at more individualized preference information so that we could minimize the number of assumptions made. An overview of how the stated preference survey would improve on the revenue model is given in Table 4-8.

Table 4-8: Benefits of Stated Preference Survey as Compared to Assumption-Based Revenue Model

<b>Revenue Model</b>	<b>Stated Preference Survey</b>
<b>1. Assumes modal split based on survey filled out by transportation benefits manager</b>	1. Asks the employee directly what modes they take and how frequently
<b>2. Assumes average spending on transportation modes and bases switch on that</b>	2. Asks the employee directly how much they spend on transport, can also calculate based on 1)
<b>3. Assumes switch to Superpass based on how overall Chicago population currently uses fare products</b>	3. Collects choice data from conjoint analysis questions where hypothetical bundles are presented. Can calculate relative preferences for different attributes and levels, and also predict market for a given bundle
<b>4. Only tests for 10 TNC ride package and doesn't include Divvy</b>	4. Includes Divvy, and varies the number of TNC rides offered, can include wider range of hypothetical scenarios in SP

The next chapter discusses in detail the employee stated preference survey that was distributed via employers to various employees throughout the CTA service area and the results of that effort.

## Chapter 5 Bundled Mobility Pass Choice Model

This chapter discusses the results of a survey launched to employees of companies in the Chicago area and uses them to create a choice model. While the previous chapter discussed the outreach to employers and their positive response to the Superpass concept, more specific information was needed on employee preferences towards passes to inform the CTA's future actions regarding the specific composition of a Superpass. The survey questionnaire can be found in Appendix A. Specifically, this chapter:

1. Presents an overview of the design of the employee survey launched in Chicago;
2. Reports general results of the survey;
3. Details the methodology used to model those results; and
4. Reports the results of the model created;

### 5.1 Employee Survey Overview

A survey was developed and launched to employees of various companies in the Chicagoland region. Response collection began in December 2018 and continued until April 2019. During this time, 1467 complete individual responses were registered (though 1277 were eventually used for model training and 133 for model testing). A total of 115 unique companies provided responses during this period. The survey took about 10 minutes to complete. It was launched through three main avenues:

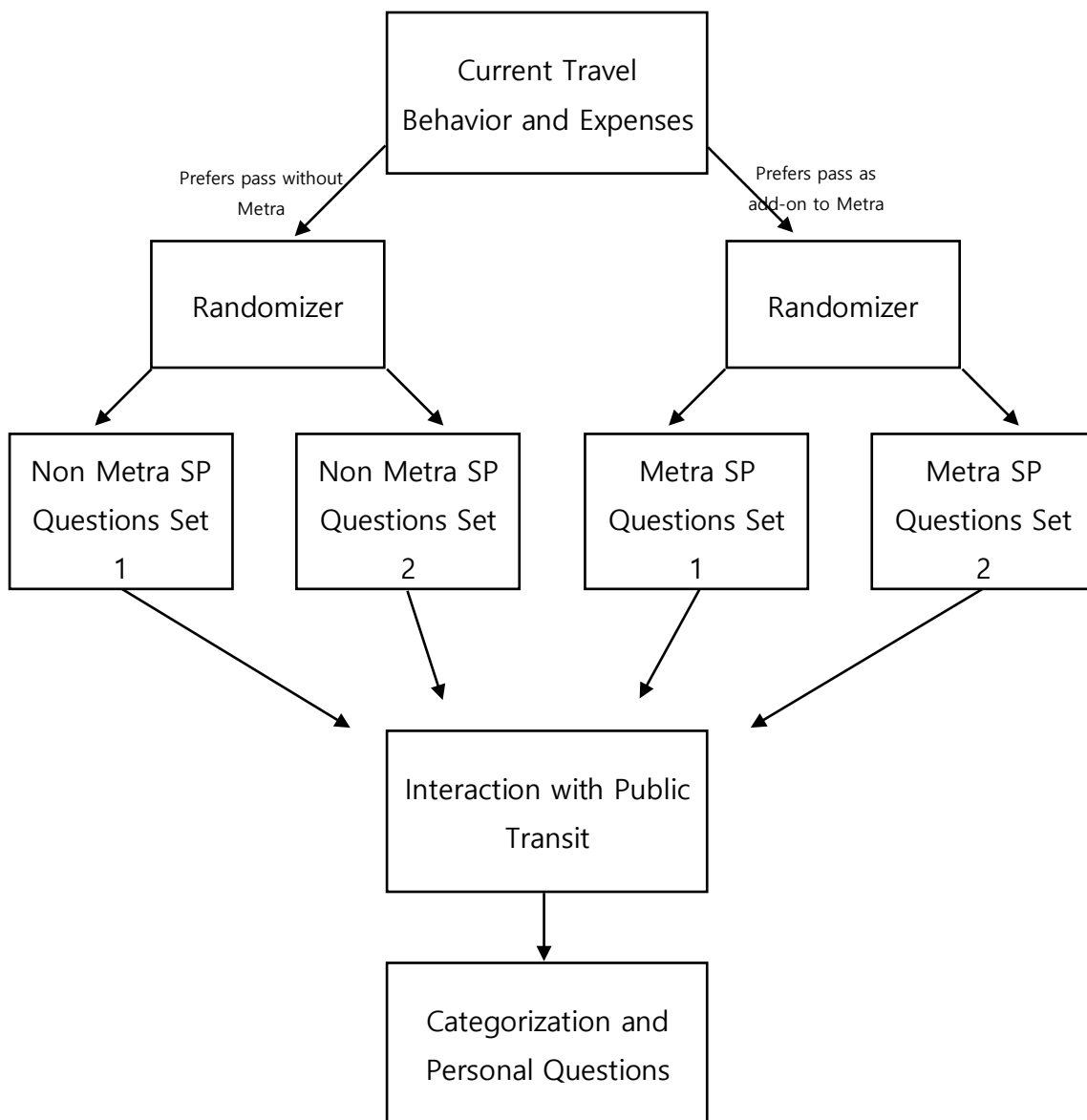
- 1) Cold emailing the companies in the CTA's Ventra database: The CTA's Ventra database contains contact information of companies that coordinated the loading of their employees' Ventra accounts with the CTA. These companies likely offered the Federal pre-tax transportation benefit to their employees.
- 2) Emailing companies with whom CTA employees have a personal connection: Certain companies were directly emailed by the CTA where there is an existing relationship and the likelihood of the contact passing on the survey was higher.
- 3) Dissemination through contacts of the Metropolitan Planning Council (MPC): The MPC provided some support in survey outreach by forwarding the survey to companies with

whom they worked with in their recent employer outreach efforts. They also forwarded the survey to a transportation management association (TMA), who then forwarded the survey to some of their member companies. They also helped launch the survey to a major university in Chicago.

### 5.1.1 Survey Flow

The survey had four main sections: current travel behavior and expenses, stated preference questions, respondent interaction with public transit, and finally, categorization and personal questions. Figure 5-1 shows the survey flow. The full survey can be found in Appendix A.

Figure 5-1: Survey Flow of Employee Superpass Survey



After a respondent completed the travel behavior and expenses section, they were asked to indicate which type of hypothetical pass they would prefer—one that included a CTA 30-day pass plus add-ons, or one that that was an add-on to an existing Metra monthly pass. This determined the types of stated preference questions the respondent saw, as the “non-Metra” passes were based on the \$105 CTA 30-day pass plus add-ons, and the “Metra add-on” passes were based on the \$55 CTA Metra Linkup pass plus add-ons. The Non-Metra and Metra branches each had two sets of stated preference questions that varied in pass features and, importantly, in the prices of options, in order to add variability and robustness to the data, but a given respondent only saw one of these sets. The set they saw was determined by built-in randomizer. After completing the stated preference branch, which comprised of six stated preference experiments and some follow-up questions, all respondents were directed to the “Interaction with Public Transit” section and then onward to the “Categorization and Personal Questions” section.

### 5.1.2 Overview of Survey Questions

A concerted effort was made to keep the survey as short as possible and for each question to give useful information. The survey was also designed so that it could be launched to any employer in Chicago and be understandable. Some questions were added during the response collection period as improvements were identified from initial responses. Table 5-1 presents a detailed outline of the survey questions and the information learned from the question for modeling purposes.

Table 5-1: Overview of Employee Superpass Survey

<b>Question in Survey</b>	<b>Importance of Question</b>
<b>Company Name</b>	Can group error by employer
<b>Typical Commute mode</b>	To see whether current commute mode impacts bundle preferences, and can see if non-PT commuters can be brought into a pass product.
<b>If PT selected: which PT service?</b>	To identify the split between CTA and Metra users
<b>Metra Fare Zone</b>	To see how interest in the Metra add-on pass varies by the Metra zone the respondent travels in
<b>Commute to/from work last 3 days</b>	To see degree of multimodality of the respondent
<b>Modes used in last 3 months</b>	Filtering question so they only see questions related to these modes going forward in which they fill out their spending and frequency of use information for each mode.
<b>Whether Divvy used during warmer months</b>	This was asked keeping in mind that the survey was administered during winter months in Chicago, and so there would likely be a negative skew towards Divvy. It was used to help identify if the respondent is a Divvy user at all.
<b>Frequency of use for each mode</b>	Useful for seeing how heavy of a user they are of different modes and relating that to their Superpass preference.



<b>Money per month spent on each mode</b>	Relates current spending on each mode to price preferences for the pass, and can capture the angle of cost savings from integrated pass for high spenders. Question asked as drop-down ranges for each mode.
<b>Overall monthly spending on transportation in Chicago</b>	Asked to check the accuracy of the previous question, and to ascertain whether any major spending option had been omitted. This value superseded the sum of the spending on each mode indicated in previous question because those were ranges. If the respondent indicated that they spend more than \$300, which was the highest value they could select in this question, then their total spending per month was calculated using the sum of their spending on each mode obtained from the previous question.
<b>Number of CTA rides taken per month</b>	Useful for calculating the consumer or producer surplus by comparing the use value of CTA rides and the value of the pass product the individual might use.
<b>Percent of CTA rides on rail vs. bus</b>	Used for calculating use value of CTA rides which was used to get more accurate spending information on the CTA. This was eventually used as a more accurate value in the overall spending variable than the spending range they selected earlier. This question was added later after the survey was launched and so this information was not collected for the full sample.
<b>Number of TNC rides taken per month</b>	Used in the “Current” travel option, or the choice the respondent makes when they choose neither of the offered passes.
<b>What fraction are shared?</b>	Used to see if this might affect propensity to accept shared TNC rides in the Superpass, given that only shared rides were offered in the pass.
<b>Spending on TNCs per month</b>	Asked to get a more exact estimate on TNC spending as compared to earlier spending question that asked a range.
<b>General TNC trip purposes</b>	To get a profile of the TNC use cases that might be fulfilled by the TNCs offered in the pass.
<b>How many Divvy rides do you take per month</b>	Used to relate current Divvy usage to propensity to purchase a Superpass.
<b>Have you purchased a Divvy annual pass?</b>	Used to see impact of currently holding a Divvy pass on probability of purchasing a Superpass with Divvy included.
<b>Spending on Divvy per month</b>	Used for similar reasons as stated above.
<b>Are you comfortable riding bicycle?</b>	Possible explanatory variable for their preferences of having Divvy in the bundle.
<b>Household vehicle ownership</b>	Useful to capture because a goal of MaaS is whether it can reduce vehicle ownership, thus looking at the preferences of vehicle owners is important.

<b>Miles driven per month</b>	Could be a useful explanatory variable to interact with car ownership, and it also acts as a “before” travel behavior benchmark to compare to their travel behavior after the launch of the Superpass if a pilot is conducted. This would be to see if the Superpass has any impact on changing personal vehicle use.
<b>SP Questions</b>	Captures how varying price points, number of TNC rides, and inclusion of Divvy impact probability of selecting a Superpass.
<b>Reasons for lack of interest in Superpass</b>	Asked if the respondent did not select any of the 6 SP questions they saw in order to get a better idea for the lack of interest, and whether a different Superpass configuration might have changed their mind.
<b>If such Superpasses were offered, would you be more likely to purchase monthly transit pass?</b>	Useful to see the qualitative impact of the introduction of the Superpass.
<b>What other modes would you like to see bundled in the pass?</b>	Asked to see if there was interest in carsharing and scooters being included, or if any other mode was mentioned.
<b>Ventra card ownership</b>	Could be a variable to consider if the Superpass will first be targeted towards current Ventra card holders, especially those who use the CTA quite a bit but do not buy a pass.
<b>Which CTA fare product purchased</b>	To see the breakdown in interest by whether the respondent is an existing pass product holder or a pay-per-use rider. A key target of the Superpass are PPU people.
<b>Which fare product did you purchase 1 year ago?</b>	To see if they used to use a pass product but then switched to pay-per-use, as a goal of the Superpass is to bring these people back into a pass product.
<b>How many times have you purchased 30 day pass in the last 6 months?</b>	To see if they are a regular pass user or sometimes buy the pass but not always – we want to target these people to bring more regularity to their pass purchase through the Superpass.
<b>Metra fare product</b>	To distinguish Metra users as those with a pass might be more likely to purchase an add-on Superpass.
<b>Do you reserve pre-tax income for commuting purposes?</b>	Important as we want see link between participation in the pre-tax benefits program and Superpass preferences. We would want to target people who are not participating even though they have the option to.
<b>How much pre-tax money do you reserve?</b>	To get another idea of transportation spending and degree of participation in pre-tax benefits.
<b>Do you own a smartphone?</b>	Important to know because any sort of Superpass or MaaS administration and use of TNCs would be through smartphone.
<b>Have you downloaded Ventra app?</b>	Important as Superpass administration would likely be through the Ventra app, and so knowing who already has it might be of interest.

<b>Have you heard about trip planning apps</b>	Want to see if knowledge of such apps impacts their likelihood of being interested in the Superpass. These apps can be a precursor for the emergence of MaaS services.
<b>Age</b>	Sociodemographic explanatory variable
<b>Gender</b>	Sociodemographic explanatory variable
<b>Street intersection near home</b>	Can use this to generate in post-processing: location in urban or suburban area, transit availability near them, land use around them, trip attributes for them to reach work by various modes, if TNC as a mode for first/last mile would even be plausible or useful (is nearest transit less than 5 miles from them, assuming that the TNC rides in the Superpass are limited to a 5 mile trip length).
<b>How close is your home to nearest public transit stop</b>	Useful to see how easy it is for them to use transit as part of their daily mobility and whether they have a first mile connectivity issue.
<b>Number of people living in dwelling unit with whom you share income</b>	Question to see “wealth” of house by dividing household income by people it is shared with.
<b>How many below 16</b>	To see the impact of having dependent children on travel and pass preferences.
<b>Combined household income</b>	Sociodemographic explanatory variable

### 5.1.3 Stated Preference Design

Stated preference (SP) questions were used to ascertain respondent preferences towards bundled mobility passes. SP questions are necessary in this situation because we wish to learn preferences towards a concept that does not yet exist in the study population, and so “revealed” preference data cannot be used. There are several approaches that could have been taken for the SP questions. When respondents are offered hypothetical options, they can “state” their preference by selecting a single choice of their preferred alternative, ranking alternatives in relative preference to each other, rate alternatives on some scale, or select the best and worst alternative in their opinion. Ben-Akiva and Gershensfeld (1998) conducted a similar survey on preferences towards telephone subscription add-on plans and employ a menu SP design approach where respondent select the attributes with prices that they would want to include in their subscription. They argue that this is a better design because it more accurately mimics how people make choices with subscriptions in the real world. However, the employee survey used choice-based conjoint (CBC) analysis in the SP questions. Conjoint analysis is widely used in market research to determine consumer preferences, attitudes, and willingness to pay for attributes to help companies develop optimal product offerings. It involves presenting a series of menus of the same product that have varying attributes and prices, and asks respondents to select their most desired choice or “none of the above” if they do not like any of the choices. By varying the attributes and obtaining preferences, the relative importance of each attribute to each other and the change in utility consumers get from changing levels of those attributes can be ascertained (Ben-Akiva et al., 2019). For example, for a company trying to determine what computer it should build and at what sale price, it could conduct a conjoint analysis varying the battery life, screen resolution, hard drive memory, and price in the conjoint questions. Then, after consolidating all the different choices relative to different the

compositions of the products chosen, detailed consumer preferences can be known. Discrete choice analysis can be used to extract such information from CBC choices, as is discussed later in the modeling methodology section.

Conjoint analysis was chosen over the menu approach in the employee survey for several reasons. First, the Superpass proposed here only has 3 varying attributes (Divvy inclusion, number of TNC rides, and price) compared to the 12 attributes in Ben-Akiva and Gershfeld (1998). This makes conjoint more plausible. Second, we did not want to allow respondents to pick and choose the attributes they would want included in the Superpass, as that might inhibit our ability to estimate the impact of including other modes in an integrated pass that they might not otherwise be exposed to. Further, the retail price per TNC ride is largely unknown, and changes due to “surge” pricing at specific high-demand periods and how aggressively a TNC operator is trying to capture market share greatly affect TNC ride prices at any given point in time. Thus a range of prices were tested. Finally, we did not want to show a discounted transit pass in the menu, even though in reality the CTA could consider reducing the revenue it collects per integrated pass if it yields greater market share in the long run. In a conjoint analysis hypothetical package all attributes can be offered for a single bundle price which hides individual components and captures a respondent’s reservation price for all the items combined.

It is important to note that stated preference data carries with it inherent sources of bias. Often, respondents overstate their interest in presented scenarios due to curiosity, but there is a somewhat counterbalancing effect by respondents showing little interest in new scenarios because of the inertia of sticking with current behavior. Respondents might also enter into a “price-bargaining situation”, where they select cheaper options than their actual reservation price with the hope that they can influence the final offered product to be cheaper (Ben-Akiva and Gershfeld, 1998). Thus, the results of stated preference surveys must be taken with the degree of uncertainty inherent to SP design.

When designing stated preference questions for surveys, a balance must be struck between testing a wide range of possibilities to capture bounds in preferences while also keeping the hypothetical situations realistic so that the respondent does not lose faith in the survey. Table 5-2 shows the attributes and levels selected for the hypothetical conjoint questions shown to respondents.

Table 5-2: Attributes and Levels Used to Create Stated Preference Questions

Attribute	Levels
CTA 30-Day Pass	Always Included
Divvy Monthly Membership	Included or Not Included
Shared TNC Rides	0, 5, 10, or 15 rides
Price	Range for Non-Metra Bundles: \$110 to \$200 Range for Metra add-on Bundles: \$40 to \$140

In the above design, there are 3 factors (Divvy inclusion, number of TNC rides, and price). The Divvy and TNC attributes had 2 and 4 levels, respectively. The price levels took on between 8 and

10 unique values. To test each combination of these attributes and levels,  $2^1 \times 4^1 \times 10^1$ , or 80 bundles would be required. This is clearly not feasible in a short survey, and so a subset of these profiles need to be shown to respondents. In the end, each respondent encountered 6 SP questions. This number was chosen to limit respondent burden, and it was also the number of SP questions employed in Ben-Akiva and Gershfeld (1998). There were two sets of 6 SP questions for both the Non-Metra and Metra bundles, though a respondent was funneled to only one of these sets in order to test more profiles in the data. The composition of the profiles eventually shown was determined from pre-testing a random selection of 20 profiles on about 30 individuals, the results of which were fed into the Stata JMP software to arrive at an “efficient” profile design. The attributes and prices in these profiles were further manually tweaked as responses to the survey began coming in, especially where certain choice profiles were dominating.

CTA 30-day passes were always included in the bundles shown to respondents as a key reason behind this effort is to increase pass sales. The “internal” cost of the CTA pass within the bundle price was \$105 for the non-Metra respondents and \$55 for the Metra respondents. The \$105 price represented the retail price of the stand-alone 30-day CTA pass and the \$55 price represented the price of the CTA Metra Linkup pass. Of course, the Link-up pass generally carries some time restrictions with it, but those were assumed to be lifted for the purposes of the survey. The full price of the public transit passes were used in the calculations of the bundle prices offered with the hope that a transit agency would not have to discount its pass to bring in new buyers, but would instead use the appeal of the bundled additional services.

Divvy membership was either included or not included in the offered bundles. It is important to note that at present Divvy does not offer a monthly version of its pass, but it for the purposes of these hypothetical bundles it was assumed they could be offered. Divvy currently offers single-ride (\$3), 24-hour (\$15), and annual pass (\$99) fares. The annual pass fare translates to \$8.25 per month. Assuming that a stand-alone monthly price should be slightly more expensive than \$8.25, the internal price of Divvy when included in bundles offerings was assumed to be between \$5 and \$10.

The price for shared TNC rides was harder to ascertain because there is no retail price for them. Their price varies based on supply, demand, distance of trip, time of day, and location. To limit the range of prices of TNC trips, a 5 mile per-trip restriction was placed on them when bundles were presented to respondents. This was also done to discourage the use of TNCs for long trips when rapid rail transit is most competitive. Based on previous personal experience with using rideshare in Chicago, it was assumed that a shared ride under 5 miles could cost between \$3 and \$10.

Eventually, a respondent only saw a single price to cover the components of the offered bundle. To this effect, the individual contributions to price of the components was not relevant. Indeed, a key point of the survey was to determine the valuation of the individual modes added to the mobility bundle. The notional individual prices of pass components were used to help set ranges for the prices of the overall bundles, but the eventual price of each offered bundle was set as a result of the pre-testing with a few individuals and manual tweaking. It has been argued that random design performs as well as an “efficient” design, and so we were not concerned with the manual changes in the price points and attributes (Walker et al., 2018). However, effort was made

to keep prices within a reasonable range to maintain the survey’s legitimacy in the eyes of the respondent.

## 5.2 General Results

This section presents general results from the survey in order to give a sense of sample population and overall how they received the Superpass idea.

### 5.2.1 Distribution of Respondents and Respondent Companies

Figure 5-2 presents the distribution of the employee survey respondent home locations and the 115 unique companies from which their responses came. The red dots in the right-hand side map represent the companies and the blue dots on the left-hand side represent the respondents’ home locations (nearest self-reported cross street). The red dots are concentrated in the Loop, as expected, and there is also a small cluster of companies in River North, the Magnificent Mile area, and on the far West side. The respondents are clustered most in the North side, South Loop, Hyde Park, and a small cluster in Oak Park.

Figure 5-2: Zoomed In Distribution of Employee Survey Respondent Home Location (Left in Blue) and Their Workplace (Right in Red)

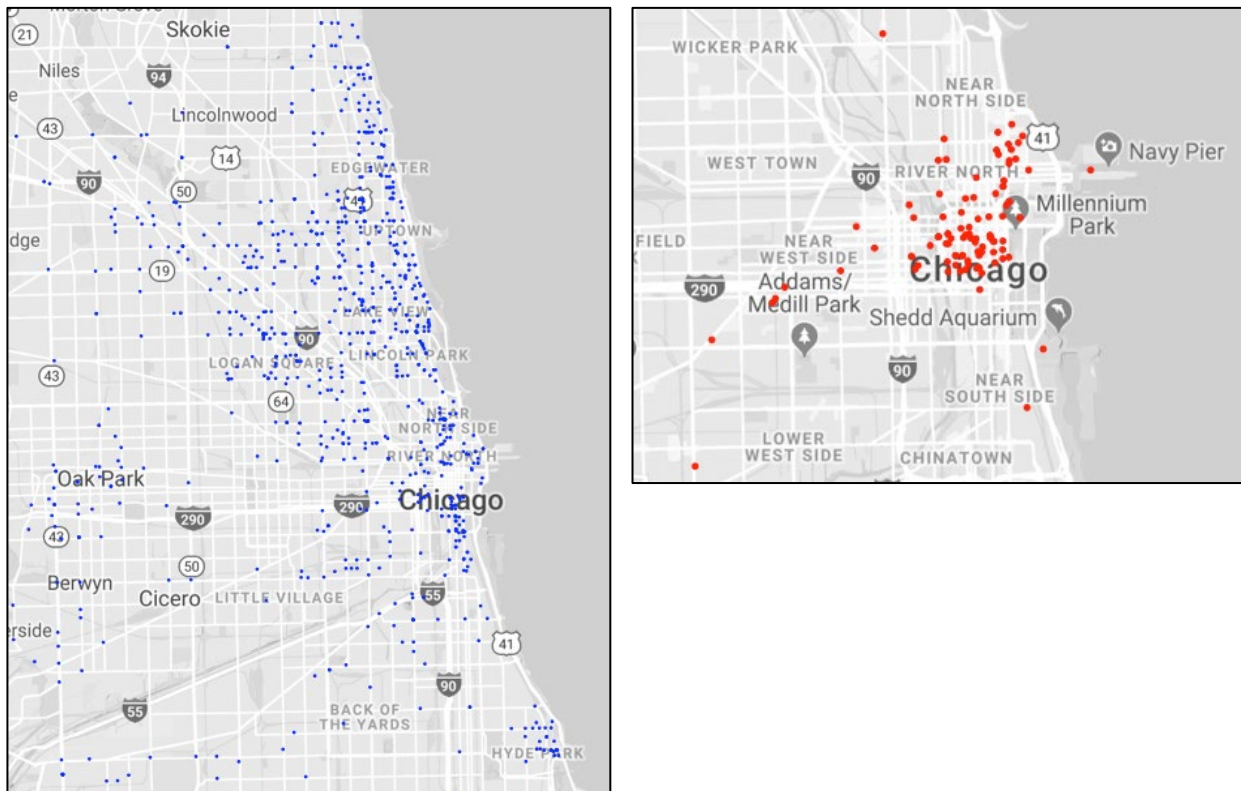
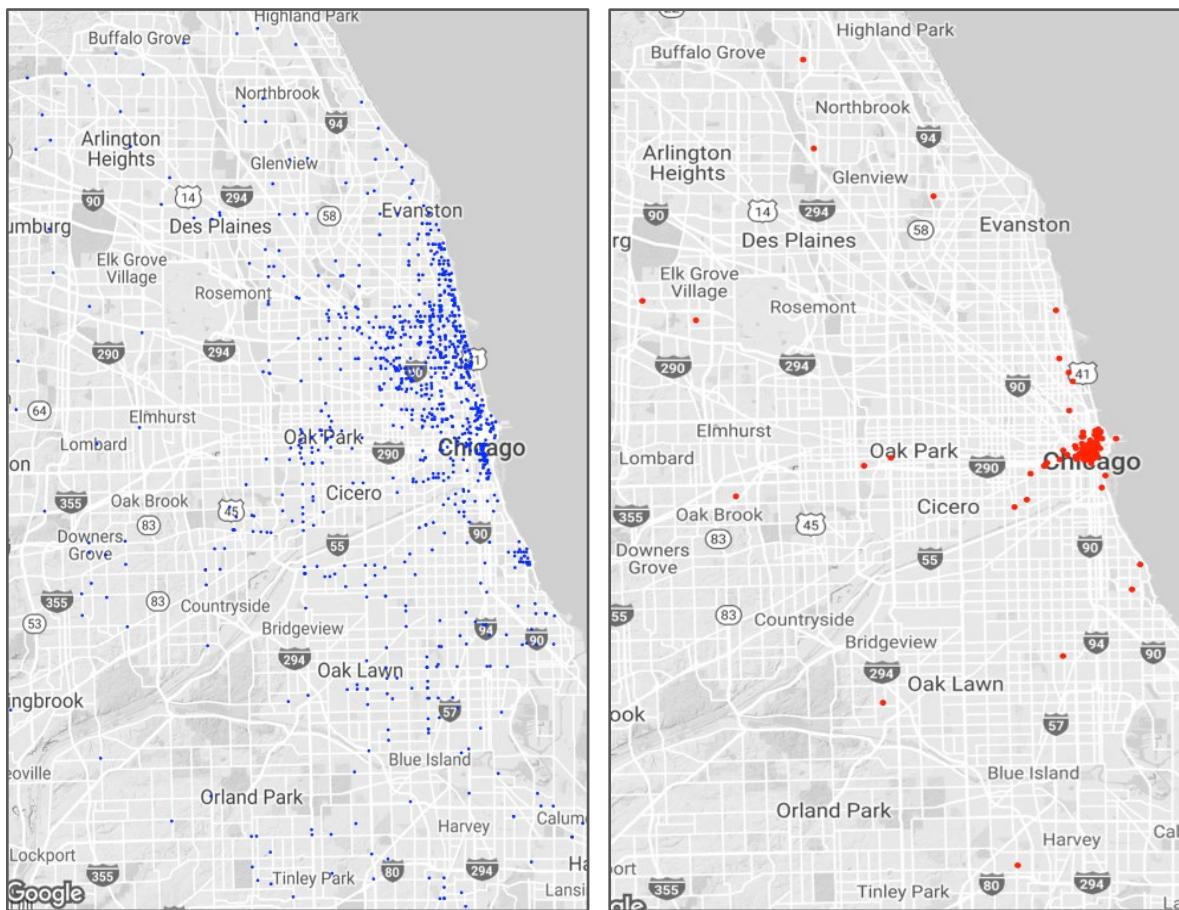


Figure 5-3 presents a more zoomed out picture of the distribution of respondents and their companies. The left map shows the concentration of respondents coming from the North Side, along the Blue line to the north-west, and the suburbs. The right map shows a heavy concentration in the Loop with a few suburban-based workplaces. The maps in Figure 5-2 and Figure 5-3 point to a clear skew of the survey towards Loop-based companies and towards North Side and some suburban respondents. Though the Loop is the central business district of Chicago, it only represents a portion of all workers that the CTA serves because it leaves out blue collar and informal workers. A similar statement can be made about the North Side, which still only makes up a section of Chicagoans even though it continues to grow in population. Thus, the results of this survey should be taken in this context, keeping in mind which preferences are and are not represented.

Figure 5-3: Zoomed Out Maps of Survey Respondents (Left) and Their Workplaces (Right)



In that same vein, it is also important to know which specific companies gave the most responses. Table 5-3 shows the top 10 companies from where responses came. Out of these, the top four companies, which also gave more than 100 responses each, are Cook County (the Loop office branch), Rush University Medical Center, Lurie Children’s Hospital, and The Field Museum. One represents a government agency, two are hospitals, and the fourth one is a museum. It is unclear what sort of bias this might impose on the findings of the survey, but one can hypothesize that

public servants might be more likely to be enrolled in pre-tax transportation benefits and hospital workers are more likely to have irregular work hours that fall outside the traditional work day.

Table 5-3: Top 10 Respondent Companies to Employee Survey

Organization Name	Responses
Cook County Downtown	288
Rush University Medical Center	180
Lurie Children's Hospital	157
The Field Museum	116
Baxter Healthcare	42
HNTB	37
McDonalds	35
Weigel Broadcasting Co.	30
University of Chicago	30

### 5.2.2 Characteristics of Sample Population and Weighting

When using survey-based data, it is important to understand the composition of the survey population and how that affects the validity of the survey results on any other population for application. The sample population is described in further detail in this section. The validity of the results depend on how closely the sample population matches the target population, the identification of which is up for debate in the case of the Superpass. Where differences can be identified, weighting would need to be done. While the survey was designed for employees in the Chicagoland region, the results came mostly from companies located inside the Loop and from transit commuters. The survey results should also be applicable to a wider audience, especially to workers not in the Loop where transit is already widely available and to potential drivers elsewhere in Chicago that can be nudged to use more public transit.

Table 5-4 presents an overview of some characteristics of the survey respondents. Some corresponding characteristics of the Chicago population are also presented for reference.

Table 5-4: Selected Descriptive Statistics of Survey Respondents (Unweighted)

Variable	Percentage in Sample (n= 1277)	Percentage in Chicago
<b>Gender<sup>9</sup></b>		
<b>Male</b>	38%	48.5%
<b>Female</b>	62%	51.5%
<b>Age</b>		

<sup>9</sup> Chicago population gender, age, income, and commute mode data are from the American Community Survey 2013-2017 5 Year Estimates.



<b>18 to 24</b>	7%	10.3% <sup>10</sup>
<b>25 to 29</b>	19%	13.6%
<b>30 to 34</b>	16%	12.3%
<b>35 to 39</b>	15%	9.9%
<b>40 to 44</b>	10%	8.6%
<b>45 to 49</b>	8%	8.0%
<b>50-59</b>	16%	15.4%
<b>60 plus</b>	10%	21.9%
<b>Income</b>		
<b>&lt;\$50,000</b>	18%	47.8%
<b>\$50-75,000</b>	17%	15.8%
<b>\$75-100,000</b>	16%	10.9%
<b>\$100-150,000</b>	23%	12.7%
<b>&gt;\$150,000</b>	27%	12.9%
<b>Primary Commute Mode</b>		
<b>PT</b>	78%	28.2%
<b>SOV</b>	11%	49.2%
<b>Other</b>	11%	22.6%
<b>Metra Zone for Commute<sup>11</sup></b>		
<b>A and B</b>	17%	9.4%
<b>C and D</b>	38%	35%
<b>E and F</b>	33%	40%
<b>G to J</b>	12%	16%
<b>CTA Fare product among CTA users</b>		
<b>Pay-Per-Use</b>	64%	65%
<b>30-Day Pass</b>	33%	19%
<b>1-, 3-, and 7-Day Pass</b>	1%	16% <sup>12</sup>
<b>Metra Link-up</b>	2%	0.50%
<b>Metra Fare product among Metra users</b>		
<b>One-way</b>	31%	12.7 <sup>13</sup> %
<b>10-ride</b>	28%	24.5%
<b>Monthly</b>	38%	59.1%
<b>Weekend</b>	4%	3.7%

<sup>10</sup> This value is actually only people aged 20-24 because of the way the ACS data is aggregated.

<sup>11</sup> This means the starting Metra zone with the end zone being A. So Metra zone E here means a zone E-A commute. The population Metra zone and fare product data are from the Metra Annual Ridership Report 2018.

<sup>12</sup> Free and U-Pass riders (21% of CTA ridership) were excluded and the numbers were accordingly normalized.

<sup>13</sup> Metra fare product by passenger trip percentages from Metra 2018 Annual Report

<b>Walking distance from PT</b>		
<b>&lt;5 mins</b>	56%	-
<b>6 to 10 mins</b>	24%	-
<b>11 to 15 mins</b>	7%	-
<b>16 to 20 mins</b>	3%	-
<b>&gt;20 mins</b>	8%	-
<b>No PT Available</b>	3%	-

Some differences between the sample population and Chicago’s population can be discussed. We see a clear overrepresentation of public transit users in the sample as compared to the Chicago population. However, the Superpass is intended to be launched through the public transit agency to people who are primarily transit users, in an attempt to switch them from pay-per-use to a pass product. Further, and perhaps most importantly, the responses of SOV commuters would need to be weighted up by almost 4 times, which can lead to greater error and instability in the model. Thus, the sample data were not weighted by the primary commute mode share variable.

However, we can weigh the sample data according to public transit fare product, as this is an important metric in determining pass preference. We can also see that CTA 30-day pass holdings among the respondents (33%) was higher than among the general CTA rider base (19%), and 7-day pass holders are almost absent from the survey sample. It would not be prudent to weigh up the few 7-day respondents in the sample to match the 11% in the CTA ridership, and so those people were grouped with the 19% 30-day ridership in the CTA population. The Metra Link-up users were also grouped among the 30-day pass numbers. Further, 1- and 3-day pass holders are essentially pay-per-use or casual users, and so they can be grouped accordingly. With this new grouping, the survey sample has 64% and 36% in PPU and 30-day pass products, respectively, which match closely to the 67% and 33% in the normalized CTA rider base. Thus, weighting on the basis of CTA fare product was not needed.

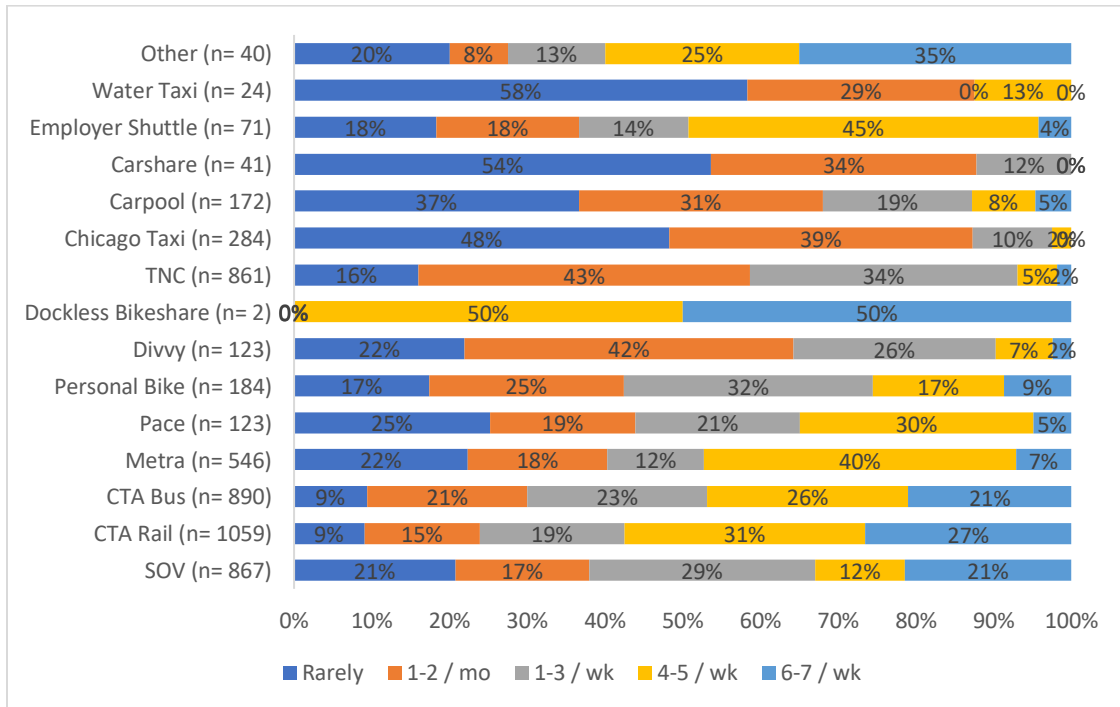
Metra users were, however, weighted to match the Metra fare products distribution in the population. This mostly involved a scaling down of the single-ticket users and a scaling up of monthly pass holders. This weighting was done through iterative proportional fitting in conjunction with weighting on the basis of age, because age was found later on to be a significant variable in determining pass preference.

### 5.2.3 Travel Behavior and Spending of Sample Population

The following figures present a general travel behavior and spending profile of survey respondents. They are again important for understanding the sample population and how it compares to different target populations to apply the model to in the future. This data can also reveal specific groups for which pass preference behavior is important to know from a policymaker’s perspective. Figure 5-4 shows the frequency of use of different modes by the survey respondents. Among these people, the fraction that use the CTA 1 to 3 times a week could perhaps be a target for switching over to more regular transit use through the Superpass. Additionally, the 41% that use TNCs at least once a week would be the ones most likely interested in a Superpass concept, but also the remaining low TNC use individuals would be a target market for any TNC operator joining the Superpass.

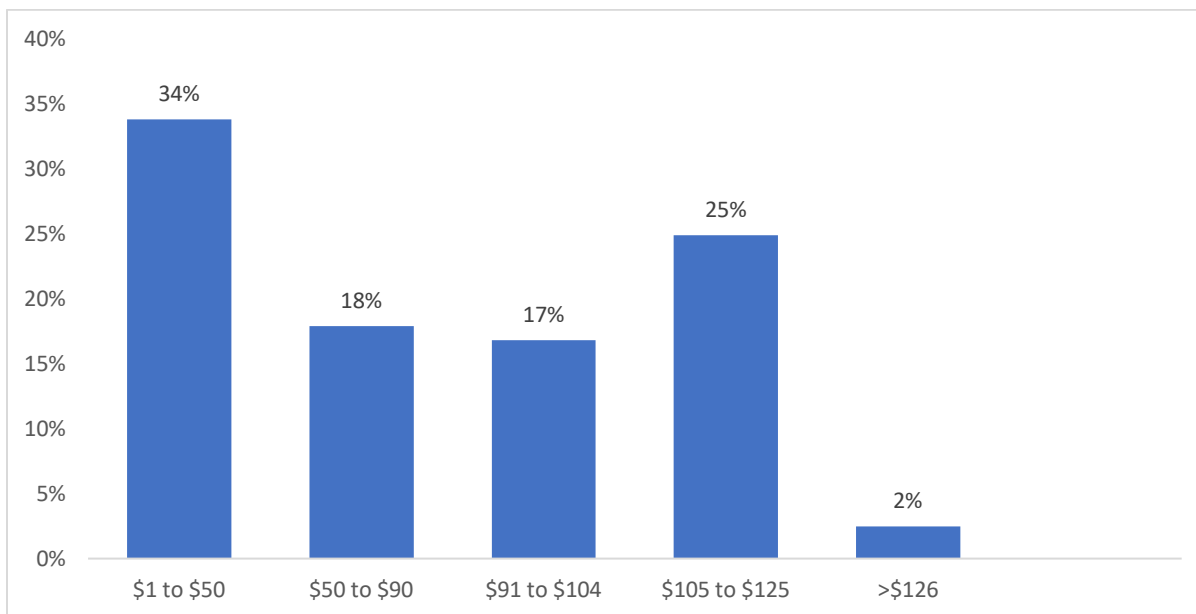
Finally, those that use a personal single-occupancy vehicle less than once a week (but still own a vehicle) could be key targets for potentially shedding a vehicle as a result of an integrated mobility pass.

Figure 5-4: Frequency of Use of Travel Modes Used by Respondent in Last 3 Months



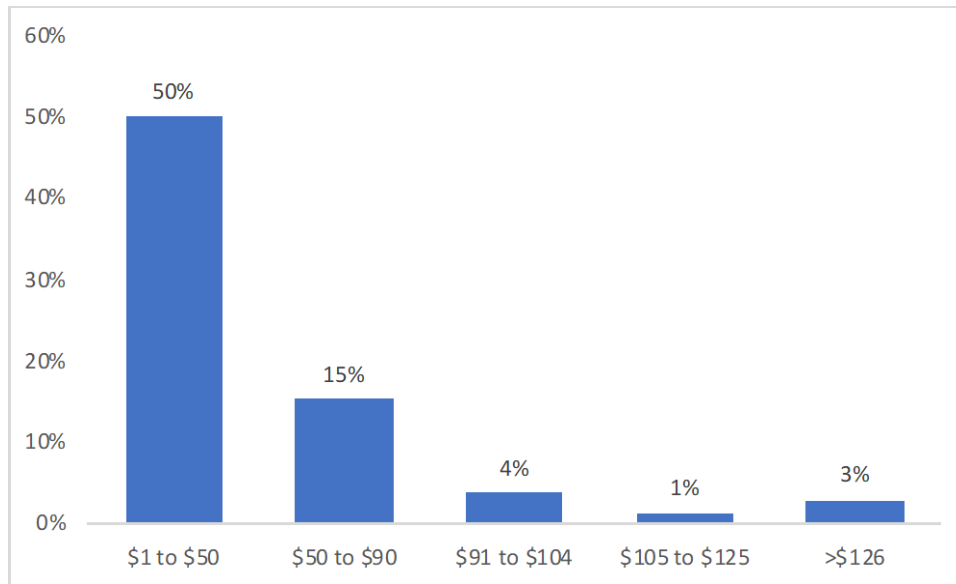
**Error! Reference source not found.** Figure 5-5 shows the breakdown of spending on the CTA by respondents who state that they have used the CTA in the previous 3 months. This graph gives a useful sense of the potential people to switch over to a pass product through initiatives like the Superpass. For example, the 17% who spend between \$91 and \$104 would be prime targets to upsell to a CTA 30-day pass.

Figure 5-5: Money Spent on CTA Per Month by CTA users



**Error! Reference source not found.** presents the spending on TNCs by respondents who have used TNCs in the last 3 months. This information is useful for a policymaker designing an integrated bundle and also for a TNC operator seeking a revenue gain opportunity through participation in a Superpass. For a policymaker, knowing the distribution of spending on TNCs can give an indication of the demand for TNCs and hence how much of TNC value should be included in the Superpass. For a TNC operator, especially a new entrant seeking to capture market share, these dollars spent on competitor TNCs can potentially be spent on their platform instead if they buy a Superpass and fulfill some of their ride-hail trip demand through the TNC rides included.

Figure 5-6: Money Spent on TNCs Per Month by TNC users



#### 5.2.4 Reception Towards Superpass Idea

The following figures present some results related to respondent interest in the Superpass. While the model later on uses characteristics to predict the chance of purchasing a Superpass, it is important to also collect qualitative data to give insight into choice behavior. The question from **Error! Reference source not found.** was only shown to respondents who did not show interest in any of the 12 Superpasses they saw across the 6 stated preference questions. Those who state that they do not use public transit or TNCs enough to make a joint pass between the two worth it for them are unlikely to be switched over to the Superpass, because it would take a lifestyle change for them to switch away from their current mode (likely driving, walking, or bicycling) to these modes. However, those who stated that price and the 5-mile restriction were their concerns could potentially be convinced if these attributes of the Superpass are relaxed. Further, many of those who selected “Other” stated that they did not like the “shared” restriction on the TNCs. However, bringing in these people would come at the cost of sustainability and congestion metrics, which is a trade-off that would need to be considered. Figure 5-8 shows the other modes that respondents would like to see in the Superpass, and about two-thirds said “None”, indicating that CTA, TNC, bikeshare (along with commuter rail for the Metra Superpass) are enough to capture their range of travel. The most popular modes to include are carsharing and electric scooters, with about 10% to 13% respondents selecting them, and so these could be modes a policymaker could consider when designing a Superpass. Of course, their inclusion might turn off some potential buyers who do not wish to purchase a pass with modes they are unlikely to use, and so this is a trade-off that should be considered.

Figure 5-7: Reasons for Lack of Interest in Superpass

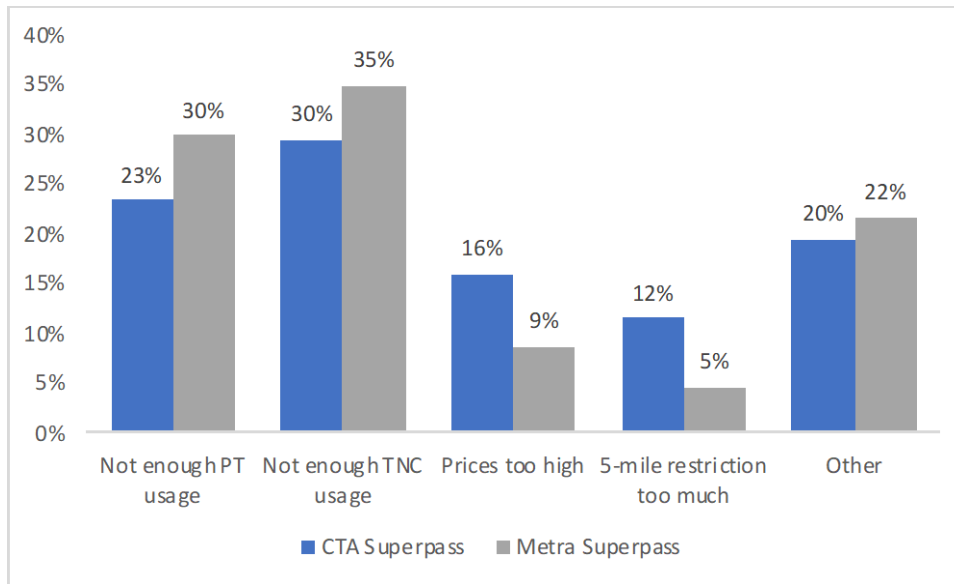


Figure 5-8: Other Modes Respondent Would Like to See in Superpass

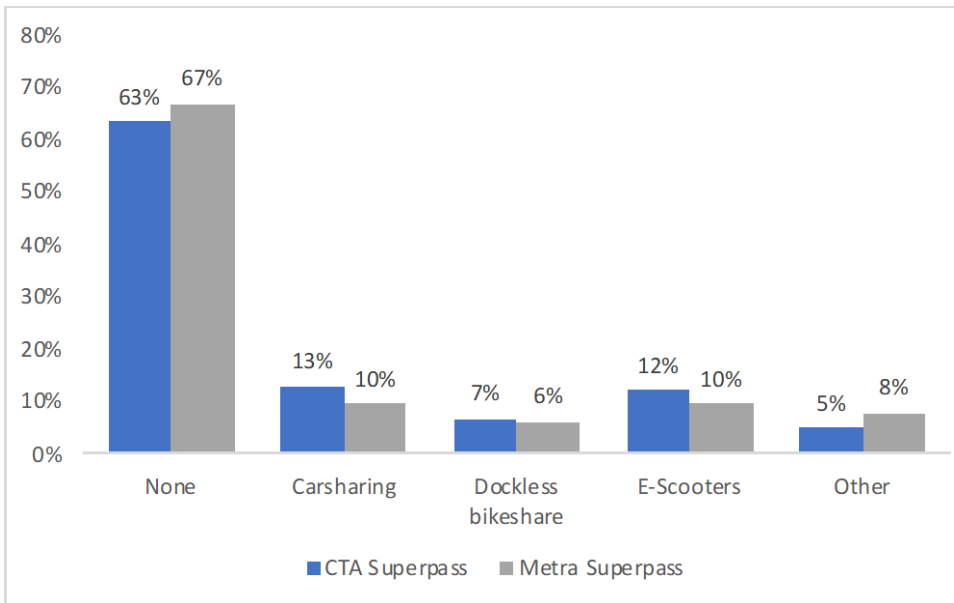
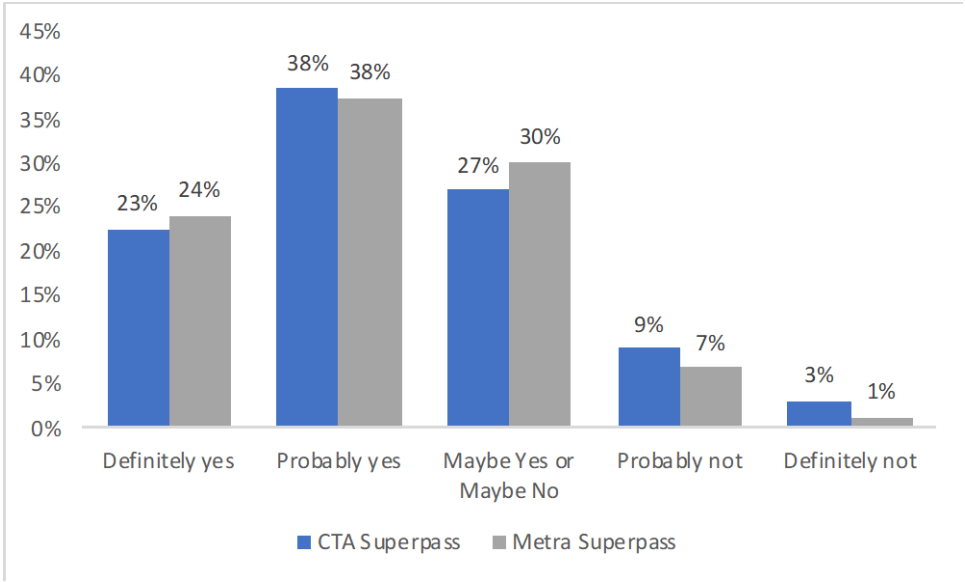


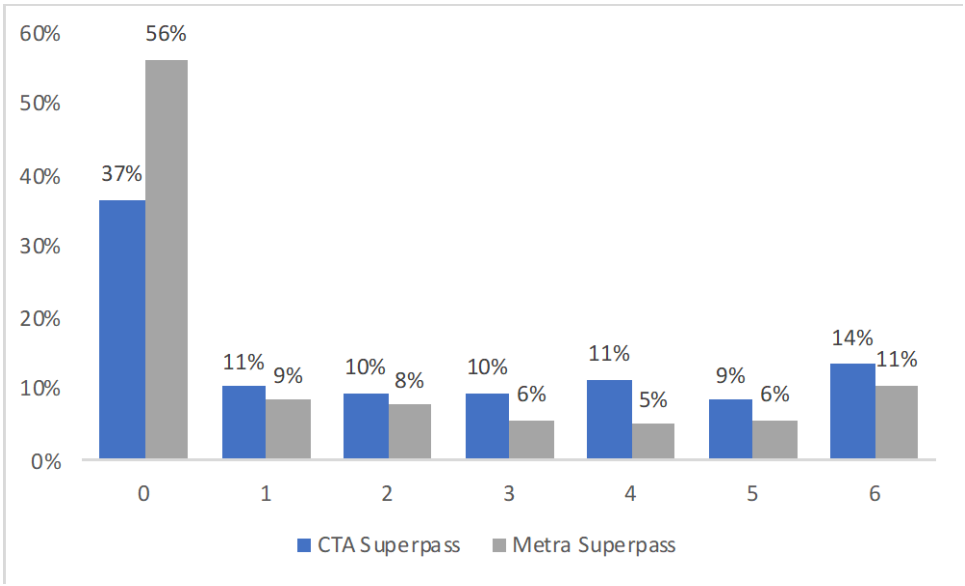
Figure 5-9 shows responses to whether the respondent would be more likely to purchase a public transit fare product as a result of the Superpass. This question was shown to respondents who selected at least one of the 12 Superpasses they were shown. This gets at a core motivation for this thesis—finding out whether or not integrated mobility products can make public transit passes more attractive. The results are promising, with 63% responding probably or definitely yes. Also interesting to note is the similarity in responses between Metra and Non-Metra Superpass respondents, indicating that both passes should be explored by the CTA or any transit agency.

Figure 5-9: Would the Respondent be More Likely to Purchase a Monthly Transit Pass Product if Superpass Offered



Finally, Figure 5-10 shows the number of times across the 6 stated preference questions a respondent saw that they selected a Superpass instead of sticking with their current travel. Here, a clear difference can be seen between Non-Metra and Metra Superpass respondents. This is interesting when juxtaposed with Figure 5-9, indicating that the positive effect towards public transit passes of the bundle is similar for those interested in at least 1 bundle, but getting a respondent to be interested in at least 1 bundle is more different for the Metra Superpass than the Non-Metra one. Figure 5-10 also reveals that 63% of Non-Metra Superpass respondents selected at least 1 of the Superpasses they were shown, versus 40% for the Metra Superpass respondents. At the very least, these people are potential individuals that can be brought into the Superpass.

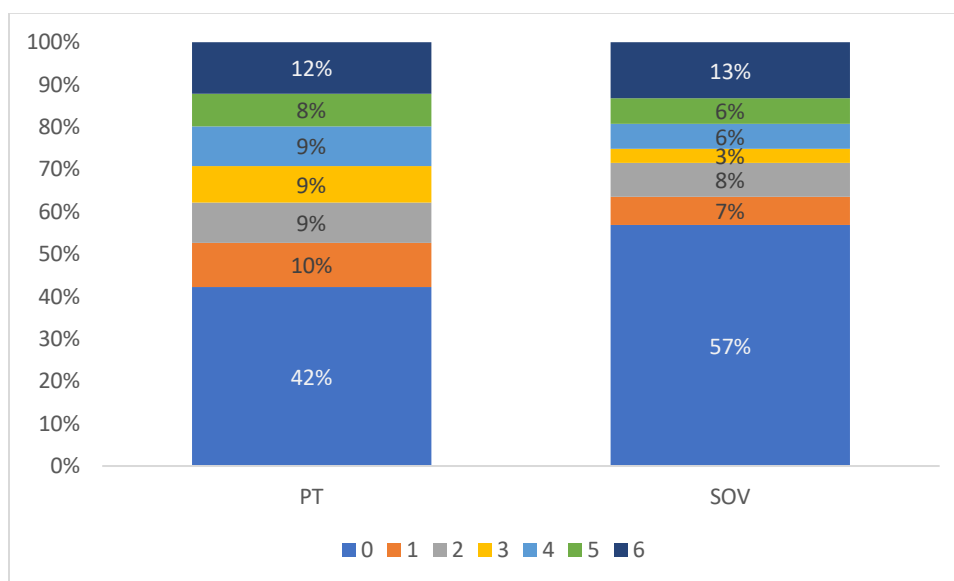
Figure 5-10: Number of Times in Stated Preference Branch Respondents Selected a Superpass



## 5.2.5 Frequency of Pass Choice by Individual Characteristics

To give some intuition into what will be seen in the forthcoming model, cross-tabs show how different groups of respondents reacted to the Superpass. Figure 5-11 shows the frequency of selecting a Superpass out of the 6 SP questions based on whether the respondent commutes by public transit or by single occupancy vehicle. While there is an expected increase in interest in the Superpass among public transit commuters, a sizeable 43% of SOV commuters still selected at least one Superpass, and 13% selected a Superpass for each of the 6 SP questions they were shown. This is promising if one of the goals of the Superpass is to switch over drivers to more sustainable commuting patterns. However, these graphs showing the number of times a Superpass is selected does not reveal the price points at which they selected, which will be illuminated later in this chapter and in Chapter 6.

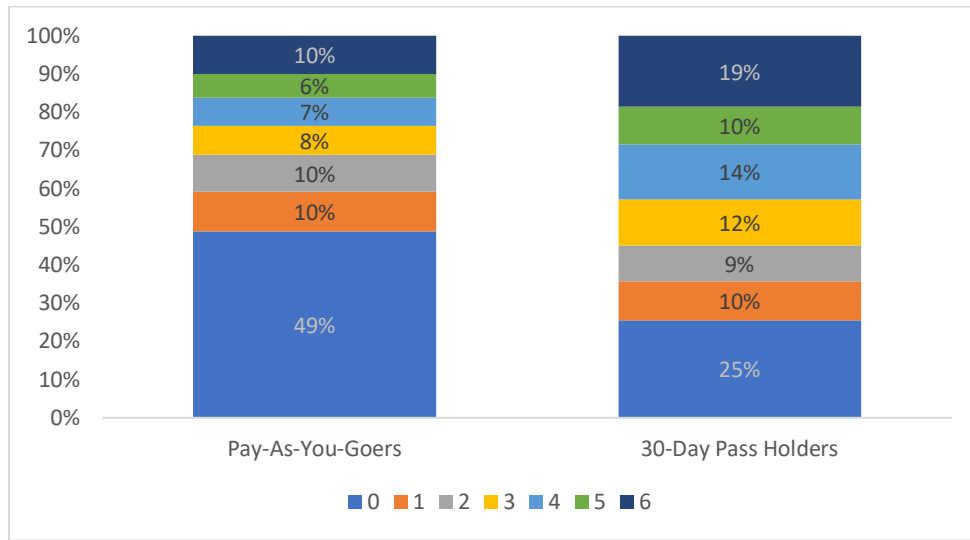
Figure 5-11: Interest in Superpass by Primary Commute Mode



We can look more closely at the respondents who use the CTA to see if the fare product used has any bearing on propensity to select a Superpass. Figure 5-12 shows the split between people who use the CTA pay-as-you-go and 30-day pass holders. Current 30-day pass holders are more likely to select a Superpass as opposed to PAYG people, which is intuitive because a Superpass for them is simply an add-on to an existing transit pass. Among these people, while the CTA might not see a direct monetary benefit, there could be greater anchoring into the 30-day pass and less “churn”. The real target, however, are at least the 51% PAYG people who expressed openness to at least one of the passes they were shown.



Figure 5-12: Interest in Superpass by CTA Fare Product



### 5.2.6 Frequency of Pass Choice by Pass Characteristics

The previous figures showing the frequency of pass choice by individual characteristics give an idea of the type of people that would be open to the Superpass idea, but do not show which passes appeal to people more or less. While this will be shown later in the model coefficients, cross tabulations can provide intuition and insight into what should be seen later in the choice model.

First, we can look at the inclusion of Divvy. In all of the 6 SP questions that any respondent saw, at least one of the two Superpass options contained Divvy. A general way to see whether the inclusion of Divvy had an effect on people’s choice is to simply see the percentage of times a respondent saw a pass that contained Divvy and actually selected it. While this method does not account for the interactions of the other components of the pass (number of TNC rides and price), it can give a general idea.

Table 5-5: Difference in SP Superpass Selection Rate With and Without Divvy Included

	Non-Metra		Metra	
	Number of Options Seen	Percent of Time Option Chosen	Number of Options Seen	Percent of Time Option Chosen
<b>Options with Divvy Included</b>	14 (4280)	14.4%	13 (3419)	8.2%
<b>Options without Divvy Included</b>	10 (3100)	25.7%	11 (2893)	19.3%
<b>No-Pass Options</b>	12 (3690)	61.6%	12 (3156)	73.4%

Note that the number of options seen are out of the 36 total choices a respondents saw across the two sets of 6 SP questions (a single respondent would only see 18 total choices). The number in the parenthesis is the first number multiplied by the number of respondents who went down the branch.

Table 5-5 shows two key points. One is that overall, Non-Metra passes were more preferred than Metra passes, though for both the “No Pass” option was most often selected. The second finding, is that the inclusion of Divvy reduces people’s likelihood of selecting that Superpass. Of course, this just looks at when Divvy is included and does not count the price or number of TNCs included, but assuming a balanced SP design, the difference is quite clear. For Non-Metra branch respondents, on 14.4% of their SP selections were Superpasses that had Divvy included versus 25.7% of selections that did not have Divvy. This is a gap of 11.3%, which stays consistent among the Metra branch respondents. There, only 8.2% of respondent SP selections were passes that had Divvy, versus 19.3% of selections being passes without. Of course, overall fewer people were interested in a Superpass in the Metra branch. Out of the passes selected (26.6% of SP selections), 31% were passes with Divvy. This can be compared to 37.5% of Non-Metra SP selections that contained Divvy. Thus, a third finding is that Non-Metra respondents were also more likely to select choices that contained Metra. These findings are corroborated later on in the modeling stage.

The next variable to examine is number of TNCs. A similar approach can be taken as with Divvy. TNCs were included in most Superpass options, and the ones in which it was not included were simply CTA passes plus Divvy. Thus, a more interesting metric than the inclusion of TNCs would be the notional valuation per ride. This can be calculated by subtracting an assumed \$10 if Divvy is included and another \$105 (for CTA 30-day pass) or \$55 (for Metra Link-up pass), and dividing the remainder by the number of TNCs included. Indeed, the price variations that respondents saw was mostly a result of variations in the per TNC ride cost, and so this would be useful to look at. In Table 5-6, we look at the percentages of SP choices selected that had a TNC valuation of less than or equal to \$5 and of over \$5 to see how dramatic the division is between the two valuations.

Table 5-6: Difference in SP Superpass Selection Rate with Different TNC Ride Valuations

	Non-Metra Branch		Metra Branch	
	Number of Options Seen	Percent of Time Option Chosen	Number of Options Seen	Percent of Time Option Chosen
<b>Options with per TNC ride valuation &lt;=\$5</b>	10 (3125)	23.8%	14 (3682)	14.9%
<b>Options with per TNC ride valuation &gt;\$5</b>	9 (2730)	14.1%	7 (1841)	12.5%
<b>No-Pass Options</b>	12 (3690)	61.6%	12 (3156)	73.4%

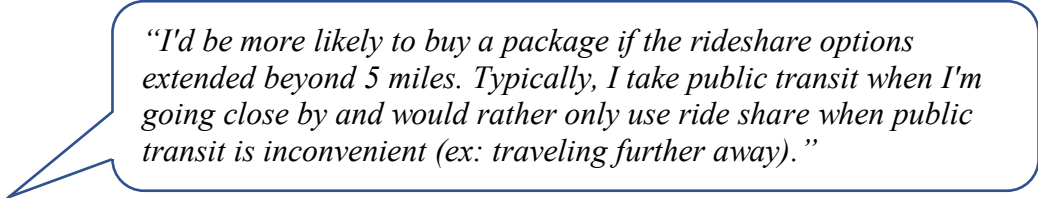
(Note that there were some options where TNCs were not shown and those have been omitted from the “Options Seen” columns)

In Table 5-6 several insights can be noted. The first one is that overall, if SP choices were presented with a per TNC ride valuation of under \$5 then more people selected that option. However, there is a much greater difference among the two TNC valuations among the Non-Metra respondents as compared to the Metra respondents. This could indicate that the Non-Metra respondents are more price sensitive to TNCs than Metra branch respondents, or it could be a function of the number of TNC rides included. These questions are answered by the model that will appear later in this chapter. Out of the Superpass SP selections among the Non-Metra respondents that contained TNCs (37.9% of the selections), about 63% were for Superpasses where the internal value of the

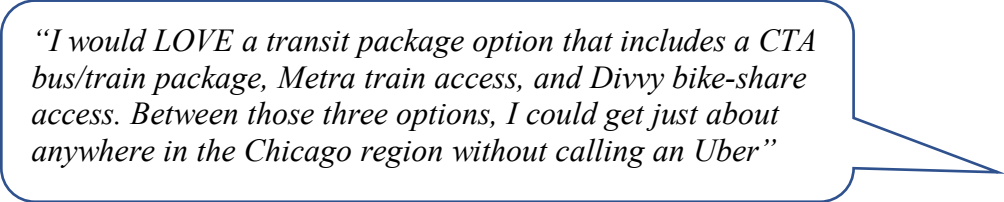
TNC rides were less than or equal to \$5. Similarly, among Metra Superpasses chosen that had TNCs included (27.4% of all Metra branch SP selections), only 54% were Superpasses with a TNC valuation of less than or equal to \$5 per ride. These results are also corroborated later on with the choice model coefficients.

### 5.2.7 Selected Respondent Comments

At the end of the survey, respondents were given the opportunity to provide a free response regarding the Superpass idea. These help provide context to the numerical results. The responses were overwhelmingly positive, with many people stating that though for their particular situation the bundled pass might not work, they were excited at the prospect and happy that the CTA was exploring new options to better serve its customers. A selection of some representative comments follow. The first comment represents many people who said that they were interested in the idea, but that the 5-mile restriction on the TNC rides made them not opt for the passes. This could be grounds for the relaxation of this constraint to see if it can lead to a greater increase in public transit pass purchases. Of course, this would need to be balanced against the systemwide impacts of having people take longer TNC rides and also would make pricing the pass more difficult.



*“I’d be more likely to buy a package if the rideshare options extended beyond 5 miles. Typically, I take public transit when I’m going close by and would rather only use ride share when public transit is inconvenient (ex: traveling further away).”*



*“I would LOVE a transit package option that includes a CTA bus/train package, Metra train access, and Divvy bike-share access. Between those three options, I could get just about anywhere in the Chicago region without calling an Uber”*

The above comment is in support of a CTA + Metra + Divvy pass, and how it would enable the respondent to *not* have to use TNCs to get around. Indeed, the initial linking of all publicly-owned systems in the Chicago area should be a first and easier step, before seeking the help of private operators.

The next comment points to how many feel that the CTA 30-day pass is not worth it unless a significant number of trips are taken each month other than commute trips, and this can be difficult for people with children. This is precisely why the linking of a 30-day pass with TNCs could induce such people to buy into the public transit pass, which on its own would not be appealing to them.

*“I don’t think the monthly fee for CTA is beneficial unless you use at the weekend. It is more cost effective for me to pay as I go as then I can mix with Uber share for when the CTA is held up this is convenient if I have kids to pick up by a certain time.”*

*“There were options for a CTA pass with no Metra and a Metra pass with CTA. I would like to see a third option: CTA monthly pass with optional Metra add-ons. I currently ride CTA nearly every day but have not purchased the 30-day pass because the cost/benefit does not make it worth it.”*

Several respondents echoed this sentiment above, asking for a Metra add-on to the CTA 30-day pass. This points to the need for greater collaboration between the CTA and Metra in order to find more creative ways to link the two and create a more seamless public transit experience in the Chicago region. If revenue sharing agreements can be worked out, a whole host of different types of “link-up” passes between the two can be created which would serve more people’s needs.

The next comment below relates to vehicle ownership and the power of MaaS plans to induce a less car-oriented lifestyle. The second comment relates again to how the inclusion of TNCs along with the CTA pass can serve trips that the CTA on its own could not serve. The respondent in question might be more inclined to purchase a CTA pass if her late night trips come discounted with a 30-day pass, versus spending pay-per-use plus TNCs separately.

*“I would love to see a bundled app with CTA, Divvy, and Uber/Lyft! This is a great idea. I am hoping to downsize our family car (maybe get rid of it altogether) and improved transit and share options would make this so much easier.”*

*“I would LOVE a monthly Uber/CTA option. As a young and single female living in Chicago, public transit is not safe for me after 10pm alone. I rely on Uber/Lyft to get me home safely after dark/late at night.”*

## 5.3 Modeling Methodology

### 5.3.1 Use of Discrete Choice Analysis

Discrete choice analysis (DCA) methods were used to elicit preference information from the choice-based conjoint (CBC) SP questions. DCA is an econometric method that is used extensively in market research, and more frequently in transportation to determine to what extent certain factors influence people’s choice of transport mode, such as cost, travel time, and socioeconomic and demographic attributes. In this case, however, DCA has been used to model mobility bundle product choice. This has been done recently in the London context by Matyas and Kamargianni (2018b), who used a “mixed methods approach” and an RP-SP estimation to obtain respondent preferences to integrated mobility bundles. More broadly, Ben-Akiva et al. (2019) describe the theoretical foundation for the use of CBC in discrete choice analysis for model estimation and subsequent forecasting of market shares and willingness to pay.

Once relative utilities gained or lost by a respondent from each choice are calculated, their probability of choosing each option can then be calculated, from which changes in market share can be calculated under different scenarios. Although assuming a rational human would choose the option that maximizes utility, randomness cannot be ignored, especially when the utilities of two choices are relatively close to each other. For example, even if taking the bus maximizes a traveler’s utility every day, there might still be days when he or she decides to walk. Thus, the propensity to select a choice is represented by a probability and the expected number of people making a certain choice in a population is simply the sum of all these probabilities. The probability of choosing an option as a function of the utility of all alternatives can be given by the following logistic function, where the probability of alternative  $i$  out of  $n$  alternatives is a function of its utility equation given by  $V_i$  with respect to the utilities of the alternatives.

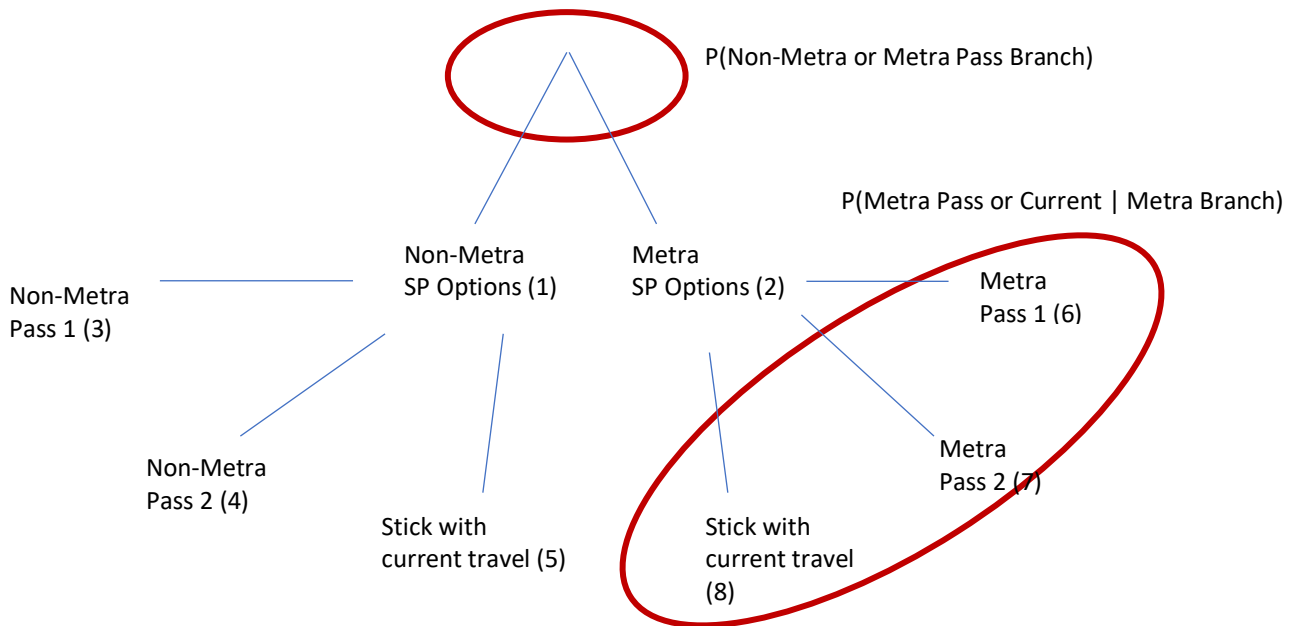
$$P(V_i) = \frac{e^{V_i}}{e^{V_1} + e^{V_2} + \dots + e^{V_n}}$$

### 5.3.2 Model Structure

Before respondents saw the 6 conjoint SP questions in the survey, they made a selection of which type hypothetical pass they would prefer—a standalone Superpass or a Superpass to add on to an existing Metra monthly pass. Based on this they then saw the corresponding SP question branch asking about that particular pass type. This was done because we could not assume for a given respondent what type of Superpass they would prefer. While exclusive Metra or CTA users could theoretically be automatically assigned to the Metra and Non-Metra Superpass branches, respectively, it is unclear which type of pass drivers or Chicago residents living near Metra zone A and B stations would prefer. Therefore, the choice was left up to the respondent and they made an SP selection which determined the subsequent questions they saw. A parallel can be drawn between this and an RP-SP estimation, where previous selections determine the SP questions a respondent sees. However, this also means that unobserved error from the initial branch choice is transferred to the SP choices shown (Train and Wilson, 2008). To address this apparent self-selection issue and the error associated with it, another model was made to predict whether an individual would prefer a Non-Metra or a Metra add-on pass. Then, the probabilities of choosing

a given Non-Metra or a Metra Superpass is contingent on the probability of them preferring that type of pass in the first place. This allows the estimation of choices of a single type of Superpass at a time on a whole sample population. Figure 5-13 shows this diagrammatically.

Figure 5-13: Diagrammatic Representation of Model Structure



The top circle represents the model estimated to determine a respondent’s probability of choosing either the Non-Metra Superpass SP branch or the Metra Superpass branch. This can be represented as:

$$P(\text{Non – Metra or Metra Pass Branch}).$$

Then, the bottom oval represents the model estimated to calculate the probability of selecting either of the two passes offered in an SP question or choosing “neither” pass, meaning they stick with their “current” travel. This can be presented as:

$$P(\text{Metra Pass or Current Travel | Metra Branch}).$$

Bringing these two together, the final probability of someone from the population choosing a Metra Superpass (for this example), is the product of the probability of them first being interested in the Metra add-on Superpass concept with the probability of them selecting the Superpass given their option of sticking with their current travel. This can be mathematically shown as:

$$P(\text{Metra Pass}) = P(\text{Metra Pass Branch}) \cdot P(\text{Metra Pass | Metra Branch})$$

Respondent sociodemographics, travel behavior and spending, and commute origin and destination were the primary variables examined that could affect utility gained from passes and thus propensity to purchase them. Of course, other factors such as marketing and promotion of the pass were not considered as they are often difficult to capture in models such as these.

The utility equations were structured as shown in Table 5-7. The numerical labels correspond to the node labels in Figure 5-13.

Table 5-7: Description of Utility Equations

1	$V_{NonMetraBranch}$	Utility obtained from selecting the standalone Superpass branch of SP questions
2	$V_{MetraBranch}$	Utility obtained from selecting branch of questions where the offered Superpass can be added-on given that respondent must purchase a Metra pass first
3	$V_{NonMetraSuperpass1}$	Utility obtained from selecting first pass offered in SP question of non-Metra branch
4	$V_{NonMetraSuperpass2}$	Utility obtained from selecting second pass offered in SP question of non-Metra branch
5	$V_{NonMetraCurrentTravel}$	Utility obtained from sticking with current travel / not selecting either non-Metra pass offered
6	$V_{MetraSuperpass1}$	Utility obtained from selecting first pass offered in SP question of Metra branch
7	$V_{MetraSuperpass2}$	Utility obtained from selecting second pass offered in SP question of Metra branch
8	$V_{MetraCurrentTravel}$	Utility obtained from sticking with current travel / not selecting either Metra pass

Keeping with the tree structure of Figure 5-13, Equations [1 and 2], or [3, 4, and 5], or [6, 7, and 8] would be evaluated with each other at any given point in time, as they reflect the options a respondent has when making a choice. This was done using availability conditions. For example, in an SP question of the Non-Metra branch, a respondent could choose the first pass offered, the second pass, or no pass at all. When selecting which branch of SP questions to see, they make a selection between non-Metra or Metra add-on passes, or between Equations 7 and 8. When deciding which equation variables were placed in, generally pass-specific attributes were included in the pass equations, and personal attributes were included in the “Current”, or no-pass equations. Thus, if a variable is in the  $Current_{Non-Metra}$  or  $Current_{Metra}$  equation, a positive sign indicates that variable makes the respondent more likely to remain with their current travel rather than opt for a pass. Conversely, a negative sign indicates a lower propensity to remain with the current situation and more utility gained from opting for one of the pass options.

Many of the same variables were used between the Non-Metra and Metra pass utility equations. However, each branch carried distinct coefficients for these variables, given the *a priori* assumption that standalone Non-Metra Superpass and Metra add-on Superpass buyers have different preferences. The same goes for the branch choice model, the decision between wanting a standalone or a Metra add-on pass is likely influenced differently than the decision between passes and no pass. Further, the coefficients between Pass 1 and Pass 2 were restricted to be the same within each branch due to the fact that the two options are not distinctly different but just variations of the same product. There should be nothing unique about all the passes that were offered first in the SP questions versus those that were offered second. Finally, though all the equations were estimated simultaneously, the use of availability conditions to estimate the models

independently and the use of distinct coefficients essentially meant that three models were estimated: one for Non-Metra branch Superpass choice, one for Metra branch Superpass choice, and the third for the choice between interest in Non-Metra and Metra branch to begin with.

### 5.3.3 Utility Equations Specification

Model specification in itself can be considered an art. Given a wide array of available variables, the most meaningful ones must be selected using *a priori* knowledge and specified in a manner that best captures its effect on the dependent variable. For example, while one might assume that price impacts choice to a large extent, the effect is likely non-linear and so different configurations must be tested (e.g., power series, Box-Cox transformation, piecewise linear, etc.). However, increasing model complexity also reduces its interpretability and more variables reduces the degrees of freedom and can make the model susceptible to overfitting. Thus, a balance must be struck.

The employee survey results contained a plethora of data covering a wide range of possible avenues of analysis when it comes to predicting pass choice. At the outset, the pass related variables (Divvy inclusion, number of TNCs, price) were included to test their impact on choice from the selections made in the SP questions. Divvy inclusion was added as a dummy variable. The number of TNCs was first added as a continuous variable to get a general idea of the trend and their impact. However, to capture the diminishing returns effect and to see if there was any optimal number of TNC rides people prefer, the TNC variable was eventually broken up into a piecewise variables and corresponding coefficients. The specification matched the SP design, where 0, 5, 10, or 15 rides were included, but in such a way that future scenarios outside those discrete values could be tested. Finally, price was tested with a Box-Cox transformation but was found to be insignificant, and eventually a power series configuration was chosen due to its significance and ease of interpretability.

Running a simple model with just pass-related variables and an alternate-specific constant for the “Current” utility equations captured basic impacts of different pass configurations, but not variations among different types of respondents. Thus, the next variables to add were related to respondent travel behavior, residence location, economic indicators, and socio-demographics. For travel behavior, their use of transit passes, commute mode share, and number of trips taken using TNCs and Divvy were reflected in the variables. Residence location was categorized by Metra fare zone and included as a series of dummy variables. Socioeconomic variables that were tested included income and spending on transportation. While income was included as several dummy categorical variables, spending was included as a continuous variable. Finally, sociodemographic variables of age and gender were also tested and eventually included. Given the number of categories for age, several were grouped into dummy variable categories. A more detailed description of the variables used and how they were calculated is given in Table 5-8.

In the end, 75 parameters were estimated. The utility equations containing these parameters are presented next.



*Branch choice equations*

$$V_{NonMetraBranch} = ASC_{NMBranch}$$

$$\begin{aligned}
 V_{MetraBranch} = & \beta_{currCTAPass_{MBranch}} \times HASCTAPASS \\
 & + \beta_{currMetraPass_{MBranch}} \times HASMETRAPASS \\
 & + \beta_{currMetraUser_{MBranch}} \times METRAUSER \\
 & + \beta_{SOVCommuter_{MBranch}} \times SOVCOMMUTER \\
 & + \beta_{ResideInChicago_{MBranch}} \times RESIDEINCHICAGO \\
 & + \beta_{ResideInChicagoUnknown_{MBranch}} \times RESIDEINCHICAGOUNKNOWN \\
 & + \beta_{MetraZoneC_{MBranch}} \times METRAZONEC \\
 & + \beta_{MetraZoneDE_{MBranch}} \times METRAZONEDE \\
 & + \beta_{MetraZoneFPlus_{MBranch}} \times METRAZONEFPLUS \\
 & + \beta_{MetraZoneUnknown_{MBranch}} \times METRAZONEUNKNOWN \\
 & + \beta_{Age35to44_{MBranch}} \times AGE35TO44 \\
 & + \beta_{Age44PLUS_{MBranch}} \times AGE44PLUS
 \end{aligned}$$

*Non-Metra Superpass Equations*

$$\begin{aligned}
 V_{NonMetraSuperpass1} = & \beta_{DivyPass_{NMPass}} \times DIVVYPASS_{Pass1} \\
 & + \beta_{InteractionDivyPassDivyUser_{NMPass}} \times DIVVYPASS_{Pass1} \\
 & \quad \times DIVVYUSER \\
 & + \beta_{TNC5Rides_{NMPass}} \times TNC5RIDES_{Pass1} \\
 & + \beta_{TNC10Rides_{NMPass}} \times TNC10RIDES_{Pass1} \\
 & + \beta_{TNC15Rides_{NMPass}} \times TNC15RIDES_{Pass1} \\
 & + \beta_{InteractionTNCIncludedTNCUser_{NMPass}} \times TNCINCLUDED_{Pass1} \\
 & \quad \times TNCUSER \\
 & + \beta_{InteractionTNCIncludedTNCSharer_{NMPass}} \times TNCINCLUDED_{Pass1} \\
 & \quad \times TNCSHARER \\
 & + \beta_{Price_{NMPass}} \times PRICE_{Pass1} \\
 & + \beta_{PriceSquared_{NMPass}} \times PRICE_{Pass1} \times PRICE_{Pass1} \\
 & + \beta_{MetraZoneCPlus_{NMPass}} \times METRAZONECPLUS \\
 & + \sigma_{NonMetraPass}
 \end{aligned}$$

$$\begin{aligned}
 V_{NonMetraSuperpass2} = & \beta_{DivyPass_{NMPass}} \times DIVVYPASS_{Pass2} \\
 & + \beta_{InteractionDivyPassDivyUser_{NMPass}} \times DIVVYPASS_{Pass2} \\
 & \quad \times DIVVYUSER \\
 & + \beta_{TNC5Rides_{NMPass}} \times TNC5RIDES_{Pass2} \\
 & + \beta_{TNC10Rides_{NMPass}} \times TNC10RIDES_{Pass2} \\
 & + \beta_{TNC15Rides_{NMPass}} \times TNC15RIDES_{Pass2}
 \end{aligned}$$

$$\begin{aligned}
& + \beta_{InteractionTNCIncludedTNCUser_{NMPass}} \times TNCINCLUDED_{Pass2} \\
& \quad \times TNCUSER \\
& + \beta_{InteractionTNCIncludedTNCSharer_{NMPass}} \times TNCINCLUDED_{Pass2} \\
& \quad \times TNCSHARER \\
& + \beta_{Price_{NMPass}} \times PRICE_{Pass2} \\
& + \beta_{PriceSquared_{NMPass}} \times PRICE_{Pass2} \times PRICE_{Pass2} \\
& + \beta_{MetraZoneCPlus_{NMPass}} \times METRAZONEPLUS \\
& + \sigma_{NonMetraPass}
\end{aligned}$$

$$\begin{aligned}
V_{NonMetraCurrentTravel} = & ASC_{NMCurrent} \\
& + \beta_{currCTAPASS_{NMCurrent}} \times HASCTAPASS \\
& + \beta_{currMetraPASS_{NMCurrent}} \times HASMETRAPASS \\
& + \beta_{currDivvyPASS_{NMCurrent}} \times HASDIVVYPASS \\
& + \beta_{currDivvyTrips_{NMCurrent}} \times CURRDIVVYTRIPS \\
& + \beta_{currTNC_{NMCurrent}} \times CURRTNCTRIPS \\
& + \beta_{Owns1PlusVehicles_{NMCurrent}} \times VEHOWN1PLUS \\
& + \beta_{InteractionOwns1PlusVehsResidesinChi_{NMCurrent}} \times VEHOWN1PLUS \\
& \quad \times RESIDEINCHI \\
& \quad + \beta_{InteractionOwns1PlusVehsResidenceUnknown_{NMCurrent}} \\
& \quad \quad \times VEHOWN1PLUS \times RESIDEINCHIUNKNOWN \\
& + \beta_{SOVCommuter_{NMCurrent}} \times SOVCOMMUTER \\
& + \beta_{MetraZoneCPlus_{NMCurrent}} \times METRAZONEPLUS \\
& + \beta_{MetraZoneUnknown_{NMCurrent}} \times METRAZONEUNKNOWN \\
& + \beta_{TransportSpending_{NMCurrent}} \times SPEND \\
& + \beta_{Income50to100K_{NMCurrent}} \times INCOME50TO100K \\
& + \beta_{Income100KPlus_{NMCurrent}} \times INCOME100KPLUS \\
& + \beta_{IncomeUnknown_{NMCurrent}} \times INCOMEUNKNOWN \\
& + \beta_{Female_{NMCurrent}} \times FEMALE \\
& + \beta_{Age35to44_{NMCurrent}} \times AGE35TO44 \\
& + \beta_{Age45Plus_{NMCurrent}} \times AGE45Plus \\
& + \sigma_{EmployerError} \\
& + \sigma_{RespondentPanelError}
\end{aligned}$$

### Metra Superpass Equations

$$\begin{aligned}
V_{MetraSuperpass1} = & \beta_{DivvyPass_{MPass}} \times DIVVYPASS_{Pass1} \\
& + \beta_{InteractionDivvyPassDivvyUser_{MPass}} \times DIVVYPASS_{Pass1} \\
& \quad \times DIVVYUSER \\
& + \beta_{TNC5Rides_{MPass}} \times TNC5RIDES_{Pass1} \\
& + \beta_{TNC10Rides_{MPass}} \times TNC10RIDES_{Pass1} \\
& + \beta_{TNC15Rides_{MPass}} \times TNC15RIDES_{Pass1}
\end{aligned}$$

$$\begin{aligned}
& + \beta_{InteractionTNCIncludedTNCUserMPass} \times TNCINCLUDED_{Pass1} \\
& \quad \times TNCUSER \\
& + \beta_{InteractionTNCIncludedTNCSharerMPass} \times TNCINCLUDED_{Pass1} \\
& \quad \times TNCSHARER \\
& + \beta_{PriceMPass} \times PRICE_{Pass1} \\
& + \beta_{PriceSquaredMPass} \times PRICE_{Pass1} \times PRICE_{Pass1} \\
& + \sigma_{MetraPass}
\end{aligned}$$

$$\begin{aligned}
V_{MetraSuperpass2} = & \beta_{DivvyPassMPass} \times DIVVYPASS_{Pass2} \\
& + \beta_{InteractionDivvyPassDivvyUserMPass} \times DIVVYPASS_{Pass2} \\
& \quad \times DIVVYUSER \\
& + \beta_{TNC5RidesMPass} \times TNC5RIDES_{Pass2} \\
& + \beta_{TNC10RidesMPass} \times TNC10RIDES_{Pass2} \\
& + \beta_{TNC15RidesMPass} \times TNC15RIDES_{Pass2} \\
& + \beta_{InteractionTNCIncludedTNCUserMPass} \times TNCINCLUDED_{Pass2} \\
& \quad \times TNCUSER \\
& + \beta_{InteractionTNCIncludedTNCSharerMPass} \times TNCINCLUDED_{Pass2} \\
& \quad \times TNCSHARER \\
& + \beta_{PriceMPass} \times PRICE_{Pass2} \\
& + \beta_{PriceSquaredMPass} \times PRICE_{Pass2} \times PRICE_{Pass2} \\
& + \sigma_{MetraPass}
\end{aligned}$$

$$\begin{aligned}
V_{MetraCurrentTravel} = & ASC_{MCurrent} \\
& + \beta_{currCTAPassMCurrent} \times HASCTAPASS \\
& + \beta_{currMetraPassMCurrent} \times HASMETRAPASS \\
& + \beta_{currDivvyPassMCurrent} \times HASDIVVYPASS \\
& + \beta_{currDivvyTripsMCurrent} \times CURRDIVVYTRIPS \\
& + \beta_{currTNCMCurrent} \times CURRTNCTRIPS \\
& + \beta_{Owns1PlusVehicleMCurrent} \times VEHOWN1PLUS \\
& + \beta_{InteractionOwns1PlusVehsResidesinChiMCurrent} \times VEHOWN1PLUS \\
& \quad \times RESIDEINCHI \\
& + \beta_{InteractionOwns1PlusVehsResidenceUnknownMCurrent} \times VEHOWN1PLUS \\
& \quad \times RESIDEINCHIUNKNOWN \\
& + \beta_{SOVCommuterMCurrent} \times SOVCOMMUTER \\
& + \beta_{MetraZoneCMCurrent} \times METRAZONEC \\
& + \beta_{MetraZoneDEMCurrent} \times METRAZONEDE \\
& + \beta_{MetraZoneFPlusMCurrent} \times METRAZONEFPLUS \\
& + \beta_{MetraZoneUnknownMCurrent} \times METRAZONEUNKNOWN \\
& + \beta_{TransportSpendingMCurrent} \times SPEND \\
& + \beta_{Income50to100KMCurrent} \times INCOME50TO100K \\
& + \beta_{Income100KPlusMCurrent} \times INCOME100KPLUS
\end{aligned}$$

$$\begin{aligned}
& + \beta_{IncomeUnknown_{MCurrent}} \times INCOMEUNKNOWN \\
& + \beta_{Female_{MCurrent}} \times FEMALE \\
& + \beta_{Age35to44_{MCurrent}} \times AGE35TO44 \\
& + \beta_{Age45Plus_{MCurrent}} \times AGE45Plus \\
& + \sigma_{EmployerError} \\
& + \sigma_{RespondentPanelError}
\end{aligned}$$

Table 5-8: Description of Variables Used in Model

Variable Name	Description and How it was Used
<i>ASC<sub>NMBranch</sub></i>	When alternative-specific constants are estimated between choices, one choice is fixed to zero so that the other ASCs are interpreted in relation to the zeroed ASC. The two pass equations were really describing different configurations of the same “mode”, or product. Thus, they were both assumed to be the same alternative for a given branch, and its ASC was fixed to zero. Relative to this fixed value of 0, alternative-specific constants were included in the non-Metra and Metra “current” equations and in the Metra “branch” equation. These should be interpreted with respect to zeroed ASCs for non-Metra passes, Metra passes, and the non-Metra branch, respectively.
<i>ASC<sub>NMCurrent</sub></i>	
<i>ASC<sub>MCurrent</sub></i>	
<i>DIVVYPASS</i>	A dummy variable indicating the inclusion of a monthly Divvy membership in the offered Superpass was included in the pass equations. It was relaxed to be different between the non-Metra and Metra Superpasses.
<i>DIVVYUSER</i>	A dummy variable indicating if the respondent had used Divvy either in the last 3 months or during summer, as this survey was conducted during the winter. It was used to measure the joint impact on pass utility of including a Divvy pass and the respondent being a Divvy user.
<i>TNC5RIDES</i>	The number of shared TNC rides offered in the Superpasses was represented by 3 piecewise linear variables. They measured the incremental utility gained or lost from the inclusion of 0 to 5, 5 to 10, and finally, 10 to 15 rides. They were all in relation 0.
<i>TNC10RIDES</i>	
<i>TNC15RIDES</i>	
<i>TNCINCLUDED</i>	A dummy variable indicating whether any TNCs at all were included in a pass. It was interacted with whether the user was a TNC user.

<b><i>TNCUSER</i></b>	A dummy variable indicating whether the respondent had used a TNC in the last 3 months. It was interacted with the dummy variable indicating the inclusion of TNCs in a pass.
<b><i>TNCSHARER</i></b>	A dummy variable indicating whether a TNC-using respondent had called any shared rides. This was interacted with TNCs being included or not.
<b><i>PRICE</i></b>	A continuous variable indicating the price of the pass in US dollars. It was also multiplied with itself to get the power series non-linear effect that price usually has.
<b><i>HASCTAPASS</i></b>	A dummy variable indicating whether or not the respondent currently has any sort of CTA pass (including 30-day, 7-day, 3-day, or 1-day). It was included in the no pass/current travel utility equation as well as in the Metra branch equation.
<b><i>HASMETRAPASS</i></b>	Whether or not the respondent had a Metra pass was included as a dummy variable in the Metra branch utility equation and the “current travel” equation for the Metra branch.
<b><i>METRAUSER</i></b>	A dummy variable called “Metra User” was included if the respondent had used Metra at all in the previous 3 months. This was only included in the Metra branch equation.
<b><i>HASDIVVYPASS</i></b>	A dummy variable was included in the “Current” travel utility equations for non-Metra and Metra if the respondent currently holds a Divvy annual pass.
<b><i>CURRDIVVYTRIPS</i></b>	A continuous variable denoting the number of Divvy trips per month a respondent makes was included in the Current travel utility equations for non-Metra and Metra branches.
<b><i>CURRTNCTRIPS</i></b>	A continuous variable was included that included the number of TNC trips the respondent makes per month in the Current travel utility equations.
<b><i>VEHOWN1PLUS</i></b>	This was a dummy variable taking the value of 1 if the respondent’s household owned one or more vehicles (and 0 if they owned no vehicles) and was included in the Current travel utility equations.
<b><i>SOVCOMMUTER</i></b>	A dummy variable indicating whether or not the respondent was a single-occupancy vehicle commuter. This was included in the Current travel equations as well as the Metra branch choice equation.
<b><i>RESIDEINCHI</i></b>	A dummy variable was used that indicated if the respondent lived in Chicago. If the residence was unknown (several did not fill out the home location information) this variable took the value of 2, so that living in Chicago was compared to definitively living outside Chicago (which was fixed to 0). It was included only in the Metra branch choice equation.
<b><i>RESIDEINCHI Unknown</i></b>	
<b><i>METRAZONEC</i></b>	A series of dummy variables were included to indicate which Metra zone the respondent used Metra for. They either indicated this if they declared they had used Metra in the last

<b><i>METRAZONEDE</i></b>	3 months, or they were asked to state what hypothetical zone pass they would purchase before adding on the Metra add-on Superpass. Thus, it can be taken as a proxy for which Metra zone the respondent lives in. Metra Zone A and B were fixed to zero because these zones are contiguous with the CTA service area. Someone who said they lived in Chicago were assumed to live in Metra zones A and B unless they indicated otherwise. A dummy for zone D or E and for Zones F or beyond were included in the Metra branch choice and the Current travel in the Metra branch equations. Another dummy for if they chose Zone C or beyond but this was only included in the Current travel for the non-Metra branch. This was done because very few Metra users went to the non-Metra branch, and so all non-Chicago zones were aggregated to one dummy variable.
<b><i>METRAZONEFPLUS</i></b>	
<b><i>METRAZONECPLUS</i></b>	
<b><i>METRAZONE Unknown</i></b>	
<b><i>SPEND</i></b>	A continuous variable was included that had the respondent's total monthly spending on transportation in Chicago in dollars. This was included in Current travel equations for the non-Metra and Metra branches.
<b><i>INCOME50TO100K</i></b>	
<b><i>INCOME100KPLUS</i></b>	
<b><i>INCOMEUnknown</i></b>	Annual household income was included in the Current travel equations for Metra and non-Metra as a series of dummy variables. The "under \$50K" category was fixed to zero. The next three categories were \$50-100K, \$100K+, and Income Unknown.
<b><i>FEMALE</i></b>	A dummy variable was included to indicate if the respondent was a female. This was included in the Current travel equations.
<b><i>AGE35TO44</i></b>	
<b><i>AGE45PLUS</i></b>	Age was included as a series of dummy variables, with the "under 35 years old" category being fixed to zero. The age range of 35-44 and 45+ were the next two categories. It was included in the Current travel equations as well as the Metra branch choice equation. Unknown ages were omitted.
<b><math>\sigma</math><i>EmployerError</i></b>	
<b><math>\sigma</math><i>RespondentPanelError</i></b>	Random error was grouped by the respondent's employer, the 6 SP panel questions the respondent answered, and by their choice of either of the two Non-Metra or Metra passes.
<b><math>\sigma</math><i>Pass</i></b>	These error terms were included to capture heterogeneity inherent to these groupings.

## 5.4 Model Results

A mixed multinomial logit (MMNL) model was estimated on the survey data using PythonBiogeme (Bierlaire, 2016). The results of the estimation are presented in Table 5-9. The random error terms were estimated using 500 Halton draws.

### 5.4.1 Parameter Estimates

Table 5-9: Estimated Parameters from Choice Model

Variable Description	Non-Metra Pass Branch		Metra Pass Branch		Non-Metra Pass		Non-Metra Current (No Pass)		Metra Pass		Metra Current (No Pass)	
	Coeff.	t-test	Coeff.	t-test	Coeff.	t-test	Coeff.	t-test	Coeff.	t-test	Coeff.	t-test
ASC	0.67	2.51	-	-	-	-	-	-4.81	-	-	-1.91	-1.79
<i>Bikeshare in Pass</i>												
Inclusion in Pass	-	-	-	-	-0.88	7.30	-	-	-1.01	6.62	-	-
Inclusion and Being a Divvy user	-	-	-	-	1.77	9.08	-	-	2.14	6.95	-	-
<i>TNCs in Pass</i>												
No TNCs included	-	-	-	-	-	-	-	-	-	-	-	-
Up to 5 TNCs included	-	-	-	-	0.19	2.48	-	-	0.25	4.04	-	-
Up to 10 TNCs included	-	-	-	-	0.01	0.20	-	-	0.14	5.31	-	-
Beyond 10 TNCs included	-	-	-	-	0.03	1.08	-	-	-0.13	2.69	-	-
TNCs included and TNC user	-	-	-	-	1.03	2.59	-	-	-0.24	0.58	-	-
TNCs included and TNC sharer	-	-	-	-	0.80	2.84	-	-	1.40	3.45	-	-
<i>Price of Pass</i>												
Pass Price	-	-	-	-	-0.16	5.60	-	-	-0.09	6.48	-	-
Price Squared	-	-	-	-	4e-4	4.34	-	-	3e-4	4.17	-	-
<i>Current PT Use</i>												
Currently has CTA Pass	-	-	-0.30	1.81	-	-	-0.87	-2.61	-	-	-0.10	-0.23
Currently has Metra Pass	-	-	1.51	5.13	-	-	1.78	1.52	-	-	0.79	1.53
Has used Metra in last 3 months	-	-	1.25	6.39	-	-	-	-	-	-	-	-
<i>Current Divvy Use</i>												
Currently has Divvy Pass	-	-	-	-	-	-	-0.01	-0.01	-	-	0.05	0.06
Current Number of Divvy Trips	-	-	-	-	-	-	0.08	1.61	-	-	0.08	1.22
<i>Current TNC Use</i>												
	-	-	-	-	-	-	-0.02	-0.52	-	-	0.01	0.16
<i>Current Car Possession and Use</i>												
Owns no vehicles	-	-	-	-	-	-	-	-	-	-	-	-
Owns 1+ vehicles	-	-	-	-	-	-	1.03	1.31	-	-	0.21	0.34
Owns 1+ vehicles and Lives in Chicago	-	-	-	-	-	-	-1.17	-1.59	-	-	-0.91	-1.80
SOV Commuter	-	-	0.57	2.31	-	-	-0.69	-1.23	-	-	-1.53	-2.33
<i>Residence Location</i>												

Outside Chicago	-	-	-	-	-	-	-	-	-	-
In Chicago	-	-	1.08	2.70	-	-	-	-	-	-
<i>Metra Zone for Current Commute</i>										
Metra Zone A and B	-	-	-	-	-	-	-	-	-	-
Metra Zone C	-	-	-0.20	0.67	-	-	-	-	0.56	1.01
Metra Zone D and E	-	-	-2.50	7.04	-	-	-	-	0.12	0.21
Metra Zone F and beyond	-	-	1.16	1.98	-	-	-	-	0.67	1.20
Metra Zone C and beyond	-	-	-	-	-	-	0.27	0.24	-	-
<i>Overall Spending on Transportation</i>	-	-	-	-	-	-	-0.01	-3.01	-	-
<i>Income</i>										
Under \$50K	-	-	-	-	-	-	-	-	-	-
\$50-100K	-	-	-	-	-	-	0.14	0.40	-	-
\$100K+	-	-	-	-	-	-	0.68	1.68	-	-
<i>Gender</i>										
Male	-	-	-	-	-	-	-	-	-	-
Female	-	-	-	-	-	-	-0.33	-0.97	-	-
<i>Age</i>										
Under 35	-	-	-	-	-	-	-	-	-	-
35 to 44	-	-	0.53	2.75	-	-	0.66	2.10	-	-
44+	-	-	0.72	3.81	-	-	0.73	1.13	-	-
Employer Panel Sigma	-	-	-	-	-	-	0.31	1.00	-	-
Respondent Panel Sigma	-	-	-	-	-	-	2.76	17.49	-	-
Sigma_Pass	-	-	-	-	-0.15	0.26	-	-	-0.31	1.75

Initial log likelihood: -6718.599

Final log likelihood: -4931.303

Rho-square-bar for the initial model: 0.255

Table 5-10: 95% Confidence Interval of Pass Coefficients

<b>Coefficient</b>	<b>Non-Metra Pass Value</b>	<b>95% Confidence Interval</b>	<b>Metra Pass Value</b>	<b>95% Confidence Interval</b>
<b>Divvy Inclusion</b>	-0.875	[-1.04,-.71]	-1.01	[-1.2,-.81]
<b>Up to 5 TNCs included</b>	0.189	[.079,.30]	0.246	[0.13,0.36]
<b>Up to 10 TNCs included</b>	0.005	[-0.04,0.05]	0.137	[0.09,0.19]
<b>Up to 15 TNCs included</b>	0.027	[-0.03,0.08]	-0.131	[-0.22,-0.04]
<b>Pass Price</b>	-0.162	[-0.22,-0.10]	-0.0922	[-0.12,-0.06]



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<b><i>Number of Non-Metra/Metra Branch SP choices made</i></b>	<i>1277</i>
<b><i>Non-Metra Branch chosen:</i></b>	<i>710</i>
<b><i>Metra Branch chosen:</i></b>	<i>567</i>
<b><i>Number of Non-Metra Pass SP choices made:</i></b>	<i>4260</i>
<b><i>Non-Metra Pass 1 chosen:</i></b>	<i>983</i>
<b><i>Non-Metra Pass 2 chosen:</i></b>	<i>658</i>
<b><i>No Non-Metra Pass chosen:</i></b>	<i>2619</i>
<b><i>Number of Metra Pass SP choices made:</i></b>	<i>3402</i>
<b><i>Metra Pass 1 chosen:</i></b>	<i>448</i>
<b><i>Metra Pass 2 chosen</i></b>	<i>431</i>
<b><i>No Metra Pass chosen</i></b>	<i>2523</i>

The model shows that all else equal, the Non-Metra branch is preferred over the Metra branch, and within the Non-Metra branch the Non-Metra Superpasses are preferred over the “No-Pass” option. The slightly positive ASC for the Non-Metra branch with respect to the zero ASC for the Metra branch is intuitive given that out of the 1277 respondents, 56% chose the Non-Metra branch. The alternative-specific constant for Metra “Current” travel, however, is not significant. The ASC for the Non-Metra “Current” equation is strongly negative, which may indicate that it is capturing effects not captured by the other variables in the equation. However, as is seen in Chapter 6, varying the inputs for the pass variables does lead to changes in predicted market share, meaning that the ASC does not dominate over the other variables. This is because the alternative that the Non-Metra Current option is compared to is the Non-Metra pass, which has a price coefficient of -0.16 (and a price squared coefficient of 0.0004). When dealing with price ranges between \$100 to \$200, this balances out the large ASC in the Current option. While current spending is a variable in the Current alternative, its coefficient is much smaller, indicating that users are likely not making a conscious choice between their current spending and comparing it side by side with the price of the Superpass. This could be because their current spending is comprised of modes not included in the Superpass, or because it is a sunk cost and so it is viewed differently than a new expense. A detailed interpretation of other estimated parameters follows.

#### 5.4.2 Interpretation of Pass Coefficients

##### *Inclusion of Bikeshare*

The inclusion of Divvy was found to have a significant negative impact on utility for both the non-Metra and Metra Superpasses. It is more negative for the Metra pass than for the non-Metra pass, which intuitively would make sense given the suburban nature of would-be Metra pass buyers. The negative utility for bikeshare is consistent with Matyas and Kamargianni’s (2018b) results. *Prima facie*, this would suggest that the CTA should forgo the inclusion of Divvy in its Superpass offerings. However, a reason for this result could simply be that a small percentage of the population bikes in general, and even less so in a city with cold climate like Chicago. Further, this

survey was conducted during the winter months, which could have impacted people’s views towards biking while filling out the survey. Given this fact, the interaction coefficient of the inclusion of bikeshare along with whether or not the user has used Divvy proves to be important. It ends up taking a highly significant positive coefficient value, and is even more positive for the Metra pass than for the non-Metra pass. This finding could be grounds for the customizable inclusion of Divvy to the Superpass. Many people simply do not bike and so even if the Divvy pass were to be included for free, people might be turned away from the pass. They might feel that they are paying for the Divvy component in some way. Thus, the CTA should be careful about including modes that people might feel would they never use as this may turn them off of purchasing the pass altogether. On the other hand, current Divvy users who also use the CTA might find such a pass to be very useful, and given that the CTA is already working to integrate Divvy into the Ventra app, Divvy’s customizable inclusion in a Superpass could be an easy first step towards building an integrated mobility pass.

### *Inclusion of TNCs*

Respondents were found to generally obtain a positive utility from the inclusion of TNCs in the Superpass. However, there are diminishing returns on utility as more TNCs are included, and this even goes to a negative utility when 15 TNCs are included in Metra add-on passes. The inclusion of 5 TNC rides is found to be positive and significant for both the Non-Metra and Metra pass. The coefficients for the inclusion of 10 and 15 TNC rides are not significant for the Non-Metra pass, though they are slightly positive. For the Metra pass, the inclusion of 10 TNC rides also carries a positive and significant utility, but the inclusion of 15 rides carries a negative and significant utility with respect to no TNC rides being included (zero TNC rides included was fixed to 0). These results suggest that the inclusion of TNC rides matters more to prospective Metra add-on Superpass buyers as compared to Non-Metra Superpass buyers, and that only up to 10 TNC rides should be included. A possible reason for this could be that the Metra would-be buyers are more suburban or car-oriented and place a higher value on the inclusion of vehicular mobility in a pass. Given that these values include people who do not use TNCs, the interaction of the inclusion of TNCs with whether or not the respondent is a TNC user is important. Indeed, it takes a significant positive value for the Non-Metra pass respondents, but it is not significant. Further, many people in their comments said that they would be open to TNCs in a pass, but they did not like the forced shared aspect of the TNCs. Thus, the interaction term of whether or not the respondent had used shared TNC rides with the inclusion of TNC rides was an important variable, and it was positive and significant for both the Non-Metra and Metra passes.

The willingness to pay for TNC rides can also be calculated by dividing the coefficient of the TNC rides variable by the coefficient for price, as shown below:

$$WTP = \frac{\beta_{TNCrides}}{\beta_{Price}}$$

Following this, the willingness to pay for the first 5 TNC rides is \$1.67 per ride in the Non-Metra pass and \$2.67 per ride in the Metra pass. The WTP for the next 5 TNC rides in the Non-Metra pass is not worth computing because it is not significant, and but for the next 5 rides in the Metra pass the WTP is \$1.49 per ride. Following this, the utility becomes negative so as a whole respondents are not willing to pay for more than 10 TNC rides in the Metra pass. These values are

lower than the general market price of shared TNC rides that are under 5 miles. This means that people are willing to pay less than the market rate to add on TNC rides to a public transit pass than they would for separate rides in the real market. This could be because the respondents expect a discount when purchasing bulk rides, and also because this WTP value includes respondents who do not use TNCs and who are not interested in the public transit pass in general.

### *Price*

Finally, the price coefficient is negative and significant for both the Non-Metra and Metra passes, as expected. However, the coefficient for price squared is positive and significant, which does not make sense. The price coefficient is about twice as negative for the Non-Metra pass as it is for the Metra pass, which means the Non-Metra pass respondents were more price sensitive. This could be correlated with the fact that wealthier respondents were more likely to choose the Metra pass because they were more likely to live in the suburbs. What is also interesting, however, is that the Metra pass branch respondents were not as price sensitive even though the prices given were assuming they would first purchase an often costly Metra monthly pass. One would expect that given that they would have to sink the high cost of the Metra pass first, they would be very sensitive to any additional expenditure. The results suggest, however, that respondents might be viewing the Metra monthly pass as a sunk cost that is not influencing their pass choice decisions in the SP questions.

### *Marginal Effects*

Marginal effects can give a more intuitive idea of how much each variable impacts overall probability, and hence overall demand. This can be useful for policymakers wishing to understand the relative impacts of the different decisions they can take. Using the impacts of a base scenario, different variables can be varied to see their *marginal* effect. As will be discussed further in Chapter 6, in this case the impacts of a scenario can be thought of as the demand for a specific Superpass configuration. In other words, we can look at the elasticity of demand with respect to different variables. The variables useful for a policymaker are primarily those over which they have control, i.e., the inclusion of Divvy, the number of TNC rides to include, and the price. These variables can be varied on an “average” Superpass configuration. For the marginal effects shown in Table 5-11, the Non-Metra Superpass base case is the CTA 30-day pass + 4 TNC rides for \$130, and the Metra Superpass base case is the Link-up pass + 4 TNC rides for \$80.

Table 5-11: Marginal Effects of Superpass Variables

Variable Marginal Change	Marginal Effect on Demand	
	Non-Metra Superpass	Metra Superpass
Inclusion of Divvy	Decrease 6%	Decrease 12%
Inclusion of 1 Additional TNC Ride	Increase 3%	Increase 5%
Price Increase by 10%	Decrease 8%	Decrease 6%

The inclusion of Divvy appears to have twice the decreasing effect on Metra Superpass demand as compared to Non-Metra Superpass demand. While the difference in their coefficients is not that large, the offset due to the interaction term with Divvy users is likely smaller among Metra Superpass buyers. Metra Superpass demand increases at a slightly higher rate than that of Non-Metra demand with the inclusion of 1 extra TNC ride from 4 to 5. Metra Superpass buyers also seem slightly less price sensitive than Non-Metra Superpass buyers. These marginal effect values have significant policy implications for the design of the Superpass for different buyer markets.

### 5.4.3 Interpretation of Current Travel Behavior Coefficients

#### *Current Public Transit Use*

The current use of public transit was a key variable in the model. First, let us look at the possession of a CTA pass (30-day, 7-day, or 3-day). Its coefficient has a negative value and significant at the 90% level when the variable is included in the Metra Pass branch choice equation, meaning that a respondent having a CTA pass was more likely to choose the Non-Metra pass branch than the Metra pass branch. This makes sense as someone already having a CTA pass (unless it is a Link-up pass) would be more likely to opt for the standalone 30-day add-on pass which is the Non-Metra pass. Once within the Non-Metra pass branch, the possession of the pass made respondents more likely to opt for a pass, as evidenced by the negative and significant coefficient value it has when included in the Current Travel utility equation. The variable was not significant in the Metra Current Travel utility equation, likely because few respondents in that branch had a CTA pass in the first place. Next, we may examine the possession of a Metra pass. As expected, this carries a strongly positive and significant effect on the propensity to choose the Metra pass branch. However, the possession of the Metra pass has a positive coefficient, though not significant, when included in the Current Travel or No Pass equations in the Non-Metra and Metra utility equations. This is in contrast to the story with the possession of the CTA pass, meaning that people who currently have a Metra pass might not be inclined to add on a Superpass. This somewhat makes sense given the low popularity of the Metra Link-up pass. Finally, having used Metra at all in the last 3 months has a strong positive impact on the propensity to choose the Metra pass branch, as would be expected.

#### *Current Divvy Use*

Current Divvy use was measured by whether or not the respondent had a Divvy annual pass and the number of Divvy trips they usually take in a month. Unfortunately, such a low number of respondents even used Divvy, especially during the winter months when this survey was launched, that all the Divvy current travel indicators had insignificant variables with low magnitudes. However, as explained earlier, the interaction of the inclusion of Divvy with whether or not the respondent uses Divvy produces significant variables.

#### *Current TNC Use*

Current TNC use was measured by the number of TNC trips taken per month, but its coefficients were insignificant and so we cannot draw definitive conclusions from them. However, when the inclusion of TNCs was interacted with whether or not the individual is a TNC user, there was a strong positive utility gained. This is intuitive, as current TNC users already spend on rideshare and obtain some positive utility from it, and so the supply of discounted rides through the Superpass would be favorable to them.

#### *Current Car Possession and Use*

The current possession of one or more household vehicles had a positive coefficient for the no-pass options in the Non-Metra and Metra branches, but they were not significant. This was interacted with whether or not the respondent lives in Chicago to draw a distinction between suburban car owners and Chicago car owners, who might not fully depend on their vehicle for mobility needs and might be more open to an integrated pass. Interestingly, these coefficients became negative for both types of passes, but it is not significant for Non-Metra pass choice and is significant at the 90% level for Metra pass choice. If the respondent was a single-occupancy vehicle commuter then they were strongly more likely to choose the Metra pass branch, likely because they lived in a suburban area and Metra is their closest substitute for a car. Interestingly, being an SOV commuter made respondents more likely to choose a pass as compared to sticking with their current travel for both the Non-Metra and Metra passes, but the coefficient was only significant for the Metra passes. This could be grounds to say that SOV commuters are more open to the Metra Superpass than non-SOV commuters, perhaps because they are looking for an all-in-one pass that could potentially replace their car use.

#### 5.4.4 Interpretation of Residence Location Coefficients

The coefficient for whether the respondent lived in Chicago or not was positive and significant towards their choice of selecting the Metra pass branch. This is counterintuitive given that we would expect people living within Chicago city limits to opt for the standalone CTA 30-day pass with add-ons and that suburban residents would opt for the Metra pass. This could mean that the metric of a respondent being in or outside Chicago is not rigorous enough to identify which pass branch they would choose, as about three-fourths of the respondents anyways lived in Chicago, and so this variable might be masking other factors that explain the choice between selecting the Non-Metra and Metra branches.

To investigate this further, we can look at the assumed Metra fare zone that the respondent lives in. If they lived in Chicago, their assumed fare zone was A or B, which was grouped and fixed to zero. Relative to that, their residing in zone C was not significant in explaining which branch of questions they selected nor in explaining whether to choose a Metra pass or stick with their current travel. This indicates that residents of zone C are heterogenous with respect to choice of preference for a Non-Metra or Metra Superpass. However, interestingly residing in zones D or E indicates a strong negative preference for the Metra branch and conversely a strong preference for the Non-Metra branch. It is not significant in explaining choice between a Metra Superpass and current travel. Residing in zone F and beyond meant a strong significant preference for the Metra branch but was not significant in explaining the choice of purchasing a Metra Superpass. Residing in zone C or beyond was not significant in explaining the choice of whether or not to purchase a Non-

Metra Superpass, perhaps because so few respondents from zones C and beyond went to the Non-Metra branch in the first place.

#### 5.4.5 Interpretation of Socioeconomic and Sociodemographic Coefficients

##### *Spending on Transportation*

Overall spending on transportation carried a negative and significant coefficient when included in the Current Travel utility equations for the Non-Metra and Metra Superpasses. This indicates that as a person spends more, they are more likely to opt for a bundled mobility pass, which is in line with intuition.

##### *Income*

As income got higher, its coefficient got more positive in the Current Travel equations, indicating a lower propensity to purchase a pass. However, the \$50 to \$100K income coefficients were only significant at the 90% level in the Metra Current Travel utility and not significant in the Non-Metra utility. The greater than \$100K income was significant at the 90% level in the Non-Metra Current Travel utility equation and at the 95% level in the Metra Current Travel utility. Higher income individuals are probably more likely to drive and also might derive less utility from discounts or integration and so overall might be less interested in a bundled mobility pass. However, higher income is associated with many other attributes, such as higher age, residence location, and rate of current use of TNCs, and so these other variables must be examined in isolation from income.

##### *Gender and Age*

Being a female was not significant in explaining pass choice, meaning that pass preferences are not influenced by gender in a systematic way. For age, being between 35 and 44 years of age meant a higher propensity to choose the Metra branch when compared to those under 35 years of age. This propensity to choose the Metra branch increased with the over 44 years of age category, reflective of the fact that as people get older they move further out from the city and would prefer commuter rail. In explaining pass choice, being over 35 years of age meant a higher propensity to stick with current travel instead of opting for a pass compared to younger people. This means that younger people are more interested in Superpasses, which is intuitive, and could be because they are more open to new ideas, more multimodal, or looking to save more money on transportation than older people.

Finally, the panel term for employer was not significant but was highly significant for the respondent. This means that the model was able to capture correlations between repeated observations of the same respondent, but that it did not find significant correlations between observations of the same employer. Further, the error term capturing correlation between the two passes was not significant for the Non-Metra passes, but was significant at the 90% level for Metra passes.

#### 5.4.6 Model Performance

To get a sense of the performance of a model, its prediction accuracy on a test dataset was examined through cross-validation. The  $\rho^2$  value reveals the goodness of fit of the model, but in order to measure a model's predictive power, its parameters need to be tested on a set of data not used for the model formulation. The model estimates were tested on 133 test data points, the results of which are shown in the following tables. First, Table 5-12 shows the number of SP choices where *either* of the two SP Superpass options were chosen versus the “no pass” option, as well as the branch choice. Each of the 133 respondents made a choice of branch in addition to 6 pass choices (so 7 SP choices each), totaling 931 SP choices in the test set. This is important to keep in mind as the base case in order to see if the estimated model improves on a “null” model of simply estimating for all respondents the highest observed choice of the training data.

Table 5-12: Test Data Statistics

	<b>Number Chosen</b>	<b>Percent of Test Sample</b>
<b>Non-Metra Pass Chosen</b>	202	39.6%
<b>Non-Metra “No Pass” Chosen</b>	308	60.4%
<b>Metra Pass Chosen</b>	113	39.2%
<b>Metra “No-Pass Chosen</b>	175	60.8%
<b>Non-Metra Branch Chosen</b>	85	63.9%
<b>Metra Branch Chosen</b>	48	36.1%

Next, Table 5-13 shows the breakdown in predictions for the Non-Metra pass choice with respect to the actual choice made. For respondents who chose a Non-Metra pass, the model was able to correctly predict they would choose a pass 59% of the time, and misattributed them to no choosing a pass 41% of the time. However, for those who chose “no pass”, the model was correct 83% of the time. Note that the choice of the first pass and second pass are grouped together as simply showing that the respondent chose a pass versus no-pass. This was done by adding together the probability predicted by the model for pass 1 or 2 for respondents that chose either pass 1 or 2. The model was assumed to have “predicted” a choice if the predicted probability of pass choice was higher than that of no pass. Not surprisingly, the accuracy of the model goes down when trying to predict which out of the two passes the respondent would choose, but given that in the final scenarios the respondent would have to only make a binary choice between selecting a given pass or not buying it, this was deemed to be a more useful metric of measuring the model performance. Overall, the number of times the model correctly predicted whether the respondent would or would not purchase a Non-Metra pass was 72.9%. This is about a 13% absolute improvement on the null model case of simply predicting “no pass” for everyone.

Table 5-13: Model Performance for Non-Metra Pass Choice

	<b>Non-Metra Pass Predicted</b>	<b>Non-Metra No-Pass Predicted</b>
<b>Non-Metra Pass Chosen</b>	59%	41%

<b>Non-Metra No-Pass Chosen</b>	17%	83%
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Next Table 5-14 shows the breakdown for the Metra Superpass choice prediction performance. Here, the model performs slightly worse than the Non-Metra predictions in its ability to correctly predict the pass choice and about the same in its ability to predict the “no pass” choice. Overall, the model was able to make a correct prediction 70.5% of the time, or a 10% absolute improvement over the null case of prediction “no pass” for everyone.

Table 5-14: Model Performance for Metra Pass Choice

	<b>Metra Pass Predicted</b>	<b>Metra No-Pass Predicted</b>
<b>Metra Pass Chosen</b>	56%	44%
<b>Metra No-Pass Chosen</b>	18%	82%

Finally, Table 5-15 shows the prediction performance for the branch choice. The model is able to correctly predict the choice of Non-Metra branch 92% of the time and the Metra branch 67% of the time, so there is a skew towards overpredicting people going to the Non-Metra branch. Overall, the model correctly predicted the branch choice 83% of the time, which is 19% more (30% positive change) than the null case of “Non-Metra branch” for everyone.

Table 5-15: Model Performance for Superpass Branch Choice

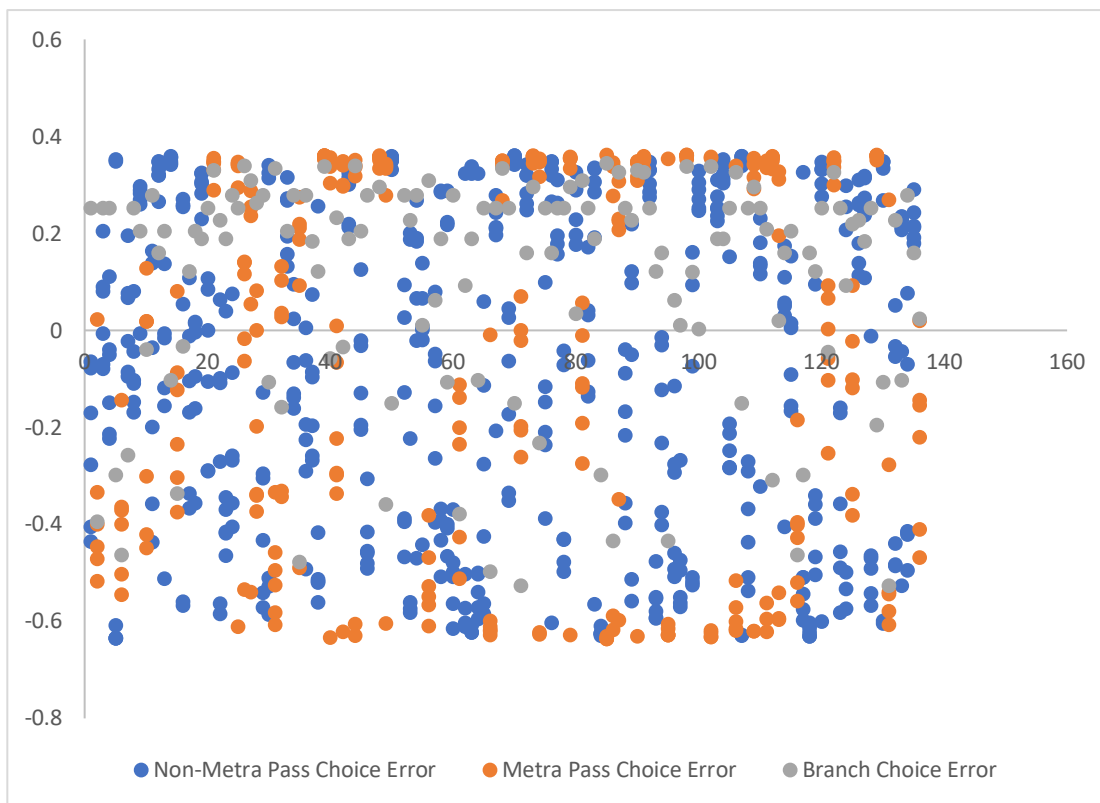
	<b>Non-Metra Branch Predicted</b>	<b>Metra Branch Predicted</b>
<b>Non-Metra Branch Chosen</b>	92%	8%
<b>Metra Branch Chosen</b>	33%	67%

For both the Non-Metra and Metra pass choices, the model does fairly well in predicting a “no pass” choice but over predicts “no pass” even for when a pass is chosen. This is preferable to the opposite type of error, where the model predicts that a person buys a pass when in reality they would not, because that error overestimates the demand and benefits of the Superpass. Assuming a preference for being conservative with estimates, the direction of error in this model is preferable compared to its counterpart.

Next, Figure 5-14 shows the distribution of the residual error from the model across observations in order to identify outliers among the test data. The points are coded by which selection the respondent in the observation made in order to see if there is any pattern, but it appears to be fairly randomly distributed.



Figure 5-14: Residual Error of Test Data



## Chapter 6 Applying Choice Model to Stakeholders

While the previous chapter converted the survey results to a choice model, this chapter shows how to apply this model keeping in mind different stakeholders that would be involved or affected by the Superpass. Specifically, this chapter:

1. Presents an overview of the stakeholders involved and their objectives, constraints, and decisions required;
2. Applies the choice model from Chapter 5 to a series of scenarios involving different configurations of the Non-Metra and Metra Superpass and calculates the impacts through a series of metrics; and
3. Discusses how different stakeholder interests can be balanced to arrive at mutually acceptable Superpass configurations.

### 6.1 Stakeholder Analysis

Inherent to the idea of an integrated mobility pass is bringing together stakeholders to provide a unified product to customers. While the Superpass discussed in this thesis only includes public transit, rideshare, and bikeshare, there are many other stakeholders beyond these 3 players who would have an interest in the Superpass. Thus, the central question for a policymaker or transit agency is then which Superpass configuration to choose that can satisfy key stakeholders and how to go about making that decision. This framework can include an appreciation for the different objectives, stakeholders, constraints, and decisions needed to be taken by each stakeholder for a given Superpass. Knowing this information can help a policymaker anticipate how interests might align or conflict during the course of discussions. This will ultimately lead to the design of a pass that will have a greater likelihood of acceptance by all parties involved.

Below is a brief description of each of the key stakeholders' concerns and motivations with regards to the Superpass. At a base level, the key stakeholders are the CTA, the TNC operator, Divvy, and Metra (for the Metra Superpass only). However, beyond these direct stakeholders are other parties impacted by the Superpass. These are discussed in greater detail.

### 6.1.1 CTA

The CTA, which provides the foundation for mobility in the City of Chicago, is a key stakeholder in the launch of the Superpass. Either they, or the City, will be leading the negotiations from the public sector side. Thus it is important for them themselves to be clear of their objectives, constraints, and decisions they will need to make. It is also useful for any reader of this thesis to be aware of what would motivate them to create a Superpass.

#### Objectives

- Increase ridership
- Increase revenue
- Position itself as anchor in Chicago mobility system, which can be done by making it the zero marginal cost option through increases pass penetration.
- Remain equitable and provide mobility for all
- Promotion of sustainable transport modes to reduce congestion and carbon emissions—though many in the organization share this view, it technically is not in the CTA’s domain. The CTA majorly contributes to this by running a mass transit system, but its primary objective is to operate its own trains and buses.
- Positive public image, which can be achieved through innovative initiatives, partnerships with employers, and partnerships with other convenient and popular mobility forms.

#### Constraints

- Resources (management) – The CTA has a finite number of staff that must plan for the medium and long-term while also operating the system 24/7. This places restrictions on how many resources it can devote to new initiatives.
- Financial (revenue minus costs, willingness to take cut on pass price)
- Political – The CTA president is answerable to the Mayor and the CTA’s performance affects the Mayor’s political capital.
- Approval for major decisions by Board of Directors

#### Decisions

- At what price to offer pass
- How many TNC rides to include
- Whether to include Divvy, and other mobility modes
- Whether to accept anything less than \$105 or \$55 in revenue from the Non-Metra or Metra Superpass, respectively
- Whether to offer concessions to participating TNC (advertising at stations or on app, etc.)
- Who to launch the Superpass to (employers, etc.)
- Logistics of implementing the Superpass (Ventra app integration, etc.)
- Whether to offer a discounted Superpass for low-income and elderly users

### 6.1.2 TNC Operator

For obvious reasons, the TNC operator is a key stakeholder to keep in mind. They are an essential component of the proposed Superpass as they will provide the on-demand component to the mobility bundle. The success of the Superpass will almost entirely depend on positive negotiations with them, and so their position should be well understood. However, they are also sometimes difficult to understand because often their words and statements differ from their actions.

#### Objectives

- Increase demand for their rides overall
- Capture market share from competitor TNCs
- Exposure to new market that did not previously use TNCs
- Increase revenue
- Increase profit, but as they are not yet profitable this is better described as “reduce losses”
- Create positive public perception as this will strengthen brand image and ultimately increase market share and revenue
- Promote favorable regulations, which could be achieved through closer partnership with public sector

#### Constraints

- Resources – This refers to the TNC’s ability to cater to additional demand due to the Superpass and might require new incentives to increase the number of drivers on its platform.
- Financial bottom line – How much revenue and profit does the TNC wish to gain from its participation in the Superpass.
- Service area – Some TNCs have a limited service area that is not necessarily contiguous with the CTA network, which would surely impact its acceptability by the CTA.
- Investor wishes
- App integration – The success of the Superpass will also depend on whether the TNC app can be integrated in some way with the app or platform that will host the Superpass.

#### Decisions

- Number of rides to offer in the pass
- Price to accept as compensation for the rides
- Other modes willing to accept as members of the pass
- Willingness to agree to other stipulations set by the public sector in return for participation in the pass (e.g., data sharing)
- Whether to participate in the pass at all

#### 6.1.3 Divvy

Divvy bikeshare is proposed to be one of the mobility services included in the Superpass and so they are an important stakeholder. The bikes have high visibility in Chicago as they use valuable road and sidewalk space, and the bikeshare network continues to expand. The objectives and constraints of Divvy are interesting in that like any organization it would normally wish to expand, but it also might not be able to serve additional demand. Further, they are a mix of public and private as CDOT owns the system but it is run by a private company. Finally, bikeshare systems

in cities with inclement winter weather like Chicago often opt for annual passes rather than monthly passes so that revenue does not dry up in months people do not ride as the organization still needs to operate. Thus, it is unclear what Divvy's response would be to its inclusion in a monthly mobility pass.

#### Objectives

- Increase number of pass holders
- Increase revenue
- Expand number of docking stations

#### Constraints

- Ability to serve extra demand – There are already often shortages of bikes in bikeshare systems at peak hours across the globe, and a service with a fixed number of docking stations might actually wish to limit new users so as to improve availability for existing users.

#### Decisions

- Price to accept for each monthly pass – The Divvy annual pass is currently priced at \$99, which is about \$8.25 per month. However, as explained above Divvy would never accept that price for a monthly pass because people would stop purchasing the annual pass. In fact, it is unclear if Divvy would have an interest in a monthly pass at all. Thus, Divvy would need to run its own revenue model to decide on what price would make sense if at all it were to offer a monthly pass.

### 6.1.4 Metra

Metra is a key player in this initiative. They connect Chicago and the CTA with the surrounding suburbs, from where a large number of workers travel to the Loop every day. Their service also has the potential to directly take on driving as long distance commuters might be more likely to use freeways to shuttle between suburban homes and urban work centers. They have also shown previous initiative in partnering with TNCs, Uber in particular, and so they may be key to the success of the Superpass. Their clientele is probably also higher income given that Metra ticket prices are higher than CTA prices, and so they may be more willing to pay for a Superpass and ultimately reduce their personal car usage due to the pass.

#### Objectives

- Increase ridership
- Increase pass sales
- Improve first/last mile connections between Metra stations and suburban homes

#### Constraints

- Past relationship with CTA – CTA and Metra have not collaborated probably as much as they should, and this would perhaps inhibit their ability to work together on the Metra Superpass.

#### Decisions

- Whether or not to agree to participating in the pass
- Whether or not they accept to enter into revenue sharing with the CTA
- The price of the pass they agree to
- The number of TNC rides they agree to

### 6.1.5 Employer

The employer could be a small, mid-sized, or large corporation. It could also be an agglomeration of employers in an association. As was discussed in Chapter 4, they act as a middleman between the employees and the State and can be a key vehicle for the implementation of new government initiatives. They are a stakeholder because it is proposed that the Superpass be launched through them to employees.

#### Objectives

- Reduce vehicular travel demand by employees to ease pressure to provide parking
- Save money on payroll tax
- Provide better perks to employees to engender better employer-employee relations
- Strengthen relationship with the City of Chicago

#### Constraints

- Financial ability to subsidize transportation for employees
- Institutional capacity to manage more complex benefits programs for employees
- Support and demand from employees for new initiatives

#### Decisions

- Whether or not to offer the Superpass to employees
- Whether or not to offer pre-tax benefits to employees
- How active of a role to play in travel demand management of employees
- Whether or not to subsidize transit use by employees
- Whether or not to subsidize car use by employees (parking, etc.)

### 6.1.6 Employee

They are a key stakeholder because it is proposed that the Superpass be sold to them via their employers. It is their preferences that the findings of this thesis are based off of, and so their voice is technically the main one represented by the choice model.

#### Objectives

- Save money
- Have more convenient transportation for commute and non-commute trips
- Increase travel options
- Be able to use benefits from work in daily life. For example, healthcare is used to improve quality of life, gym membership, transport pre-tax benefits are surely used for trips other than commuting. Likewise, components of the Superpass can be used outside of work.

### Constraints

- Willingness to pay
- Ability to bicycle, if bikeshare is included
- Possession of a smartphone if Superpass is offered that way

### Decisions

- Whether or not to buy the Superpass
- Whether or not to reserve income pre-tax for commuting

## 6.1.7 The City

The Superpass has been discussed largely in the context of the CTA so far, but the CTA president is appointed by the Mayor, who heads the city government. The Mayor also appoints the Transportation Commissioner, who heads the Chicago Department of Transportation, which is tasked with managing much of the physical infrastructure of the mobility system. The City also sets the regulation of TNCs through its Office of Business Affairs and Consumer Protection. Thus, the City is an important stakeholder in the Superpass and any interaction between a Chicago public entity and TNCs. One can even go as far as to imagine a scenario where they take over the management of the Superpass, and so their motivations and constraints are important to keep in mind.

### Objectives

- Regulate mobility in the whole city in order to keep it equitable, efficient, sustainable, safe, and livable
- Maintain street space to meet the first objective
- Reduce congestion and carbon emissions, also to meet first objective

### Constraints

- Politics – Perception of the project by public and media, election cycle pressures, perception of remaining equitable or of only serving interests of white-collar Loop employees. Also, with the newly elected new mayor there will be greater scrutiny on decisions.
- Relationship with the taxi lobby and TNCs
- Financial and budgetary constraints

### Decisions

- Whether to approve the creation of the pass
- Whether to take over management of the Superpass
- How to brand and market it for the public and media
- Whether to give regulatory concessions to participating TNCs (TNC fee, stopping at curbside near CTA stations, etc.)

## 6.1.8 Other Stakeholders

### **RTA**

The Regional Transit Authority is responsible for transit planning in the 6 counties around Chicago. They bring together the CTA, Pace, and Metra through integrative projects and initiatives. Thus, the Metra Superpass sounds like the exact type of initiative that they would have a stake in. In fact, they might be an agency that could implement and manage the pass in the future.

### **Third Party Benefits Providers**

At present, the key third party benefits providers in Chicago are Edenred and WageWorks. They manage not only a suite of transportation benefits for employers, but even healthcare benefits. Their website shows that they already partner with services such as carshare and microtransit in their transportation benefit offerings. Thus, in a way, the Superpass offered by the Chicago public sector is a direct competitor to the benefits offered by third party providers. Most of the pre-paid benefit 30-day passes in Chicago are already administered by third party providers, and this market share is one that the CTA could capture. The benefit of this would be closer connection between the CTA and its pass buyers and greater ability to directly market new initiatives. Thus, while third party providers are not direct stakeholders, their actions and motivations should be kept in mind as it is likely they will react in some shape or form to the announcement of a government-managed Superpass.

### **Technology Platforms**

Paramount to the Superpass' success will be the mobile phone application through which it is managed and used. At present, due to the success and market penetration of the Ventra app it would be expected that they be the primary vehicle through which to launch the Superpass. However, the operator of the Ventra app, Cubic, has already been struggling to integrate Divvy with the app for several years. They will need to be taken on board to understand their own capability to deliver an integrated mobility app and timeline for production.

### **Pace**

The 30-day pass and Metra Link-up pass can both be used on Pace buses, so they are a stakeholder to keep in mind. They also get 15% of the Metra Link-up revenue. They primarily serve suburban riders that connect to the CTA and Metra, as well as riders with disabilities through their paratransit service.

### **Society**

It is not easy to describe what are “society’s” interests in relation to any government initiative. With regards to the mobility provided by the Superpass, they would generally want more convenient, affordable, and safe transportation options. They would also want negative externalities caused by a few to be mitigated, as all of society feels the externalities of congestion and pollution. Societal interests include those of Superpass buyers and even non-buyers. Pass buyers of course are an important stakeholder for obvious reasons. However, non-pass buyers, or perhaps people who do not have access to buying this pass, might feel a resentment for not having this same access. Indeed, a common concern raised by the CTA in response to the Superpass were the optics related to offering a special pass to wealthier individuals who work for wealthy-enough companies that offer pre-tax benefits. Thus, keeping in mind the sentiments of those who do not buy the pass can have an impact on the initiative’s success.



## 6.2 Model Application Methodology

Keeping the understanding of stakeholders in mind, the model from the previous chapter can be used to develop scenarios that can find mutual acceptance across stakeholders. This section uses the choice model for scenario testing and narrows down scenarios given the stakeholder analysis in 6.1.

### 6.2.1 Forecasting Methodology

While the coefficient information from the model in Chapter 5 is interesting from an individual behavioral perspective, the ultimate usefulness of a choice model is in the aggregation of choice probabilities across individuals in all or a segment of the population under different scenarios. The model parameters estimated can be used to calculate the probability of choice of a given individual under different pass configurations. During the estimation phase, a respondent had 3 choices in the pass-related questions: Superpass 1, Superpass 2, and “Stick with Current Travel”. During forecasting, the respondent is assumed to have two choices: Superpass scenario and “Stick with Current Travel”. Recall that the coefficients estimated for Superpass 1 and 2 were fixed to be the same, and so we are left with one set of coefficients for just the Superpass alternative, which is used during forecasting. Once the relative utilities are found from the scenario simulation with different inputs for the price, TNC rides, and Divvy inclusion variables, the probability of alternative choice can be computed using the logistic function. This whole process can be more easily understood from Figure 6-1.

Figure 6-1: Estimation to Forecasting Methodology

#### ESTIMATION

$$V_{\text{pass1}} = \beta_{\text{price}} * \text{Price}_1 + \beta_{\text{TNC}} * \text{TNC}_1 + \beta_{\text{Divvy}} * \text{DIVVY}_1 + \dots$$

$$V_{\text{pass2}} = \beta_{\text{price}} * \text{Price}_2 + \beta_{\text{TNC}} * \text{TNC}_2 + \beta_{\text{Divvy}} * \text{DIVVY}_2 + \dots$$

$$V_{\text{current}} = \dots$$

#### FORECASTING

$$V_{\text{ScenarioPass}} = \beta_{\text{price}} * \text{Price}_{\text{Scenario}} + \beta_{\text{TNC}} * \text{TNC}_{\text{Scenario}} + \beta_{\text{Divvy}} * \text{DIVVY}_{\text{Scenario}} + \dots$$

$$V_{\text{current}} = \dots$$

#### PROBABILITY OF SUPERPASS PURCHASE

$$P(\text{Buy Superpass}) = P(\text{Pass Branch}) * P(\text{Buy Superpass} | \text{Branch})$$



Different scenarios can test the impact of a range of policies or products not only on overall demand, but how this demand is distributed across groups of people. In the case of the Superpass, the scenarios are created by varying the following: whether or not it is a Non-Metra or Metra Superpass (as this changes the coefficients used for forecasting), whether Divvy was included or not, the number of TNC rides offered varied between 0 and 20 rides, and finally, the different price points for each configuration were a function of a rough valuation per TNC ride of \$2, \$4, \$6, \$8, and \$10. All of these variations lead to a total of 124 scenarios (62 each for the Non-Metra and

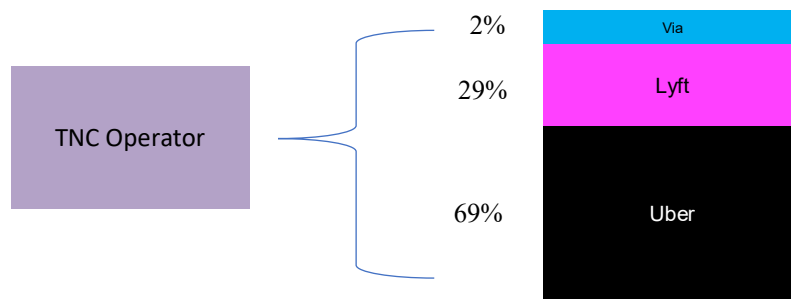
Metra Superpass). Thus, for each scenario different inputs were used for forecasting resulting in different probabilities of purchasing the given Superpass.

After calculating the probability of purchase versus sticking with current travel for each individual, useful metrics are computed so that each stakeholder can make sense of a scenario's impact. For each of the 4 entities involved (TNC Industry, TNC Operator, CTA, and Divvy) the following two key metrics were calculated across all 62 scenarios and plotted: change in revenue, and change in rides provided (for the TNC Industry or Operator) or pass penetration (for CTA and Divvy). Additionally, CTA and Divvy were combined at one point to see if taken together they tell a different story with respect to revenue. The distinction between TNC Industry and TNC Operator is explained in 6.2.2 and the methodology for the impact calculations follows.

### 6.2.2 TNC Industry vs. TNC Operator

Before proceeding, it is important to draw a distinction between the impacts to an individual TNC operator that might supply rides through the Superpass and impacts on the TNC industry. The industry can refer to all rides taken on TNCs. This distinction is only relevant if a single, or a few TNC operators are chosen to supply rides through the Superpass. If all TNCs are allowed to supply through the Superpass, then the operators themselves represent the whole industry. The distinction is important because the element of competition that exists between different operators leads them to be more concerned with increasing their own revenue and tally of rides even if it is at the expense of other operators and the TNC industry as a whole. It also provides a way for a policymaker to separate the benefits that might accrue to a specific operator that is party to negotiations versus benefits to an industry that overall poses a threat to public transit.

To calculate the potential for a specific operator to capture market share from competitors, a baseline starting market share needs to be established. While respondents were asked how many TNC rides they current take per month, the specific operator they used was not asked, and so the starting market shares need to be assumed. At present in Chicago, there are three TNCs in operation: Uber, Lyft, and Via. Nationwide, the market shares for these three operators are estimated to be 69%, 29%, and 2%, respectively, by using billions of anonymized credit card transactions (Gessner, 2019). This market share breakdown is applied to the sample data, i.e., a person's monthly TNC trips are assumed to be distributed as such. The capture of market share by a specific TNC operator and the impacts on the TNC industry can be illustrated in the following example.



In the case that only one TNC operator is selected to provide rides, let us assume for the moment that Lyft is selected as the operator because it has the mid-level market share. Suppose the Superpass that is being offered includes 7 TNC rides (all provided by Lyft), and a given respondent who purchases the Superpass already uses 10 TNC rides per month. With the assumed market share, this would mean they take on average 2.9 rides on Lyft already, along with 6.9 rides on Uber, and 0.02 rides on Via. With the pass purchase, Lyft keeps the 2.9 rides it already had from the individual, adds a further 4.1 rides taken from the Uber and Via share of the person's rides. After purchasing the Superpass, the buyer still has a demand of three rides unmet by the pass, and we assume they use those three rides according to the market share of 69-29-2. Thus, Lyft gets a further 29% of the remaining 3 rides, or 0.87 rides. In the end, Lyft takes up 7.87 of the user's 10 rides as opposed to 2.9 rides before, or a gain of 4.97 rides. However, the gain to the TNC industry, or the overall number of TNC rides taken by the pass purchaser, is zero because they still take only 10 rides. This, of course, assumes no induced demand from the cheaper rides that the person gets. It also assumes that the rides given through the Superpass with the restriction of being shared and under 5 miles would be able to directly substitute the rides currently taken by the buyer. These are two major assumptions that could have a large impact on the forecasted results. Finally, since this example assumes Lyft is the chosen Superpass operator with a 29% average market share, it should be noted that if a company with a larger market share were to be the operator their benefits would be lower, but a company with a lower market share would gain even more.

### 6.2.3 Calculating Revenue Impacts

Next, the percent change in revenue was computed for each of the stakeholders. To calculate the percent change for each stakeholder, first their current revenue from the sample was computed, then their revenue after the Superpass is introduced is computed, and then the two are compared. The current revenue is simply how much the respondent currently spends with the stakeholder. The revenue after the Superpass is introduced is calculated by adding the revenue the stakeholder gets from a Superpass purchase (multiplied by the probability of the respondent buying the Superpass) to the revenue the stakeholder would get without a Superpass purchase (multiplied by the probability of no purchase). The revenue the stakeholder would get without a Superpass purchase is simply what they get from the respondent currently. These calculations can be summarized as follows:

$$\text{Revenue After Superpass} = P(\text{Buy Superpass}) * \text{Revenue Entity Gets from Superpass} \\ + P(\text{No Buy}) * \text{Revenue Entity Currently Gets From Individual}$$

$$\% \text{ Change in Revenue} = \frac{\text{Revenue After Superpass} - \text{Revenue Before Superpass}}{\text{Revenue Before Superpass}} \times 100$$

To complete this calculation, we must estimate how much each stakeholder would get from each Superpass purchase. While this ultimately will be determined by revenue sharing negotiations, some reasoned assumptions can be made. From the CTA's perspective, they might not wish to take any cut on their \$105 revenue from the 30-day pass embedded in the Non-Metra Superpass or on their \$55 revenue from the Link-up pass in the Metra Superpass. Under that assumption, the CTA's revenue can be assumed to be \$105 or \$55 and they can only stand to gain revenue from any Superpass purchased.

For scenarios where Divvy is included, it is difficult to assume what Divvy's share would be because it does not currently offer a monthly pass. Divvy currently has an annual pass costing \$99 with a deferred monthly payment plan of \$10 per month. Santa Monica's Breeze Bikeshare offers its annual pass also at \$99 but also has a 30-day pass costing \$25. Washington D.C.'s Capital Bikeshare offers a 30-day pass at \$28. However, it can be assumed that to be part of this Superpass that Divvy would be willing to offer some sort of discount on their price. Further, Lyft owns Motivate, the company that operates Divvy. While Divvy is still owned by CDOT as a system, it can be assumed that if Lyft were chosen as the TNC operator that an even deeper discount could be offered. There is currently a deal on the anvil relating to an increased investment in Divvy by Lyft to the tune of \$50 million, though CDOT would still control prices and receive revenue (Greenfield, 2019). The converse is also true, however, that if a Lyft competitor were chosen as the TNC operator then there might be more difficulty in getting a workable revenue sharing agreement. Keeping all of these considerations in mind and assuming for the scenarios in this chapter that Lyft is the chosen TNC operator, a Divvy revenue of \$10 per Superpass sold was assumed. If an annual pass holder switches to the Superpass with Divvy, then Divvy only gets the difference between \$8.25 and \$10, or \$1.75.

In calculating TNC operator revenue, if the respondent previously did not use TNCs and then chooses a pass with TNCs, the operator gets all new revenue. However, if the respondent currently uses more rides than what is offered in the pass, then they will substitute some of their current rides with the rides offered in the pass as was explained earlier in the Lyft example. For the remaining rides, it is assumed that they spend on each of those rides the average of what they were spending on TNC rides before the Superpass. For now, we also ignore the induced demand effect of cheaper TNC rides on the propensity to take more rides and spend more on TNCs, to not only be conservative with estimates but also because we do not have a model to estimate this.

#### 6.2.4 Calculating Sales Impacts

Beyond the revenue impacts are the sales impacts. This is computed by looking at the percent change in passes sold for the CTA and Divvy, or the percent change in rides supplied for the TNC operator. These changes in growth of sales eventually impact the stakeholder's market share among those who are offered the Superpass.

For the CTA and Divvy, the increase in pass holders was calculated by looking at the number of Superpasses demanded by individuals not currently holding a CTA 30-day pass or a Metra Link-up pass and dividing that by the existing number of pass holders. A similar method was used to calculate the increase in Divvy pass holders to account for current Divvy annual pass holders switching to the monthly Superpass.

Summing the probability of purchase by each individual gives the absolute number of passes demanded or absolute revenue gain. However, more useful metrics are the percent increase in pass product holders and the percent change in revenue. For example, many of the Superpass buyers are people who currently already hold a 30-day CTA pass, in which case there is no added benefit to the CTA or society

## 6.2.5 Applying the Metra Superpass

Computing the impact with Metra is slightly more complicated. The stated preference questions in the survey asked the respondent's pass preference, "assuming you have already bought your monthly Metra zone pass." Thus, the survey did not ask whether the respondent would purchase the Metra zone pass along with the add-on Superpass, which is perhaps a shortcoming of the survey. About 33% of the 590 Metra branch respondents currently hold a monthly zone pass. The forecasts from different scenarios of the model only make sense to directly apply to this subset of people. In reality, the CTA might consider offering both the Non-Metra and the Metra Superpasses, and so these scenarios can be limited to the Metra Superpass impacts on current Metra monthly pass holders, while the Non-Metra Superpass scenarios can be applied to the rest.

It is also worth noting that 15% of Metra branch respondents use Metra in their typical commute and purchase a 10-ride pass. From this segment especially, additional sales of the Metra monthly zone pass could be expected due to the Superpass, but this is difficult to estimate.

## 6.2.6 Metrics

For each of the two types of passes, the following metrics were computed for each scenario to help each stakeholder identify their optimal bundle and to inform negotiations.

- Price
- Divvy Inclusion
- Number of TNC rides
- Percent Change in 30-Day Pass Holders
- Percent Change in CTA Revenue
- Percent Change in TNC Industry Rides
- Percent Change in TNC Operator Rides
- Percent Change in TNC Industry Revenue
- Percent Change in TNC Operator Revenue
- TNC Revenue per Ride
- Percent Change in Divvy Revenue
- Percent Change in Divvy Pass Holders

## 6.2.7 Key Assumptions

There are some key assumptions made when calculating impacts that should be reported, some of which have already been mentioned. The calculations:

- Assume Divvy gets \$10 from each Superpass sold in which it is included;
- Ignore induced demand effect on TNC demand the Superpass;
- Assume the marginal cost for Divvy and CTA to cater to additional demand from Superpass is zero, hence all revenue is assumed to be "profit";
- Assume that the 5-mile shared rides provided in the Superpass can directly substitute existing TNC trips taken by buyers, though this assumption becomes more realistic as the TNC ride restrictions are eased;

- Assume that selected TNC operator has a 29% starting market share (positive impacts for the operator increase if its starting market share is lower);
- Ignore Pace’s 15% revenue cut from the Link-up pass for now (the revenue impacts for the CTA look at the percent change and so since Pace’s revenue cut is ignored even for the starting revenue, the percent change in revenue for the CTA is unaffected).

### 6.3 Non-Metra Superpass Scenarios

This section shows for all 62 scenarios the range of impacts on the CTA, TNC industry, TNC operator, and Divvy. For each of the four stakeholders, the following 4 metrics are shown graphically:

- 1) Change in Revenue without Divvy
- 2) Change in Revenue with Divvy
- 3) Change in Rides or Pass Holders without Divvy
- 4) Change in Rides or Pass Holders with Divvy

#### 6.3.1 TNC Industry impacts

First, scenario testing is done on the Non-Metra Superpass. The first two figures, Figure 6-2 and Figure 6-3, show the “base case” TNC revenue impacts in the no-Divvy and Divvy scenarios. The base case refers to the assumption that the TNC operators are working as one entity and that they are not competing with each other. In a way, this can be interpreted as the impact on the rideshare industry as a whole due to the Superpass. A cursory glance at the first two figures reveals that as a whole, the TNCs involved do not stand to gain a tremendous amount by way of revenue. In fact, there are many scenarios where TNCs could lose revenue. Without Divvy included, TNCs as a whole can increase their revenue by up to 8% but can also lose up to 20% in revenue. With Divvy included, they can increase revenue by up to 4% and lose up to 19%. Thus, it should be noted that Divvy reduces the demand for the Superpass and so brings down revenue, which is a theme that will be frequently repeated in this chapter.

Figure 6-2: Percent Change in TNC Industry Revenue Under Different Non-Metra Superpass Scenarios (No Divvy)

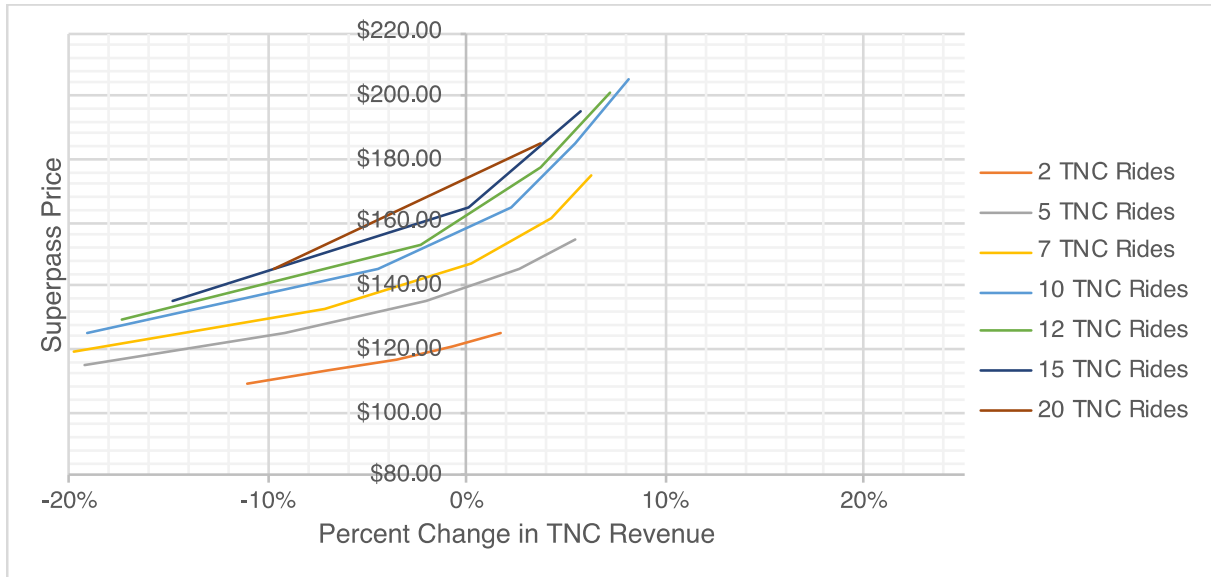
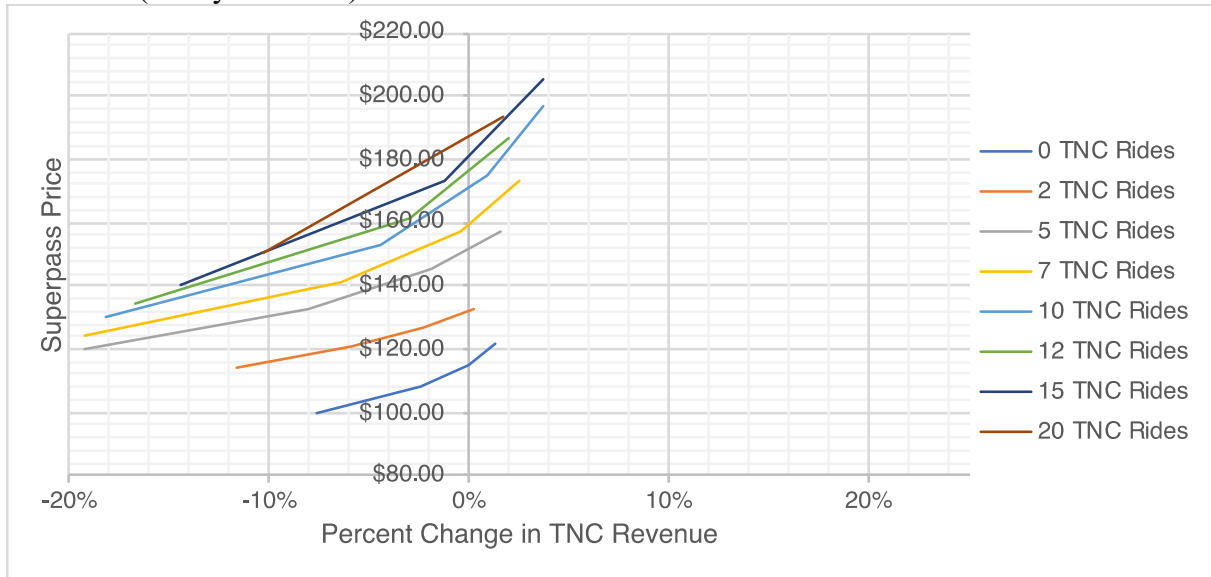


Figure 6-3: Percent Change in TNC Industry Revenue Under Different Non-Metra Superpass Scenarios (Divvy Included)



Keeping with the base case, the next two figures show the impacts on TNC industry rides. Because this is the base case where the operators are assumed to be one and there is no competition, Figure 6-4 and Figure 6-5 can be better interpreted as market growth, as it shows the increase in TNC rides overall among the respondent population due to Superpass purchases. Notice that marked on these two graphs are points labeled where the TNCs would “accept” the scenario. The assumption made here, as stated earlier, was that the TNC does not lose revenue overall, and they also receive at least \$4 per ride provided. This marking system will be used throughout this chapter to indicate the scenarios that TNCs would not outright reject over revenue and profit loss concerns. Thus,

only the scenarios where the TNC earns additional revenue and at least \$4 per ride are shown in black boxes in subsequent figures. While the TNCs could increase the number of rides they provide by 54% from the Superpass (and without Divvy included), with the “acceptable” conditions they could increase the rides provided by up to 24%. These graphs are key to understanding that through the Non-Metra Superpass, the number of TNC rides could increase between 0% and 24% for the target population.

Figure 6-4: Percent Change in TNC Industry Ride Growth Under Different Non-Metra Superpass Scenarios (No Divvy)

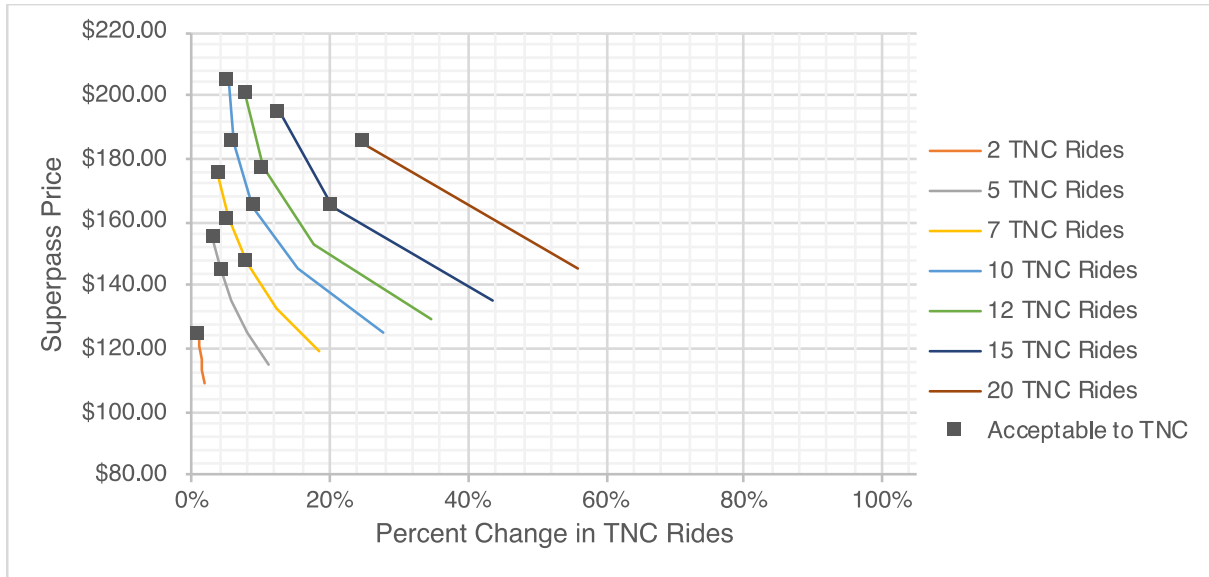
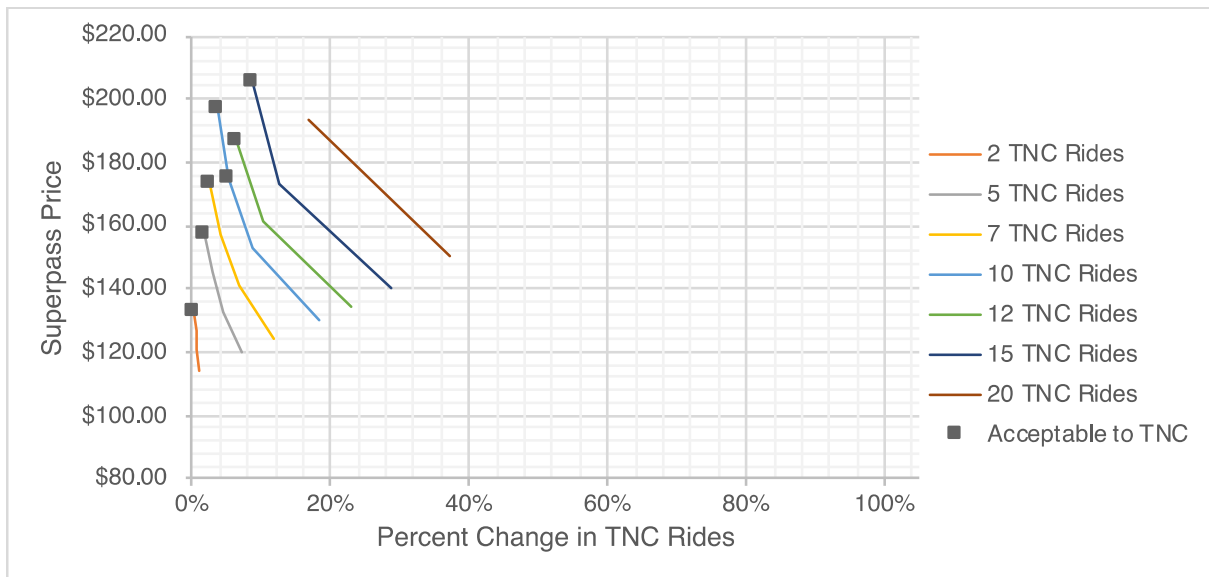


Figure 6-5: Percent Change in TNC Industry Ride Growth Under Different Non-Metra Superpass Scenarios (Divvy Included)





### 6.3.2 TNC Operator Impacts

Having understood the base case in which all TNC operators are assumed to be one, we can move on to the more realistic case in which there is competition between operators. As was explained in the methodology section, the three market shares for the three operating TNCs in Chicago can be assumed to be 69%, 29%, and 2%. For the purposes of this section, we look at the case in which the 29% market share TNC, in this case Lyft, is selected as the Superpass TNC component provider. It can be inferred that the positive impacts for the TNC operator go up the lower their starting market share is, as they have more to gain. Thus, if Via were selected, the benefits will be much greater for them, and if Uber were selected, the benefits would be smaller.

Figure 6-6 and Figure 6-7 show the change in revenue for the 29% market share TNC, or Lyft. Comparing to the base case, the TNC clearly earns more revenue in both the Divvy and no-Divvy configurations. The maximum it could earn in the no-Divvy and Divvy cases are a 50% and 36% revenue increase, respectively. This “shift” of scenarios to the right of the y-axis unlock more scenarios that are plausible, as there are more cases in which the TNC earns money and so would be more willing to engage on different pass configurations and stipulations.

Figure 6-6: Percent Change in TNC Operator Revenue Under Different Non-Metra Superpass Scenarios (No Divvy)

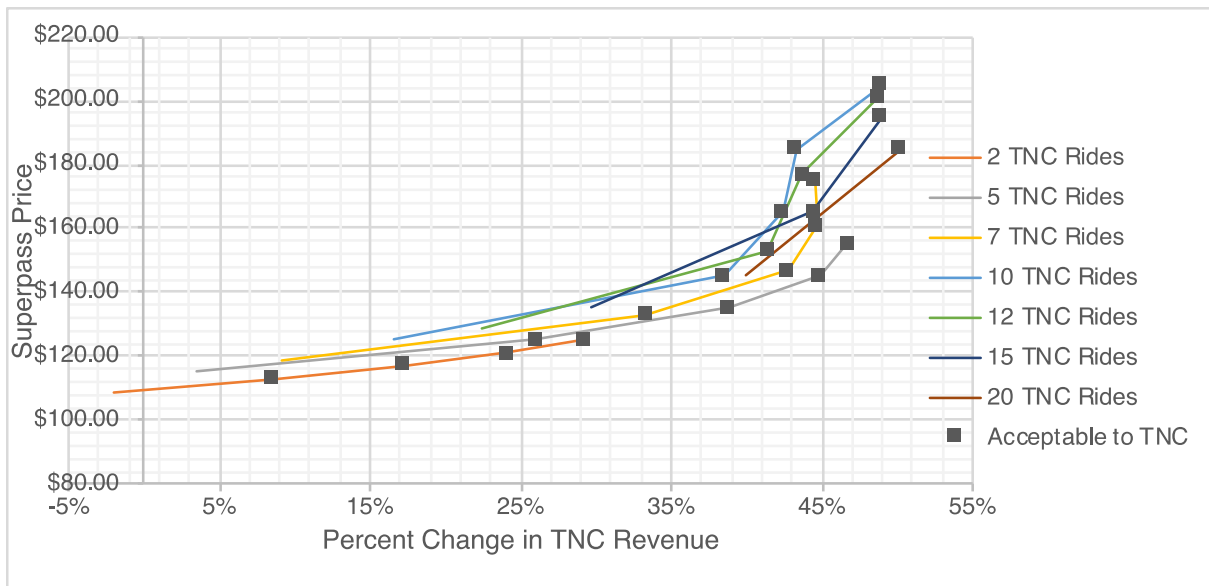
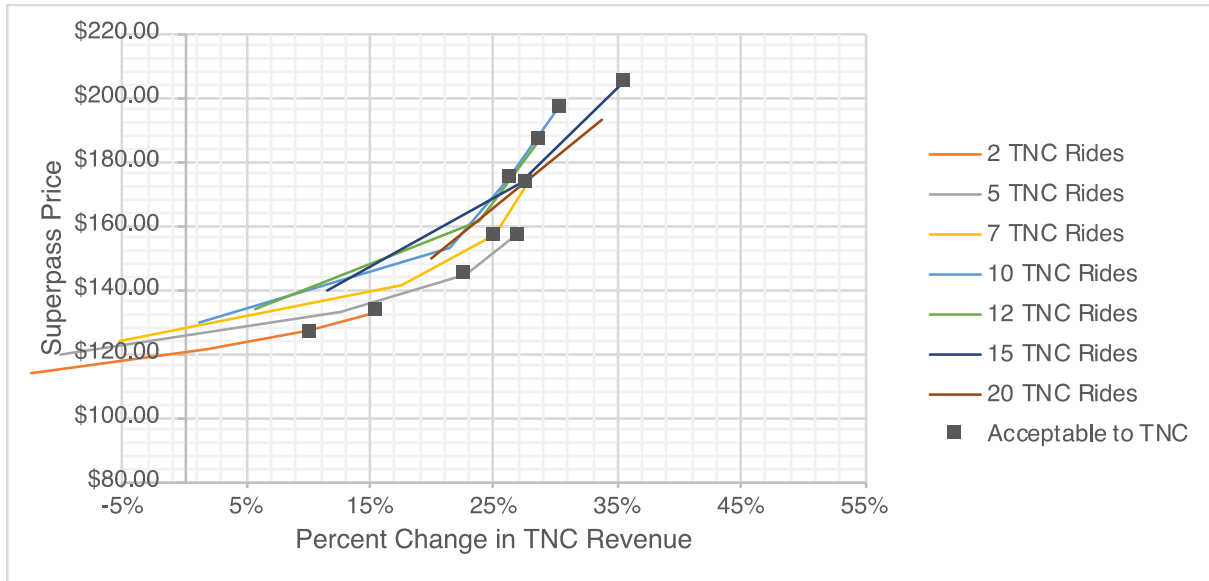


Figure 6-7: Percent Change in TNC Operator Revenue Under Different Non-Metra Superpass Scenarios (Divvy Included)



The next big impact on the selected TNC is in its percent change in ride growth, as shown in the next two figures. As the TNC operator increases people’s overall use of TNCs through their participation in the Superpass, it also switches people over to their platform from competitors. Thus, some calculation is necessary. Note that the induced demand effect from having access to cheaper TNCs is ignored, so these are probably slightly underestimated.

Figure 6-8: Percent Change in TNC Operator Rides in Non-Metra Superpass Scenarios (No Divvy)

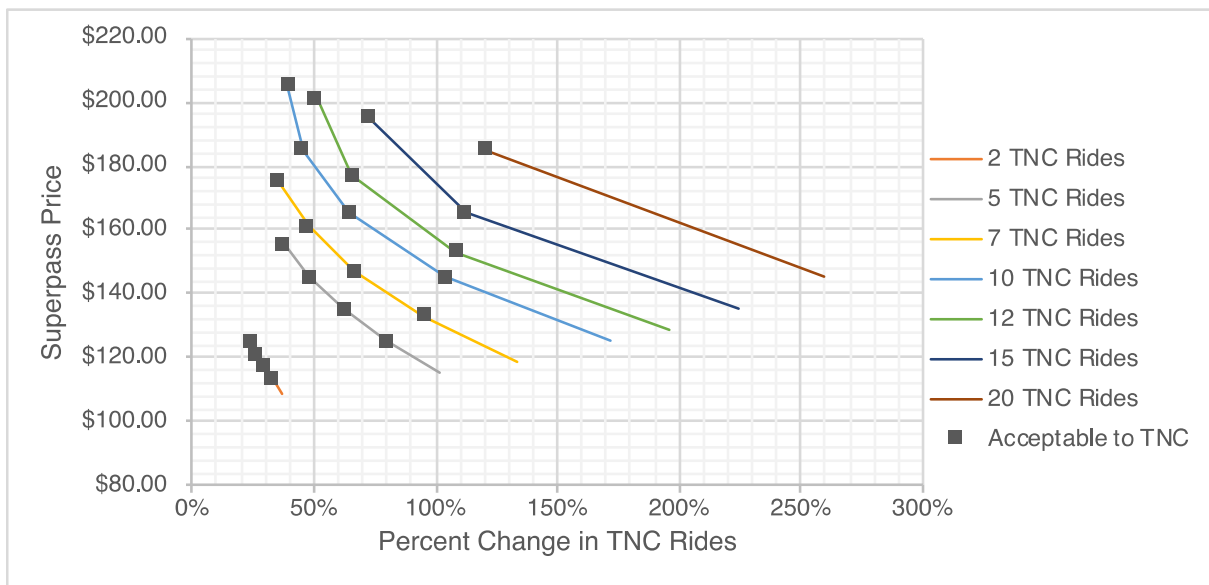
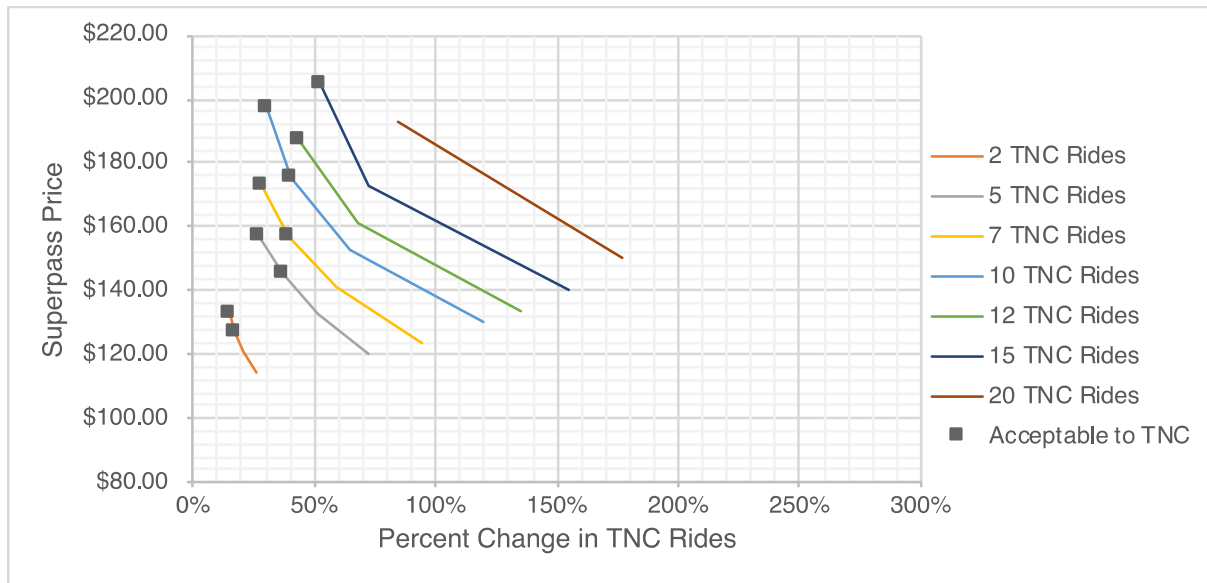


Figure 6-9: Percent Change in TNC Operator Rides in Non-Metra Superpass Scenarios (Divvy Included)



If looking at the points that are acceptable to the TNC in the no-Divvy case in Figure 6-8, a TNC operator starting with a 29% market share has the potential to increase the number of rides it provides by 121% in the 20 TNC Superpass for \$185. This implies a per-ride valuation of \$4. With Divvy included in Figure 6-9, it can increase its rides by up to 53% by offering 15 rides with Divvy for \$205, and this values each ride at \$6 if Divvy gets \$10 in revenue.

### 6.3.3 CTA Impacts

The next figures now show the implications for the CTA. Figure 6-10 and Figure 6-11 show the additional CTA 30-day or Link-up pass holders among the survey respondents under different scenarios, and Figure 6-12 and Figure 6-13 show the percent change in CTA revenue under different scenarios. The percent change in Link-up pass holders is included because some respondents are shown as switching between the Link-up pass and the 30-day pass, and while knowing this is important from a revenue standpoint, the graph looks at the overall holdings of either pass to see the increase in people holding a CTA long term pass product. On each of the graphs the scenario is marked by whether it results in additional revenue for the TNC operator.

Figure 6-10: Percent Change in CTA 30-Day Pass Holders Under Different Non-Metra Superpass Scenarios (No Divvy)

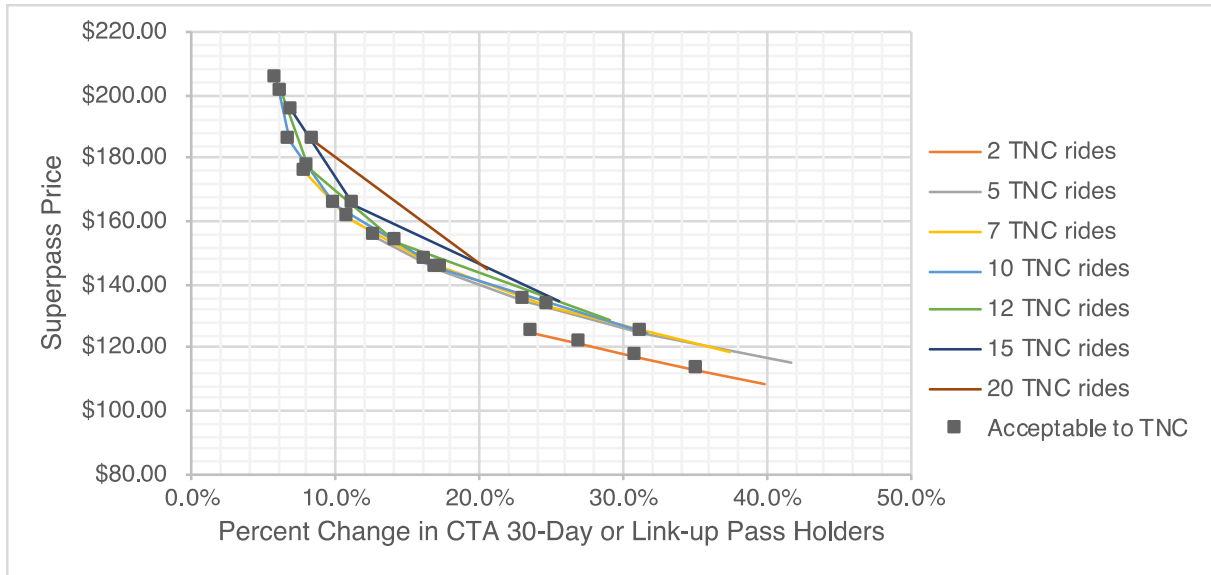


Figure 6-11: Percent Change in CTA 30-Day Pass Holders Under Different Non-Metra Superpass Scenarios (Divvy Included)

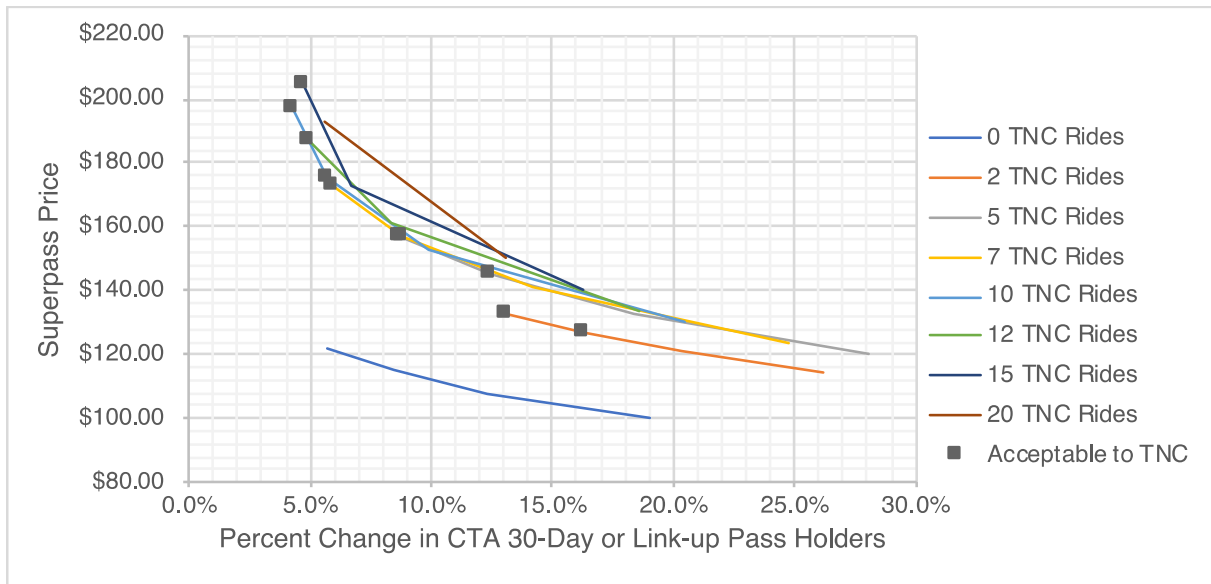


Figure 6-12: Percent Change in CTA Revenue Under Different Non-Metra Superpass Scenarios (No Divvy)

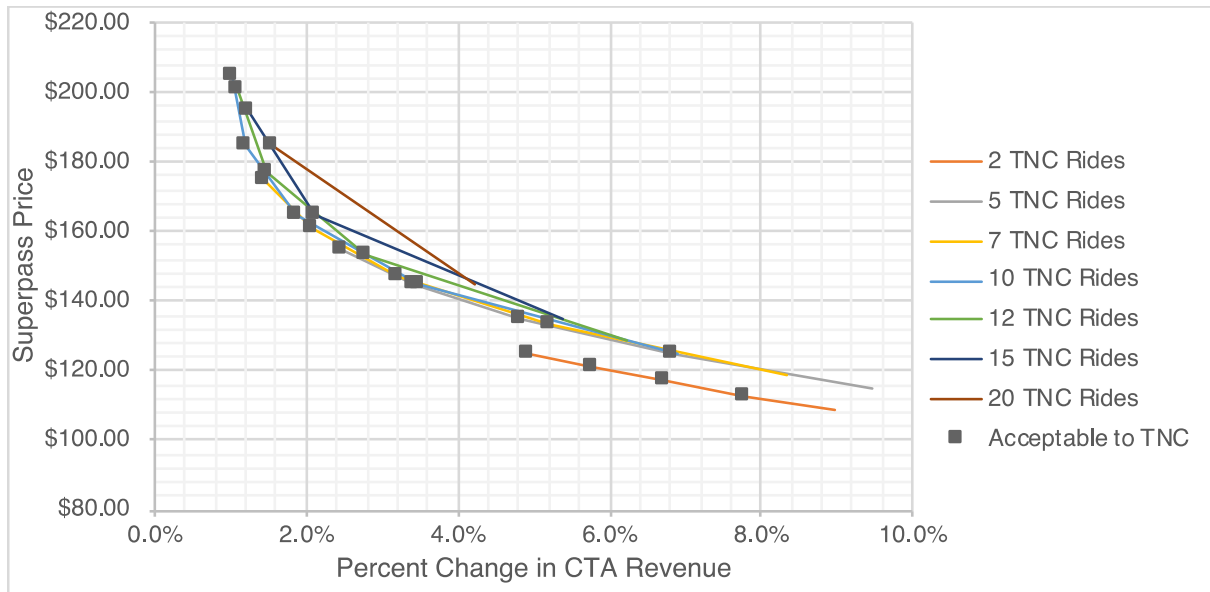
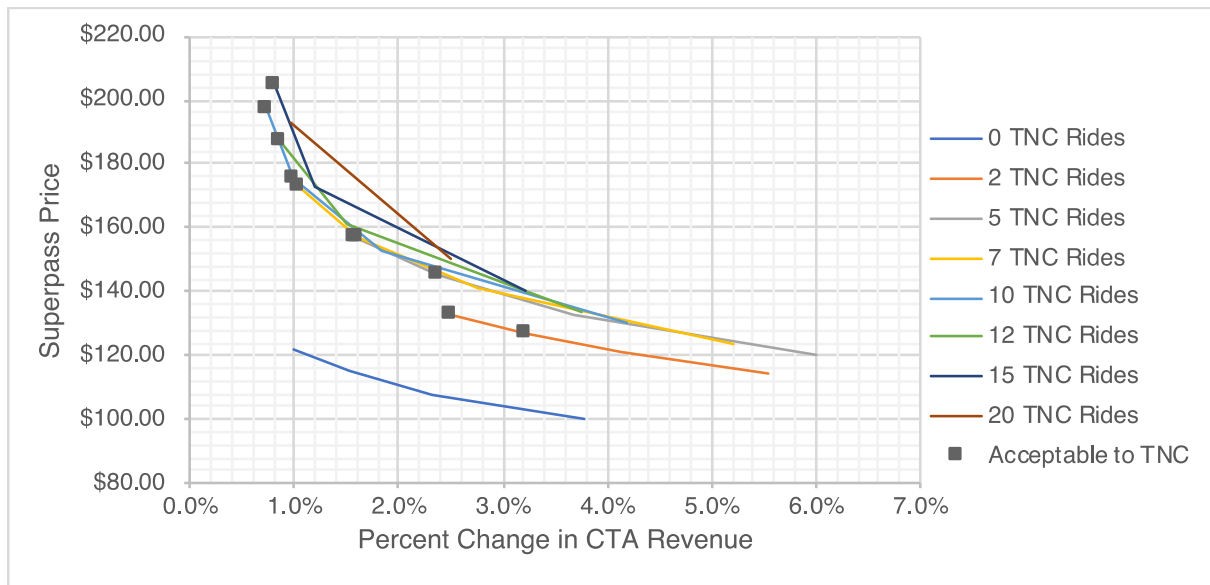


Figure 6-13: Percent Change in CTA Revenue Under Different Non-Metra Superpass Scenarios (Divvy Included)



At the outset, it appears that the introduction of the Superpass increases the CTA 30-day market share and revenue in all scenarios. As shown in the TNC impacts, the inclusion of Divvy reduces all numbers due to the strong negative coefficient that the inclusion of Divvy carries. The magnitude of the percent increases in pass holdings is larger than the increases in revenue, though both are positive. This makes sense as people switching to a pass already had some spending on the CTA, which is now being bumped up to \$105. The scenario in which the TNC operator earns additional revenue and gets at least \$4 per ride that maximizes CTA 30-day passes is the 2 TNC

inclusion without Divvy for \$113 which leads to a 35% increase in passholders. This same pass also maximizes CTA revenue with a 8% increase. An interesting point to also note is that while there are jumps in benefits between the non-inclusion of TNC to 2 rides and then to 5 TNC rides, after that there are diminishing returns as can be seen by the clustering of lines. This is due to the large dip in the magnitude of the TNC coefficient when the number of rides included goes beyond 5 in the Non-Metra model. The implications of this are that the CTA is unaffected by the inclusion of more TNCs after a certain point, which could mean that it allows the TNC operator to supply as many rides as it wishes if it means they offer a competitive price for the CTA pass buyers.

### 6.3.4 Divvy Impacts

Finally, we explore the impacts on Divvy passholders and revenue. This is only done for scenarios in which Divvy is included, as we assume no impact to Divvy in the no-Divvy scenarios. Earlier, it was clear that the inclusion of Divvy reduced benefits for the CTA and the TNC operator. Figure 6-14 and Figure 6-15 show that Divvy stands to gain a hefty amount from its inclusion in the Superpass.

Figure 6-14: Percent Change in Divvy Revenue in Non-Metra Superpass Scenarios

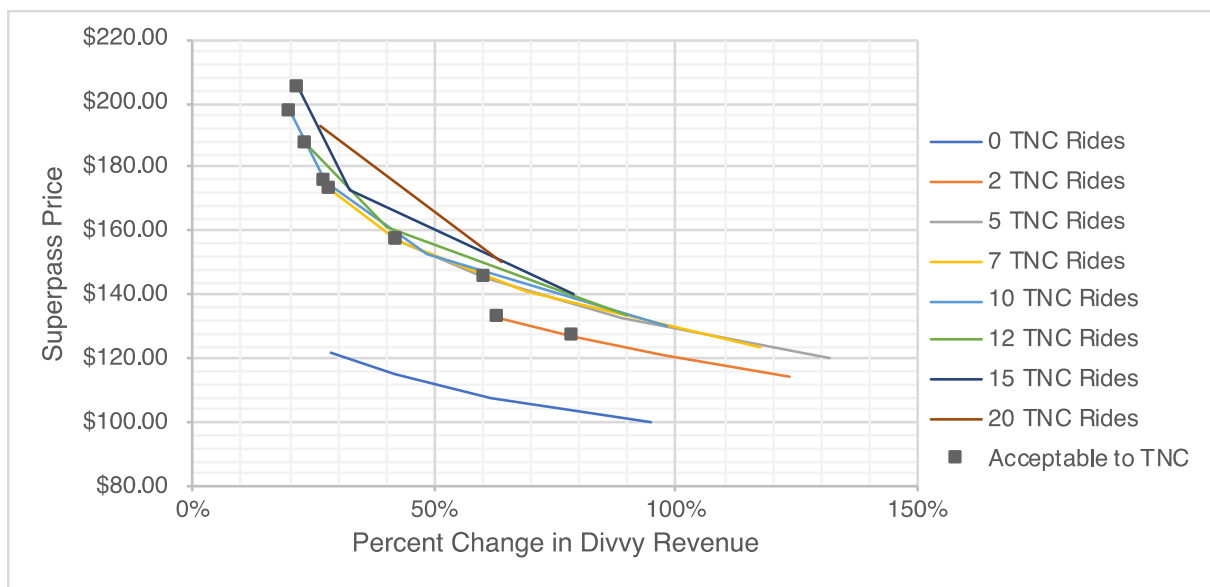
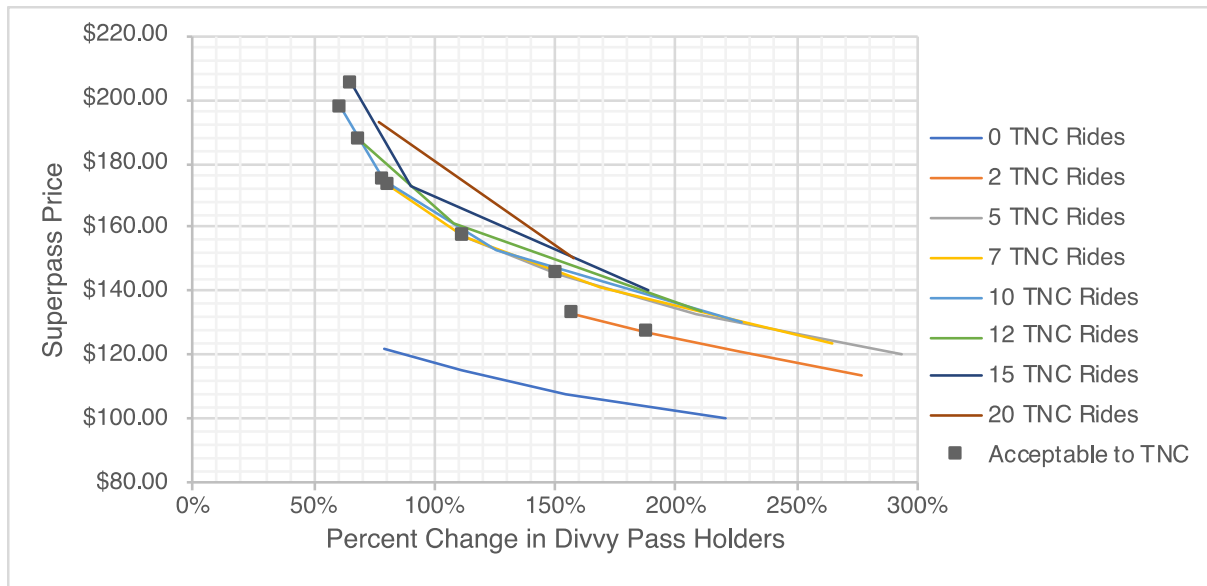


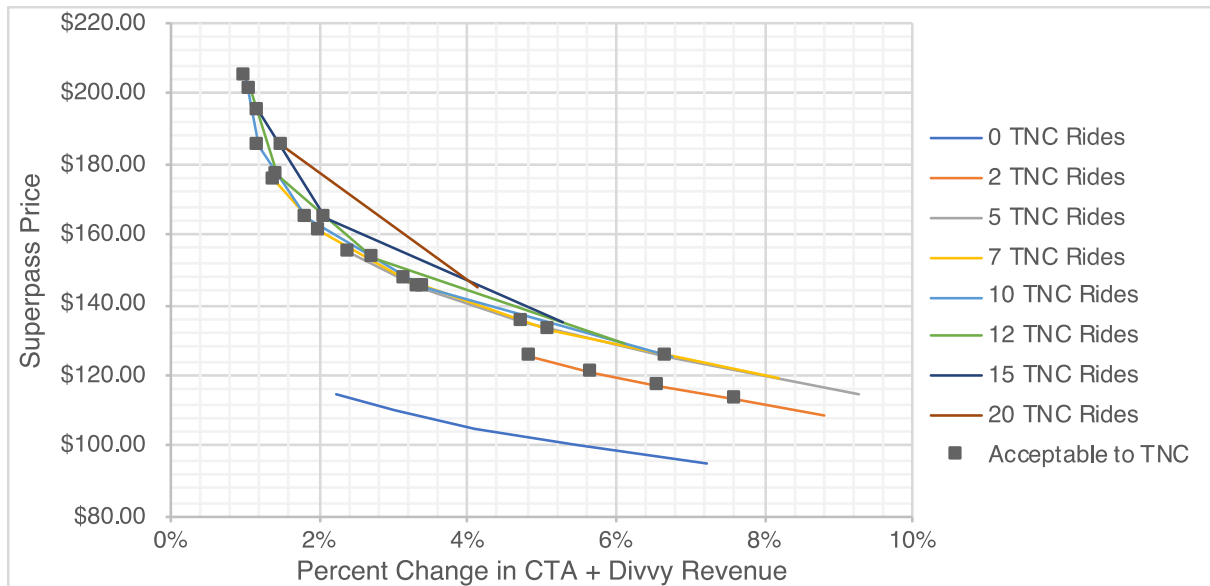
Figure 6-15: Percent Change in Divvy Pass Holders in Non-Metra Superpass Scenarios



Looking only at cases that are acceptable to the TNC operator in Figure 6-15, Divvy can increase its pass holders between 61% and 189% from the Non-Metra Superpass. It can also earn between 20% and 79% additional revenue as shown in Figure 6-14. Note that Divvy currently only sells a day pass and an annual pass, priced at \$15 and \$99 respectively. Its concern with offering a monthly pass would be that people abandon the annual pass in favor of monthly passes in months where weather permits riding. Divvy would need them to purchase monthly passes for at least 10 months in the year to make up for the lost annual pass revenue, with the assumption that they get \$10 for the monthly pass. This may call for either the reduction of the annual pass price, an increase in the assumed monthly pass price, or an understanding from Divvy that with the heavily reduced monthly pass price of \$10 they stand to gain in the long run through more pass sales. Regardless, Figure 6-15 shows the percent increase in overall pass holders and so excludes those who already hold an annual pass. This is grounds for Divvy to explore the creation of annual and season passes, which may be able to bring in non-passholders to a pass.

While Divvy is operated by a private entity (which happens to be owned by Lyft), it is owned by the City of Chicago. Thus, it is useful to look at its benefits if grouped with the CTA, another public sector entity in this pass. Figure 6-16 shows the impacts on their joint revenue.

Figure 6-16: Percent Change in CTA + Divvy Revenue in Non-Metra Superpass Scenarios



The graph looks very similar to the graph of just CTA revenue, and that is because Divvy revenue is much smaller than CTA revenue in magnitude. The optimal case for both of them together is the same case that optimizes just CTA revenue, and results in a 7.6% increase in revenue for both of them.

### 6.3.5 Comparing Stakeholder Impacts

If each of the 3 entities (plus TNC industry as a whole) were only concerned with their own revenue and market growth, Table 6-1 shows the “greedy” optimal bundle for each. This only looks at overall revenue percent increases, not “profit”, which would narrow down some of the cases for the TNC as its costs increase from providing more rides, though it does earn at least \$4 per ride in these cases.

Table 6-1: Optimal Non-Metra Pass Configurations for TNC Industry, TNC Operator, CTA, and Divvy from Revenue and Market Growth Perspective

		<b>TNC Industry</b>	<b>TNC Operator</b>	<b>CTA</b>	<b>Divvy</b>
<b>Revenue</b>	No Divvy	10 rides for \$205 (+8%)	20 rides for \$185 (+50%)	2 rides for \$113 (+8%)	-
	Divvy Included	15 rides for \$205 (+3%)	15 rides for \$205 (36%)	2 rides for \$127 (+3%)	2 rides for \$127 (+79%)
<b>Growth in Rides or Pass Holders</b>	No Divvy	20 rides for \$185 (+24%)	20 rides for \$185 (+121%)	2 rides for \$113 (+35%)	-
	Divvy Included	15 rides for \$205 (+8%)	15 rides for \$205 (+53%)	2 rides for \$127 (+16%)	2 rides for \$127 (+189%)



From the numbers in Table 6-1, it is clear that the CTA earns more money with lower cost passes while the TNC operator earns more from higher cost passes. Divvy and the CTA seem to maximize their benefits from the same pass configurations. In order to select potential optimal bundles out of the 62 original scenarios, we must narrow down based on some metrics. The plausible scenarios can be narrowed between these two bounds first by looking solely at the “Acceptable to TNC” scenarios, where they earn additional revenue and get at least \$4 per ride. These conditions for the moment put aside other possible benefits for the TNC by taking part in a Superpass (greater exposure, strengthening bonds with the public sector, perception, etc.). All scenarios technically would be acceptable to the CTA and Divvy because they earn additional revenue and pass sales, but other narrowing conditions can be applied. It can be assumed that the marginal cost to the CTA and Divvy of providing service to the new passholders (and thus the increased ridership) is negligible, except for the management costs of the Superpass. Table 6-2 shows the scenarios that were marked with “Acceptable to TNC” and the impacts on the TNC operator, TNC industry, and the CTA. Divvy has been omitted for space considerations, but its optimal pass curves generally match those of the CTA.

Table 6-2: Non-Metra Superpass Scenarios Assumed to be Acceptable to TNC Operator

No.	Price (\$)	Divvy	TNC	Percent Increase in 30-Day Passes	Percent Increase in CTA Revenue	Percent Increase in TNC Industry Rides	Percent Increase in TNC Operator Rides	Percent Increase in TNC Industry Revenue	Percent Increase in TNC Operator Revenue	TNC Revenue per Ride (\$)
1	113	0	2	35%	8%	2%	33%	-6%	9%	4
2	117	0	2	31%	7%	1%	30%	-3%	17%	6
3	121	0	2	27%	6%	1%	27%	-1%	24%	8
4	125	0	2	24%	5%	1%	24%	2%	29%	10
5	125	0	5	31%	7%	8%	80%	-8%	26%	4
6	135	0	5	23%	5%	6%	62%	-2%	39%	6
7	145	0	5	17%	3%	4%	48%	3%	45%	8
8	155	0	5	13%	2%	3%	38%	5%	47%	10
9	133	0	7	25%	5%	12%	95%	-7%	33%	4
10	147	0	7	16%	3%	8%	67%	0%	43%	6
11	161	0	7	11%	2%	5%	48%	4%	45%	8
12	175	0	7	8%	1%	4%	36%	6%	45%	10
13	145	0	10	17%	3%	15%	104%	-4%	38%	4
14	165	0	10	10%	2%	8%	65%	2%	42%	6
15	185	0	10	7%	1%	6%	46%	5%	43%	8
16	205	0	10	6%	1%	5%	39%	8%	49%	10
17	153	0	12	14%	3%	17%	108%	-2%	41%	4
18	177	0	12	8%	1%	10%	66%	3%	44%	6
19	201	0	12	6%	1%	7%	51%	7%	49%	8

20	165	0	15	11%	2%	19%	112%	0%	44%	4
21	195	0	15	7%	1%	12%	73%	5%	49%	6
22	185	0	20	9%	2%	24%	121%	3%	50%	4
23	127	1	2	16%	3%	1%	18%	-2%	10%	6
24	133	1	2	13%	3%	0%	15%	0%	16%	9
25	145	1	5	12%	2%	3%	37%	-2%	23%	6
26	157	1	5	9%	2%	2%	27%	1%	27%	8
27	157	1	7	9%	2%	4%	39%	-1%	25%	6
28	173	1	7	6%	1%	3%	28%	2%	28%	8
29	175	1	10	6%	1%	5%	40%	1%	26%	6
30	197	1	10	4%	1%	4%	31%	3%	30%	8
31	187	1	12	5%	1%	6%	43%	2%	29%	6
32	205	1	15	5%	1%	8%	53%	3%	36%	6

Having narrowed down the original 62 scenarios to 32 scenarios, they can be visually shown to make better sense of them. The revenue and ride/passholder growth figures between the CTA and TNC operator and between the CTA and TNC industry are shown in the four figures that follow. The Divvy and no-Divvy scenarios are combined in each graph. These graphs can be used by each stakeholder to isolate scenarios that would be acceptable to them. For example, the CTA or TNC operator might have minimum revenue gain requirements from the Superpass. Regulators might only push for scenarios where it is clear that overall there is not much growth in TNC industry rides or even a loss in TNC industry revenue.

Figure 6-17: Change in TNC Operator Revenue Versus Change in CTA Revenue in Non-Metra Superpass Scenarios

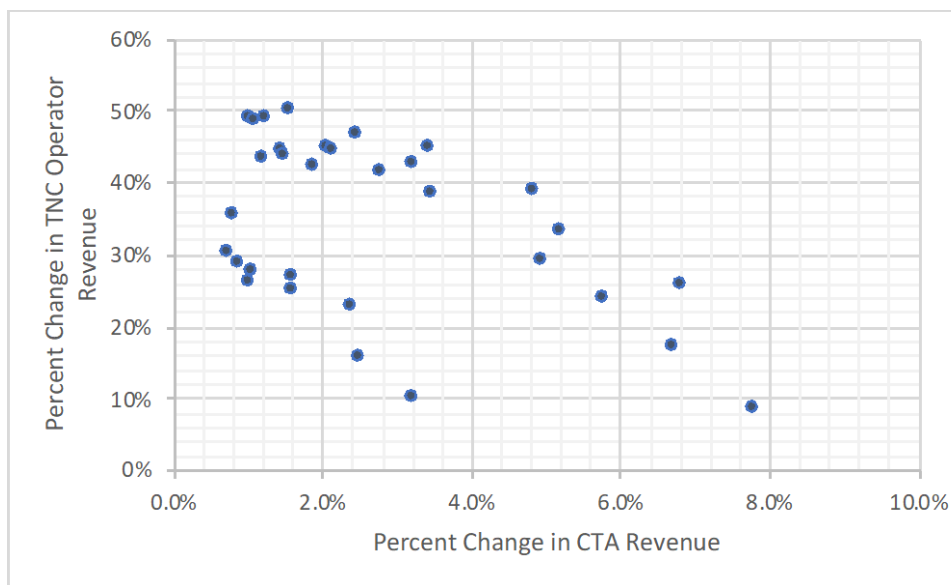


Figure 6-18: Change in TNC Operator Rides Versus Change in 30-Day Pass Holders in Non-Metra Superpass Scenarios

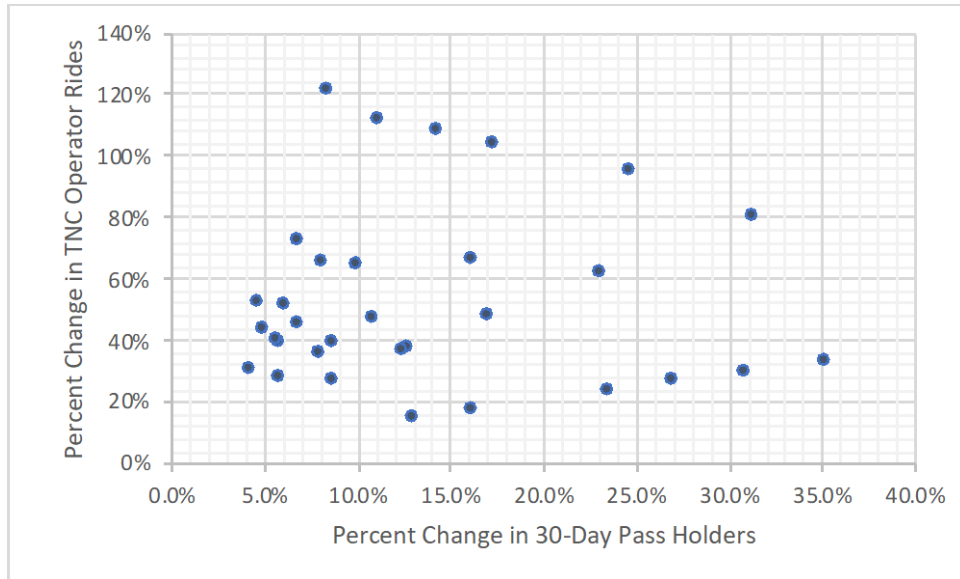


Figure 6-19: Change in TNC Industry Revenue Versus Change in CTA Revenue in Non-Metra Superpass Scenarios

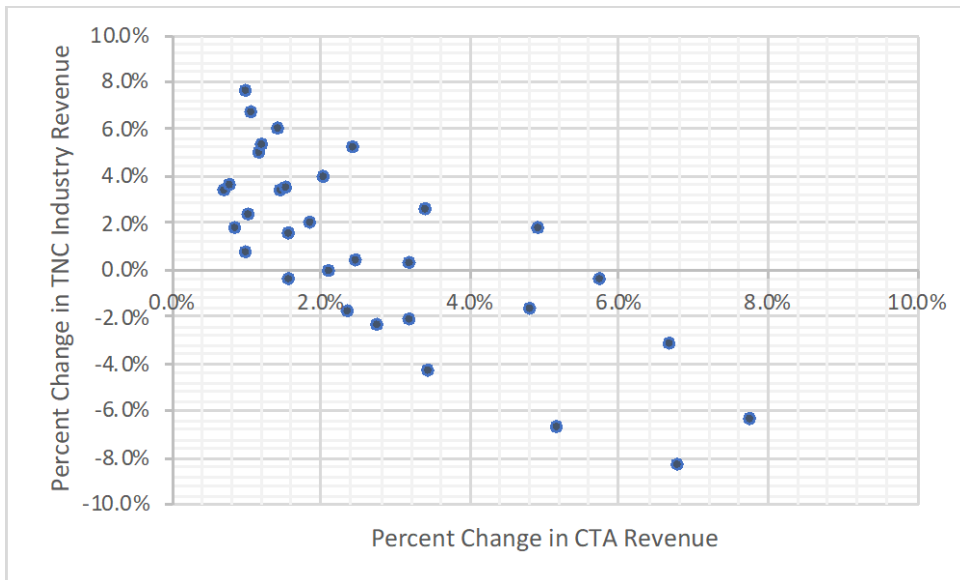
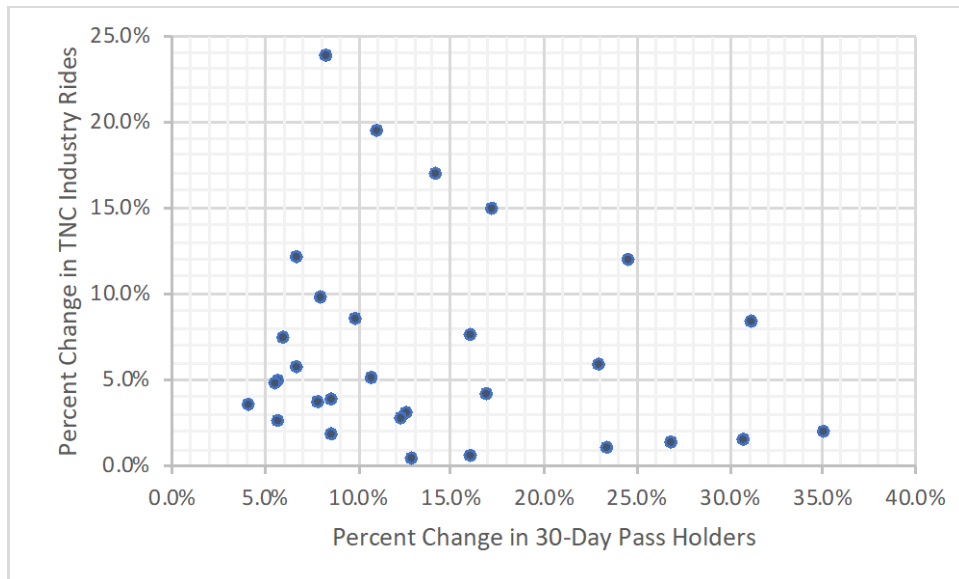


Figure 6-20: Change in TNC Industry Rides Versus Change in 30-Day Pass Holders in Non-Metra Superpass Scenarios



For revenue, there appears to be an inverse relationship between benefits to the CTA and benefits for the TNC operator. However, this relationship is not as clear when comparing ride and pass holder growth. The question lies in what the optimal bundle would be taking into account minimum acceptable conditions set by the CTA, TNC, Divvy, and of course, the City, who would be interested in system-wide impacts due to the Superpass. The points on these graphs will guide the discussion in 6.5 that details the different objectives of stakeholders and the metrics they might see as valuable to them. This knowledge can better prepare the CTA or any policymaker that is entering into negotiations to bring together partners to create the Superpass.

## 6.4 Metra Superpass Scenarios

Next, Metra Superpass scenarios were tested in a similar fashion to those of the Non-Metra pass. Recall that because the Metra Superpass assumes the possession of a Metra monthly pass, these scenarios were only applied to the respondents who currently already have a Metra monthly pass.

### 6.4.1 TNC Industry Impacts

As was done with the Non-Metra scenarios, we first examine the impacts on the TNC industry as a whole, that is, looking at revenue and ride gains for TNCs as a mode in general. The gains are much smaller than with the Non-Metra pass. In terms of revenue, even in the best case the industry only gains about 3% but can also lose as much as 10% as shown in Figure 6-21. With Divvy included in Figure 6-22, it mostly loses money or can just about break even. In terms of ridership growth of TNCs, it could gain up to 8% without Divvy under the “acceptable to TNC” conditions of earning revenue and receiving at least \$4 for each ride. With Divvy, it could gain up to 2% as shown in Figure 6-24.

Figure 6-21: Percent Change in TNC Industry Revenue Under Different Metra Superpass Scenarios (No Divvy)

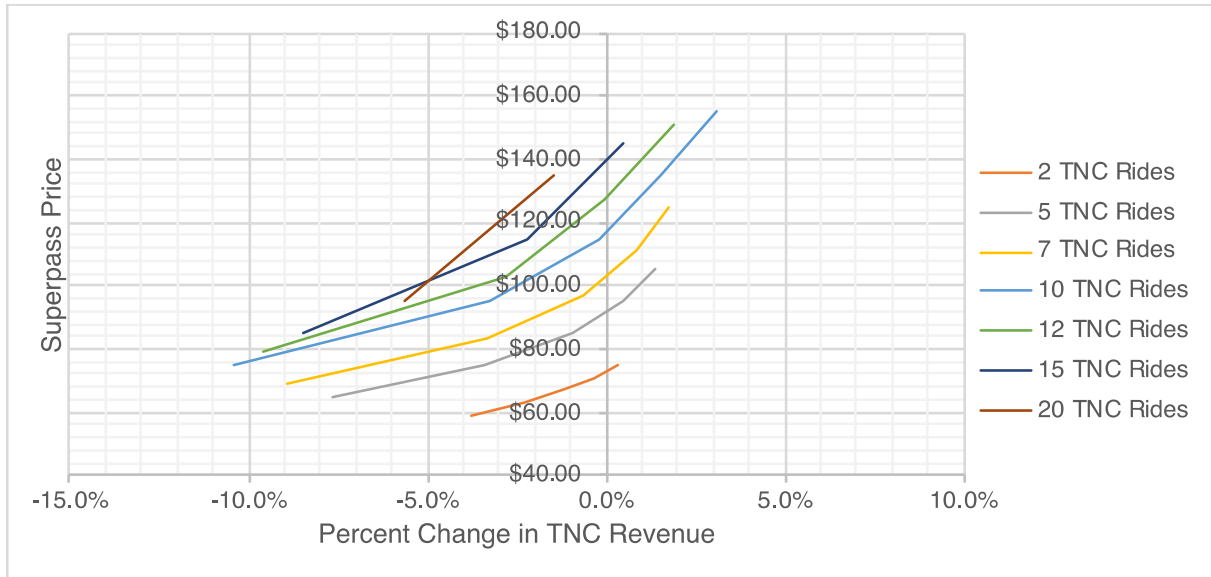


Figure 6-22: Percent Change in TNC Industry Revenue Under Different Metra Superpass Scenarios (Divvy Included)

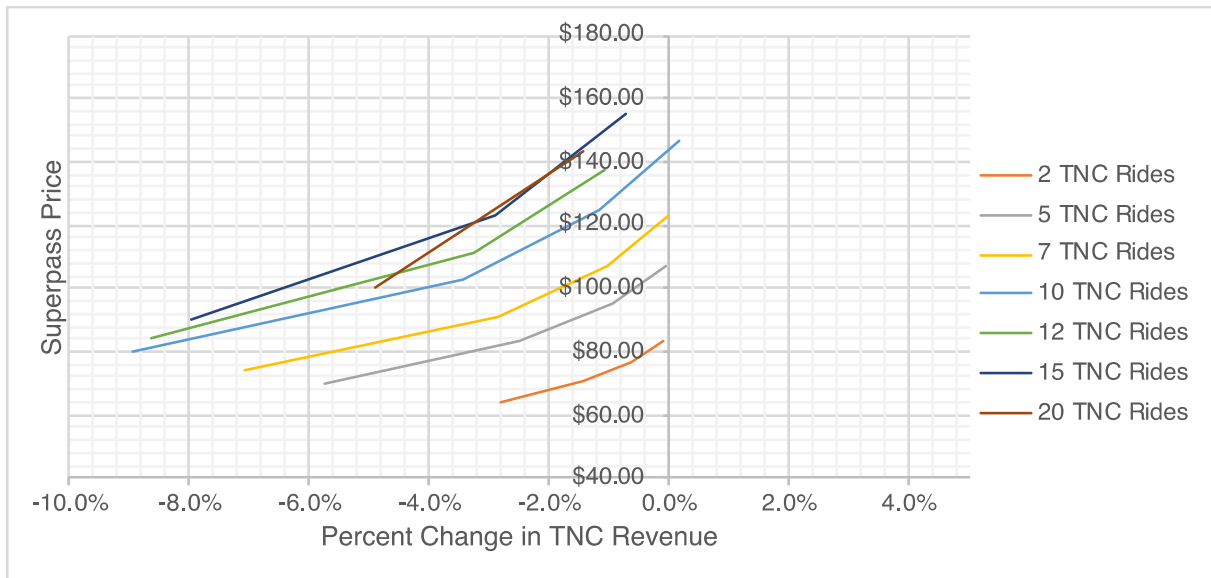


Figure 6-23: Percent Change in TNC Industry Ride Growth Under Different Metra Superpass Scenarios (No Divvy)

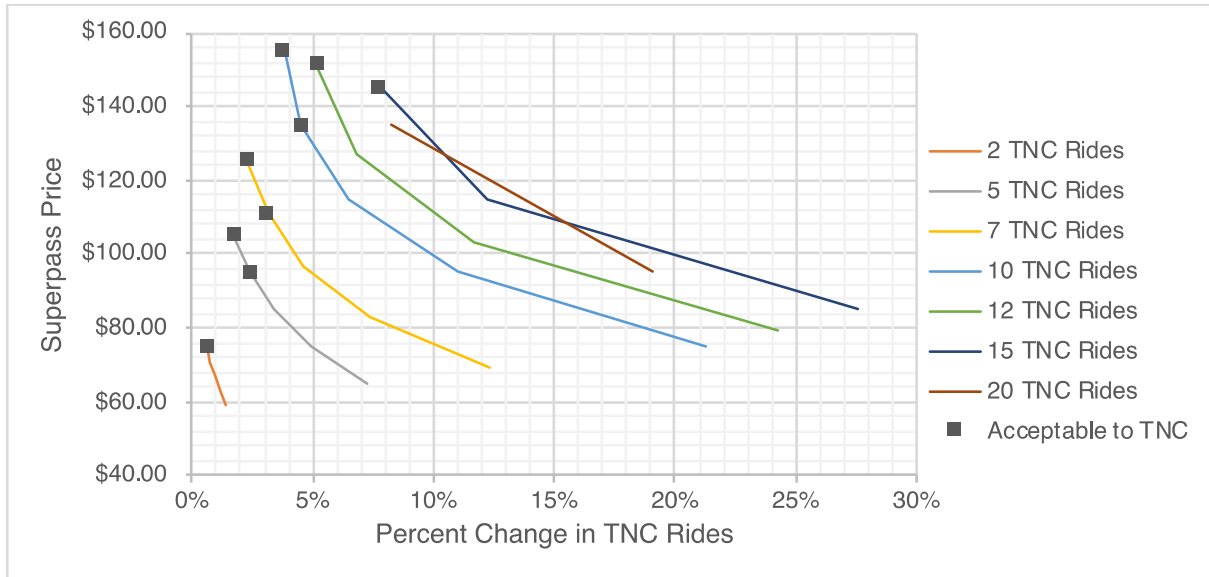
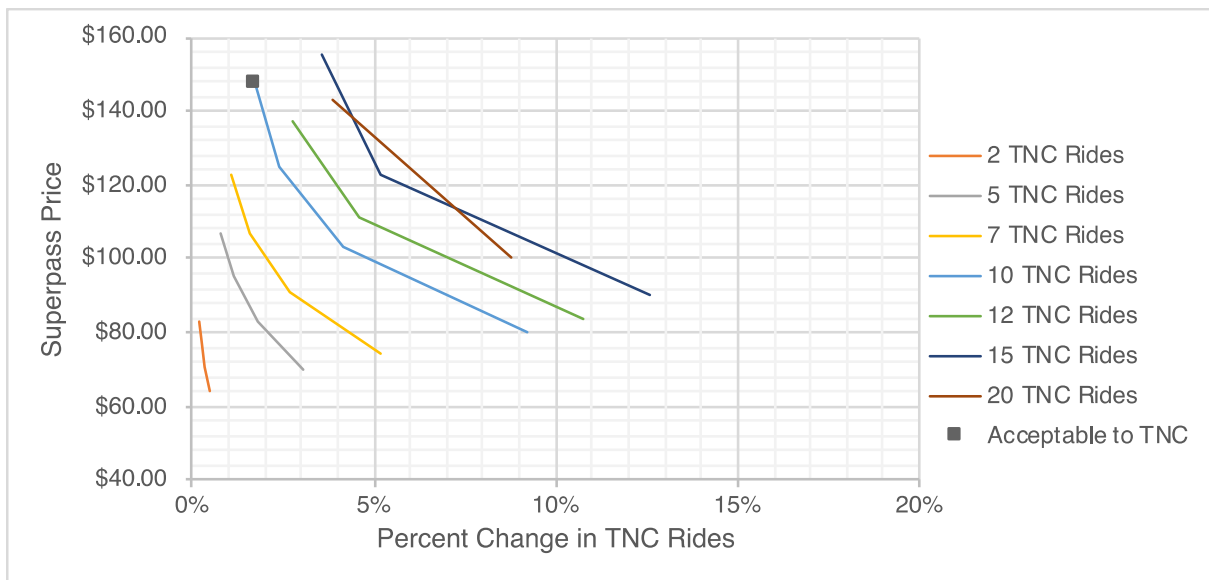


Figure 6-24: Percent Change in TNC Industry Ride Growth Under Different Metra Superpass Scenarios (Divvy Included)



### 6.4.2 TNC Operator Impacts

Next, we look at the impacts on whichever TNC operator wins the Superpass contract. As with the Non-Metra scenario, a 29% starting market share is assumed for the TNC. This assumption could be tested, especially given that Lyft probably has a lower market share in suburban areas relative to Uber and surely relative to Via, but for consistency and comparability with the Non-Metra scenario it is kept at 29%. Further, it is possible that these users still take their TNC rides in the Chicago city area despite the fact that they might be more likely to live in the suburbs.

Figure 6-25: Percent Change in TNC Operator Revenue in Metra Superpass Scenarios (No Divvy)

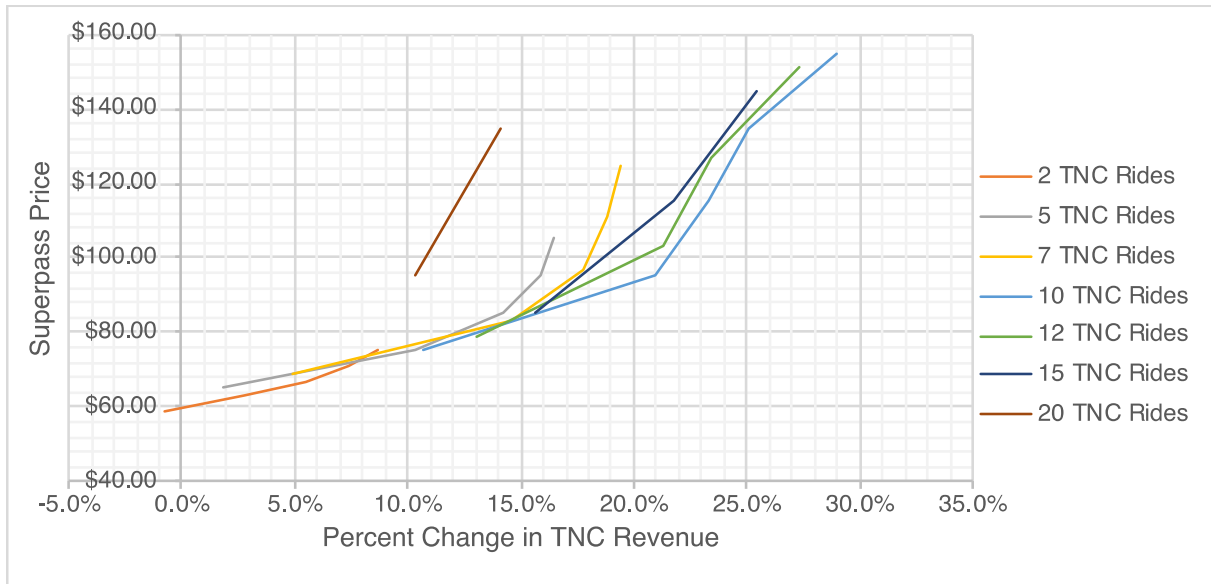


Figure 6-26: Percent Change in TNC Operator Revenue in Metra Superpass Scenarios (Divvy Included)

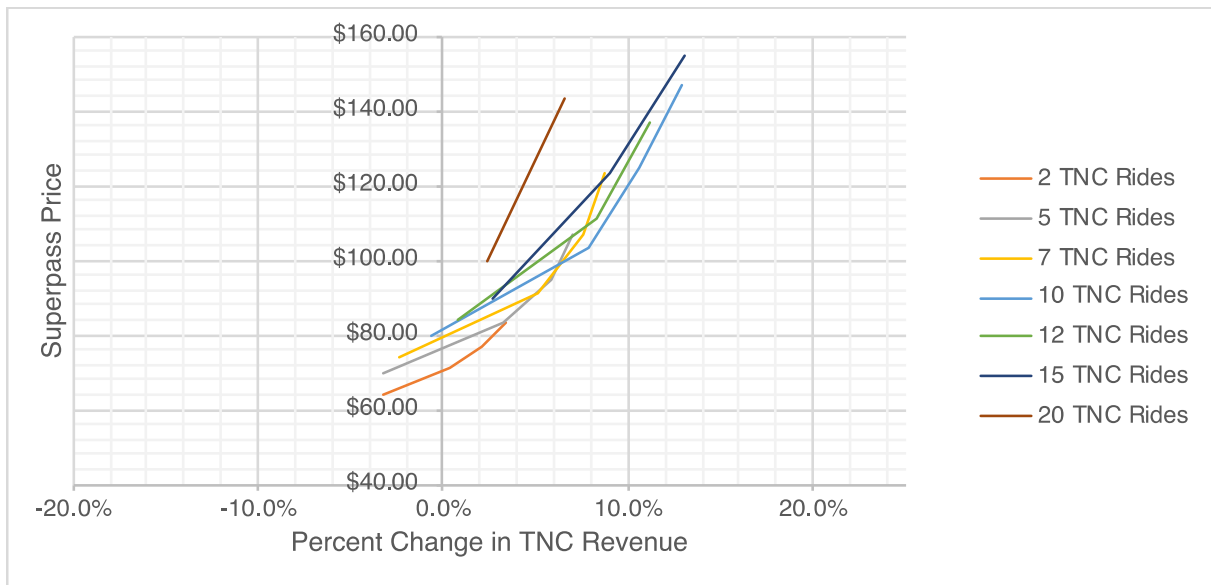


Figure 6-27: Percent Change in TNC Operator Rides in Metra Superpass Scenarios (No Divvy)

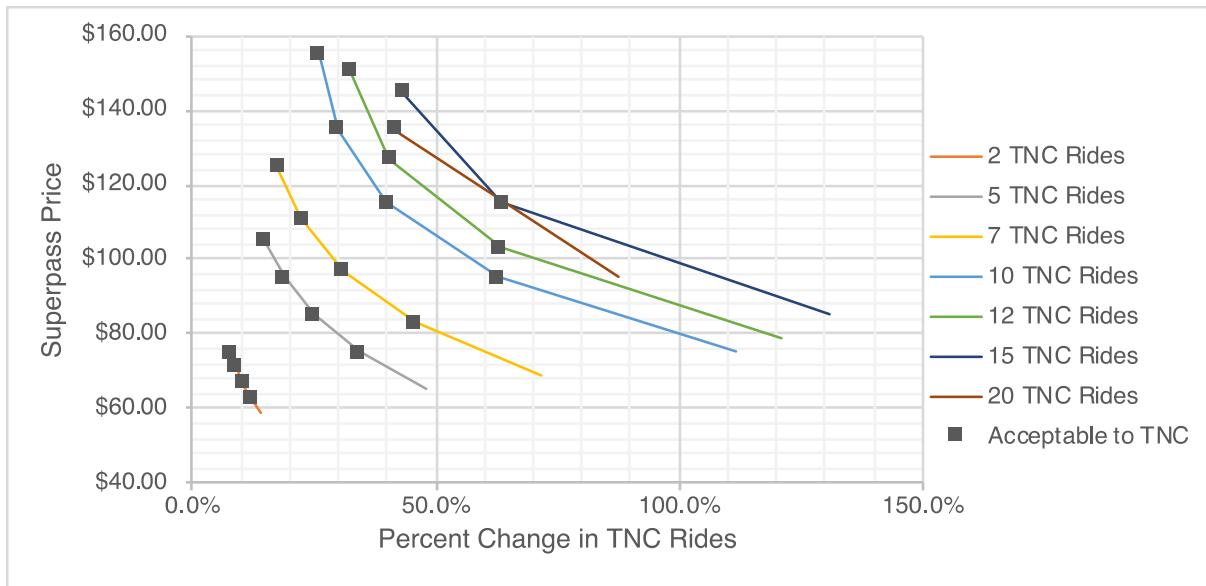
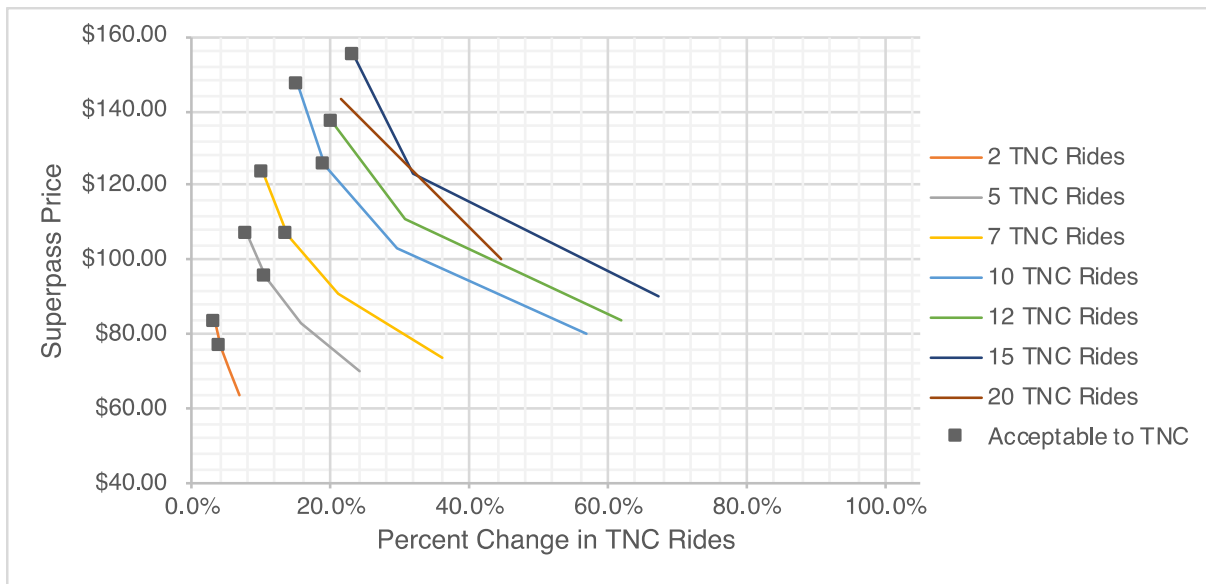


Figure 6-28: Percent Change in TNC Operator Rides in Metra Superpass Scenarios (Divvy Included)



The TNC operator can grow the number of rides they provide by up to 64% in the no-Divvy scenarios shown in Figure 6-27 or up to 23% with Divvy as shown in Figure 6-28. This is quite a bit less than in the Non-Metra situation, where they could increase their rides by 121% and 53% for the no-Divvy and Divvy configurations, respectively.



### 6.4.3 CTA Impacts

The following figures now show the increase in the Link-up pass or 30-day pass holders and revenue impacts for the CTA of different scenarios on current Metra monthly pass holders. Recall that the Metra Superpass is essentially a CTA Metra Link-up pass, which is only available to those who currently hold a Metra monthly pass.

Figure 6-29: Percent Change in CTA Metra Link-up or 30-Day Pass Holders Under Different Metra Superpass Scenarios (No Divvy)

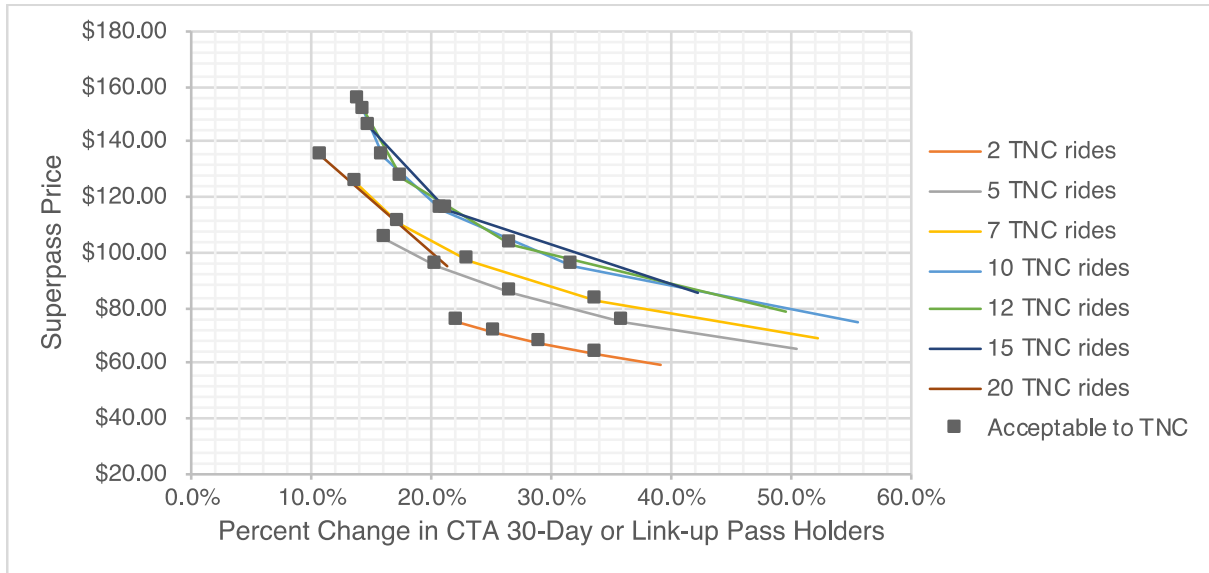


Figure 6-30: Percent Change in CTA Metra Link-up or 30-Day Pass Holders Under Different Metra Superpass Scenarios (Divvy Included)

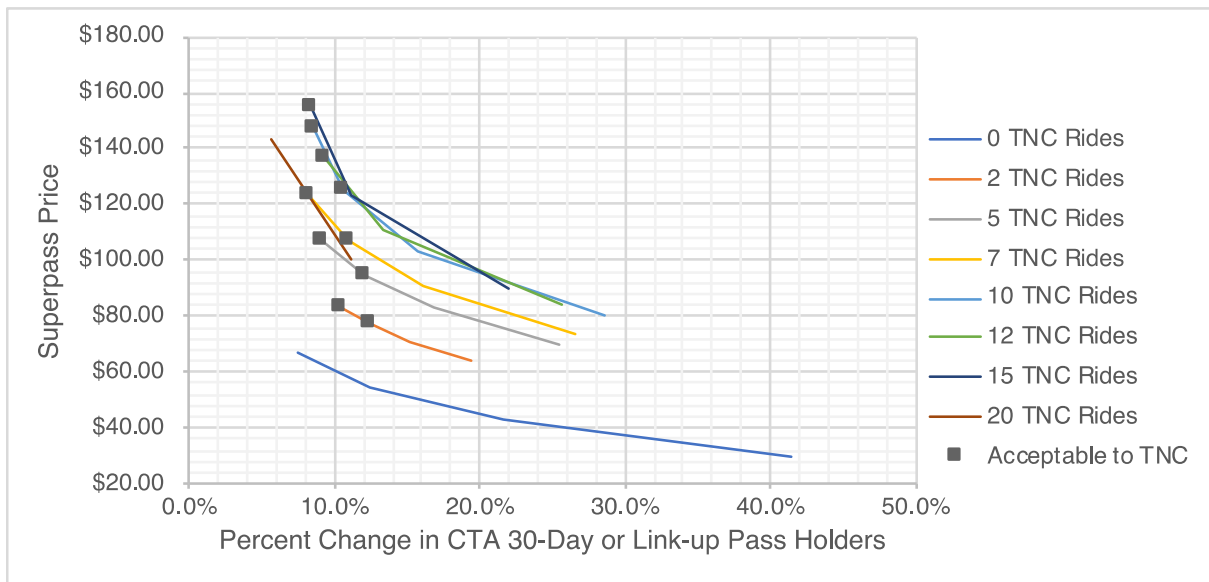


Figure 6-31: Percent Change in CTA Revenue from Metra Monthly Passholders Under Different Metra Superpass Scenarios (No Divvy)

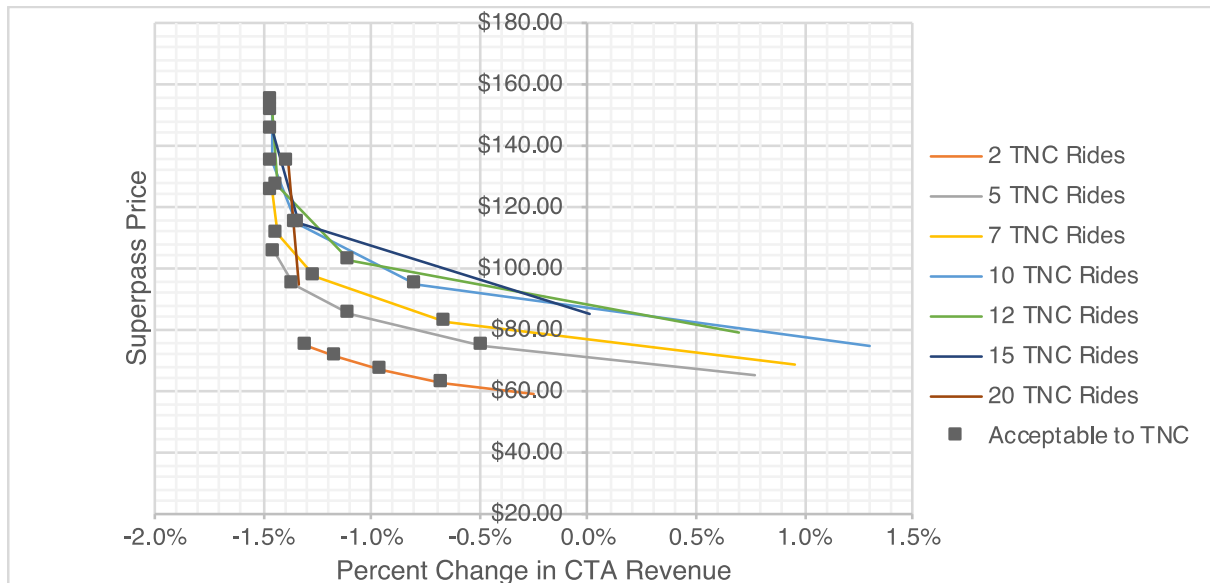
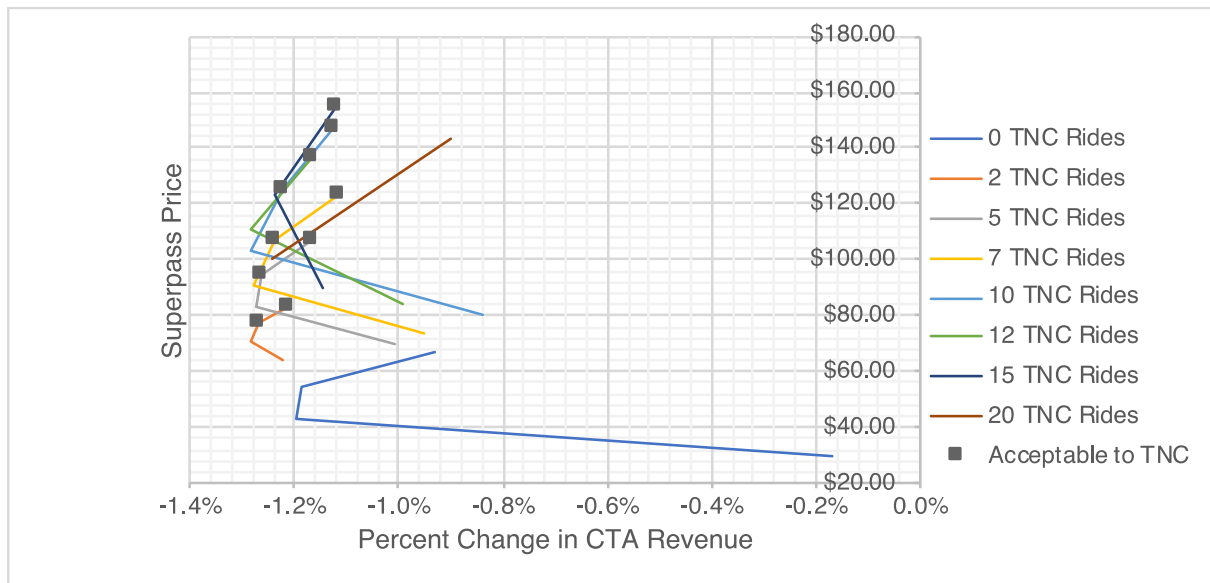


Figure 6-32: Percent Change in CTA Revenue from Metra Monthly Passholders Under Different Metra Superpass Scenarios (Divvy Included)



The figures above paint a fascinating picture. With respect to new CTA pass sales (so this excludes current 30-day pass holders who opt for the Metra Superpass), there are high percent increases in sales for the CTA but not much change in revenue. The TNC operator would only be willing to accept scenarios where the CTA earns up to around 36% in additional pass sales without Divvy included, and at the 12% level with Divvy included. It is important to note that the percent increases in pass sales are large also due to the fact that in the sample population of Metra monthly pass users, only 17 respondents currently have a Metra Link-up or 30-day CTA pass. Thus, it is this number that is being increased by the Metra Superpass. On the revenue front, the CTA could

gain a 1.3% increase in revenue with the 10 TNCs for \$75 scenario, but the scenarios that the TNC operator would accept result in an essentially revenue-neutral situation, where the numbers range between 0% and -1%. In fact, the curves in Figure 6-32 are shaped oddly because the changes in revenue are so miniscule that x axis has to range between -1.5% and 0.5%, making small changes look dramatic. The low values are not surprising given that in the SP design, the internal price of the CTA add-on was kept at a rather overpriced \$55 to mimic reality, and today with this price the Link-up pass accounts for less than 1% of the CTA's annual ridership because so few people purchase it. The dramatic difference between pass sale increase and revenue increase is likely due to the fact that these buyers are already spending on average around \$55 on the CTA in addition to their Metra monthly pass, but for some reason do not already have a Link-up pass. This could be because of the restrictions on times and days when it is valid and from lack of awareness among the population.

#### 6.4.4 Divvy Impacts

Finally, we can look at Divvy impacts. First, it is important to note that out of the 196 Metra monthly pass holder respondents, only 4 have a Divvy annual pass and Divvy only earns \$96 per month from all of them. Thus, any change in Divvy metrics should be viewed relative to these starting conditions.

Figure 6-33: Percent Change in Divvy Revenue in Metra Superpass Scenarios

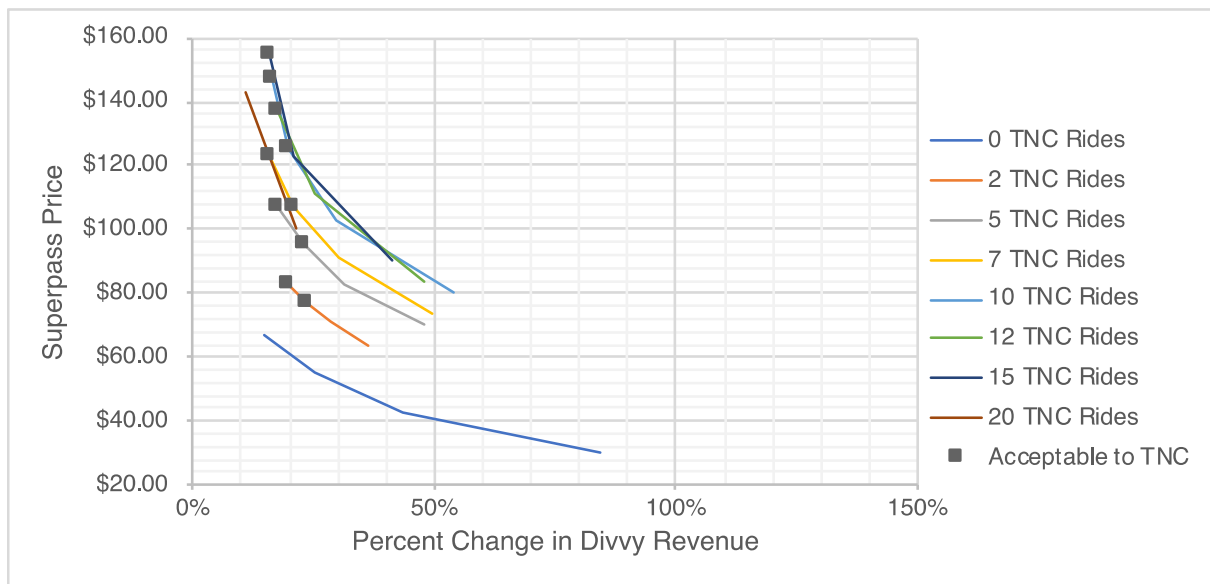
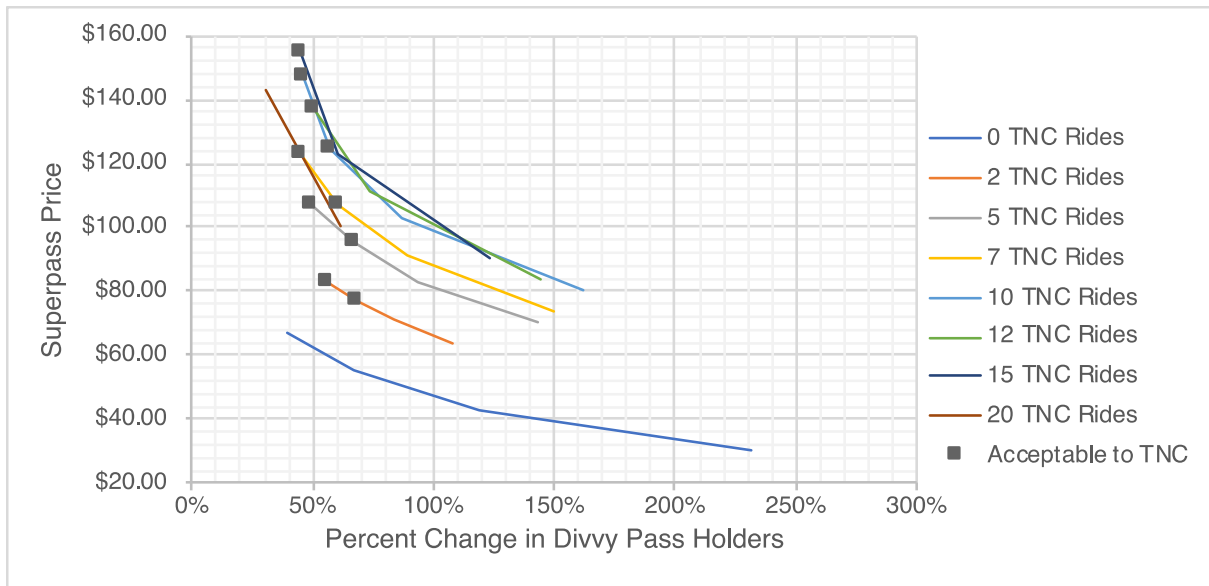
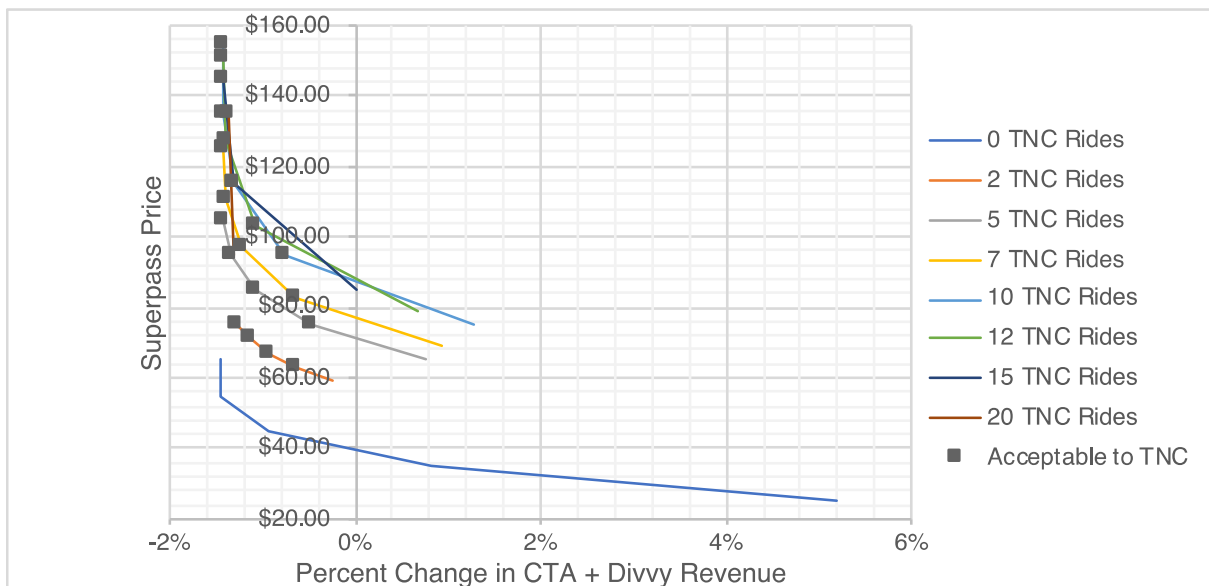


Figure 6-34: Percent Change in Divvy Pass Holders in Metra Superpass Scenarios



Divvy can increase its revenue of \$94 by 23% at a maximum (where the scenario is acceptable to the TNC operator). Further, it can increase its 4 pass holders by 68%, or by about 2.7 passes among the 196 current Metra monthly pass holders. Percentage-wise, these are healthy numbers but are miniscule in absolute terms. Further, the increases are constrained by the scenarios that we have stipulated the TNC would be likely to accept. Finally, below is a look at CTA and Divvy revenue numbers combined. As with the Non-Metra scenario, combining the two does not yield new insights as the CTA revenue dwarfs Divvy revenue and the curves follow the same pattern as just CTA revenue.

Figure 6-35: Percent Change in CTA + Divvy Revenue in Metra Superpass Scenarios



#### 6.4.5 Comparing Stakeholder Impacts

There are some key differences when comparing the curves of the Metra and Non-Metra scenarios. For example, the varying number of TNC rides has a greater impact on increasing pass purchases, as would be expected given the coefficient signs for the different TNC bands. Recall that in the Non-Metra scenarios after the inclusion of 5 TNC rides the curves started to overlap and cluster. In the Metra pass, we do see that there are diminishing returns after a certain number of TNC rides.

As was done with the Non-Metra scenarios, Table 6-3 shows the “greedy” optimum for each player.

Table 6-3: Optimal Metra Pass Configurations for TNC Industry, TNC Operator, CTA, and Divvy as Measured by Different Metrics

		<b>TNC Industry</b>	<b>TNC Operator</b>	<b>CTA</b>	<b>Divvy</b>
<b>Revenue</b>	No Divvy	10 rides for \$155 (3%)	10 rides for \$155 (8%)	7 rides for \$83 (0%)	-
	Divvy Included	10 rides for \$147 (0.3%)	10 rides for \$147 (3%)	15 rides for \$155 (-1%)	2 rides for \$77 (18%)
<b>Growth in Rides or Pass Holders</b>	No Divvy	10 rides for \$147 (2%)	10 rides for \$15 (21%)	7 rides for \$83 (30%)	-
	Divvy Included	20 rides for \$193 (17%)	15 rides for \$115 (7%)	2 rides for \$77 (11%)	2 rides for \$77 (54%)

As was done in the Non-Metra section, we can narrow down the 62 scenarios to just those where the TNC operator earns money and receives at least \$4 per ride it provides. Under those conditions, the 62 scenarios can be narrowed down to 32 just like in the Non-Metra case, which are shown in Table 6-4. The CTA loses money in all scenarios acceptable to the TNC operator, but it is only by about 1% in all cases. The real benefit is in the percent increase of CTA passes sold. This value ranges from about 8% to 36%.

Table 6-4: Metra Superpass Scenarios Assumed to be Acceptable to TNC Operator

No.	Price (\$)	Divvy	TNC	Percent Change in 30-Day Passes	Percent Change in CTA Revenue	Percent Change in TNC Industry Rides	Percent Change in TNC Operator Rides	Percent Change in TNC Industry Revenue	Percent Change in TNC Operator Revenue	TNC Revenue per Ride (\$)
1	63	0	2	34%	-1%	1%	12%	-2%	3%	4
2	67	0	2	29%	-1%	1%	10%	-1%	5%	6
3	71	0	2	25%	-1%	1%	9%	0%	7%	8
4	75	0	2	22%	-1%	1%	8%	0%	9%	10
5	75	0	5	36%	0%	5%	34%	-3%	10%	4

6	85	0	5	27%	-1%	3%	25%	-1%	14%	6
7	95	0	5	20%	-1%	2%	19%	1%	16%	8
8	105	0	5	16%	-1%	2%	15%	1%	16%	10
9	83	0	7	34%	-1%	7%	46%	-3%	15%	4
10	97	0	7	23%	-1%	5%	31%	-1%	18%	6
11	111	0	7	17%	-1%	3%	22%	1%	19%	8
12	125	0	7	14%	-1%	2%	17%	2%	19%	10
13	95	0	10	32%	-1%	11%	63%	-3%	21%	4
14	115	0	10	21%	-1%	7%	40%	0%	23%	6
15	135	0	10	16%	-1%	5%	30%	2%	25%	8
16	155	0	10	14%	-1%	4%	26%	3%	29%	10
17	103	0	12	27%	-1%	12%	63%	-3%	21%	4
18	127	0	12	18%	-1%	7%	40%	0%	23%	6
19	151	0	12	14%	-1%	5%	32%	2%	27%	8
20	115	0	15	21%	-1%	12%	64%	-2%	22%	4
21	145	0	15	15%	-1%	8%	43%	0%	25%	6
22	135	0	20	11%	-1%	8%	42%	-1%	14%	4
23	77	1	2	12%	-1%	0%	4%	-1%	2%	6
24	83	1	2	10%	-1%	0%	3%	0%	3%	9
25	95	1	5	12%	-1%	1%	11%	-1%	6%	6
26	107	1	5	9%	-1%	1%	8%	0%	7%	8
27	107	1	7	11%	-1%	2%	14%	-1%	8%	6
28	123	1	7	8%	-1%	1%	10%	0%	9%	8
29	125	1	10	11%	-1%	2%	19%	-1%	11%	6
30	147	1	10	9%	-1%	2%	15%	0%	13%	8
31	137	1	12	9%	-1%	3%	20%	-1%	11%	6
32	155	1	15	8%	-1%	4%	23%	-1%	13%	6

Interestingly, it appears that the 32 scenarios in the Metra case correspond to the 32 scenarios in the Non-Metra case. This makes sense because the scenarios tested essentially correspond to each other, except that the internal price of the CTA pass that set the overall price (barring some ad-hoc changes to the SP design that were made based on initial low responsiveness to some Superpass bundles). Relative to the CTA pass, the TNC and Divvy valuations were the same.

These numbers can be shown graphically as well, as was done in the Non-Metra section.

Figure 6-36: Change in TNC Operator Revenue Versus Change in CTA Revenue in Metra Superpass Scenarios

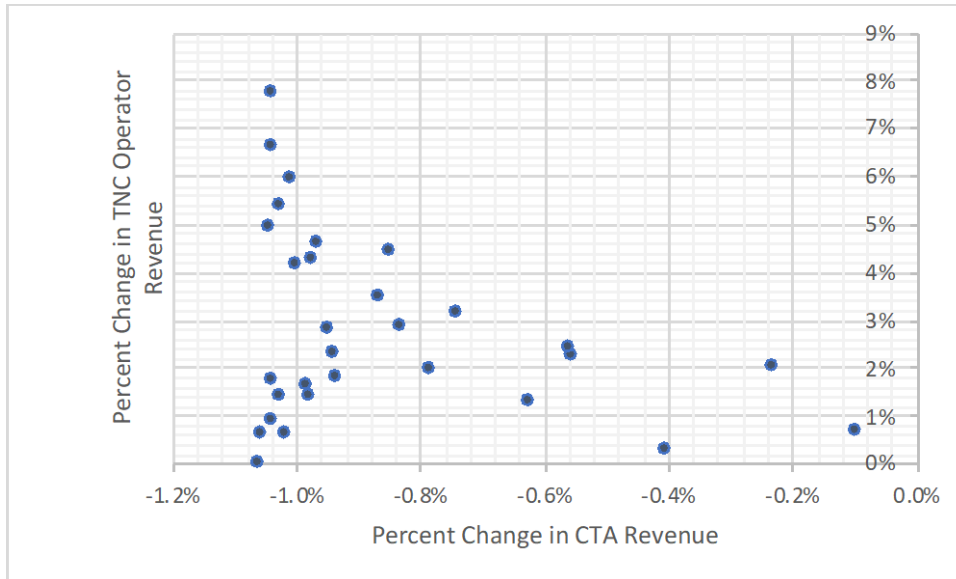


Figure 6-37: Change in TNC Operator Rides Versus Change in 30-Day Pass Holders in Metra Superpass Scenarios

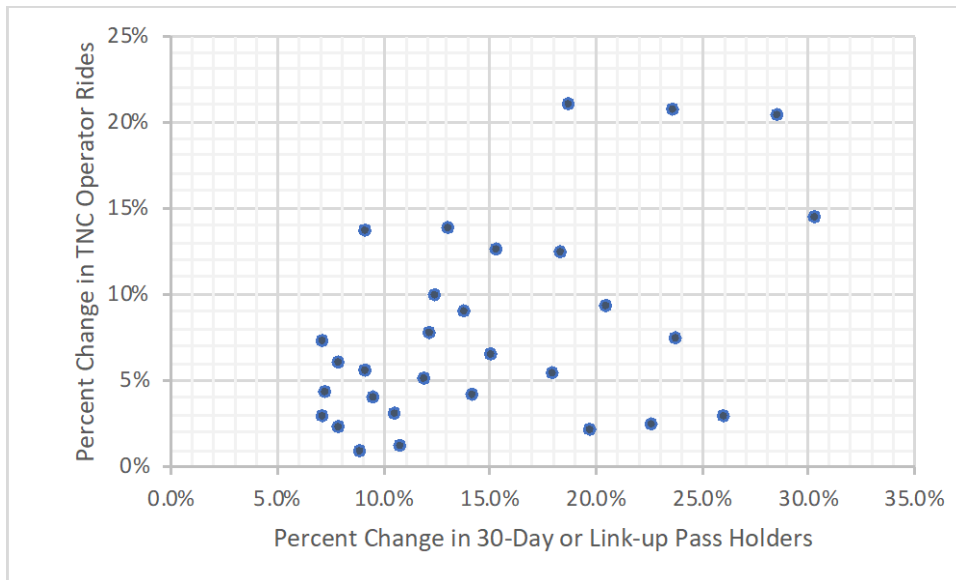


Figure 6-38: Change in TNC Industry Revenue Versus Change in CTA Revenue in Metra Superpass Scenarios

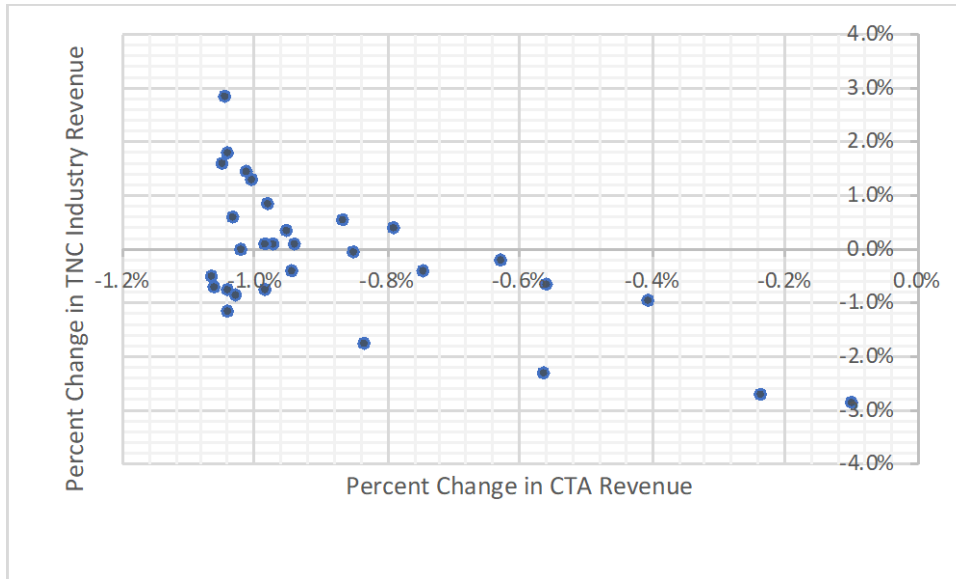
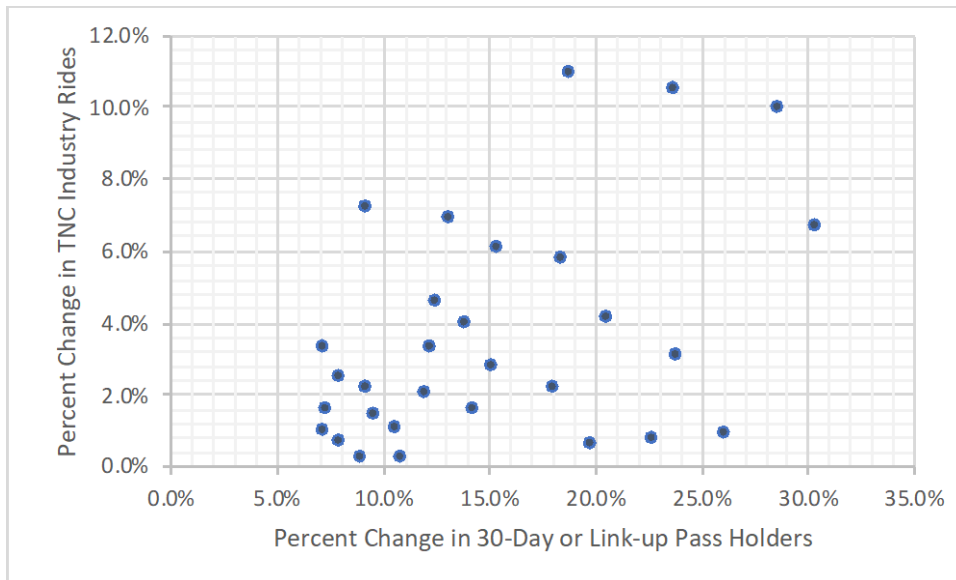


Figure 6-39: Change in TNC Industry Rides Versus Change in 30-Day Pass Holders in Metra Superpass Scenarios



Revenue between the CTA and the TNC operator are inversely related, but there is a positive relationship between the CTA’s pass holder increase and the TNC operator’s ride growth increase. In any case, because the revenue loss for the CTA is so low, it should focus on maximizing its pass growth from the Metra Superpass, which align with the pass configurations the TNC operator would want as well.

For Metra itself, at first it would appear that it does not gain from the Superpass because it would only be available to people who have already bought its monthly pass. However, the appeal of the



Superpass for monthly pass holders could induce some current high spenders such as 10-ride pass holders to buy up into the monthly pass. Further, the purchase of a Superpass on top of a Metra monthly pass anchors the user more deeply into the pass product as they would have invested more money into it and would have enjoyed its benefits.

Metra has already shown that it is open to working with TNCs in the past. It made Uber its official rideshare partner and allowed it to advertise at its stations in the hope of promoting some sort of first and last mile connection relationship with Metra stations. This history of engagement between the two entities is likely to smooth Superpass negotiations as compared to the Non-Metra pass where the entities involved would be the City, CTA, and the TNC operator. Thus, the inclusion of Metra as a party in the negotiations might help things, but it may also create friction with the CTA or the City of Chicago, who may not agree on the ideal pass configuration. For example, CDOT might be more concerned with limiting the overall increase in TNC ride growth when viewed in the “industry” case, but Metra might see less of an issue with that given that TNCs pose less of a threat to congestion in the suburbs than in downtown Chicago.

## 6.5 Selecting the “Optimal” Bundle

The 124 scenarios analyzed in the previous sections provide the realm of foreseeable bundles given the inclusion of the CTA, Divvy, and TNC. They were cut down to 64 scenarios with the criteria that the TNC operator makes a net positive revenue and that it get \$4 per TNC ride provided. Out of these 64 scenarios (32 for the Non-Metra and Metra bundles each), the process of selecting a pass that works for all stakeholders will involve balancing each of their overarching objectives, desired metrics that meet those objectives, and their power to influence negotiations. Table 6-5 outlines for each stakeholder given their objectives, which scenarios they would prefer. Following this is a discussion and then some illustrative examples to show that a plausible bundle that works for all would likely not be any specific stakeholder’s desired optimal scenario.

Table 6-5: Optimal Scenarios for Different Stakeholder Objectives

Stakeholder	Overarching Objective	Relevant Metric	Non-Metra Scenario	Metra Scenario
<b>CTA</b>	Financial sustainability	% Change in CTA Revenue	1	9
	Cement position in mobility system, ridership	% Change in 30-Day Pass Holders	1	5
<b>TNC Operator</b>	Beat Competition	% Change in Ride Growth	22	20
	Become financially sustainable	% Change in TNC Operator Revenue	22	16
		TNC Revenue per Ride	4, 8, 12, 16	4, 8, 12, 16
<b>TNC Industry</b>	Grow the industry	% Change in Ride Growth	20	20
	Become financially sustainable	% Change in TNC Industry Revenue	14	16
<b>Divvy</b>	Increase popularity	% Change in Divvy Pass Holders	23	23
	Financial sustainability	% Change in Divvy Revenue	23	23

<b>CDOT</b>	Promote sustainable mobility in Chicago	% Change in CTA 30-Day Pass Holders	1	5
	Regulate other mobility in Chicago	% Change in Divvy Pass Holders	23	23
		% Change in TNC Industry Rides	22	24
<b>City</b>	Promote equity	TNC Revenue per Ride	7, 11, 15, 18, 20	1, 5, 9, 13, 17, 20, 22
		Overall Price of Superpass	1	1
<b>RTA</b>	Promote integrated mobility in the region	% Change in 30-Day or Link-up Pass Holders	-	7
		Inclusion of Divvy while maximizing pass sales	-	21
<b>Metra</b>	Anchor more people into using Metra through	% Change in 30-Day or Link-up Pass Holders	-	7
<b>High TNC users</b>	Self Interest	Most number of TNCs for as cheap as possible per ride	22	22

Table 6-5 shows the optimum cases for each stakeholder, and clearly these will not necessarily overlap with each other. The primary challenge for any policymaker will be to find common ground between these boundary cases that satisfies everyone enough that the Superpass can be launched. This is more difficult if each entity acts in its own self-interest. However, a closer examination reveals that many of the stakeholders in Table 6-5 share similar interests. For example, the CTA, Metra, and Divvy are all operators and so they wish to increase their revenue and pass holders. Within this grouping also, CTA and Metra are more closely aligned because they are both transit agencies wishing to promote sustainable travel and to provide quality service to riders. If they both act together rather than separately, more common ground can be found and the public sector overall emerges stronger in its negotiation with private players. A clear example of this would be revenue sharing when it comes to the Metra Link-up pass. Purchases of this pass have fallen in recent years since Metra withdrew its subsidy of the pass in 2012, leading its price to rise from \$39 to \$55 today. If the CTA and Metra overcome revenue sharing differences and instead offer an affordable integrated Metra and CTA pass, perhaps the need to even include other mobility services would be diminished.

Another grouping that can be seen in Table 6-5 is that of the holistic regulator. While this thesis has argued for the public transit operator to think of itself as the “guarantor of mobility” in its jurisdiction, under the current set up entities like CDOT, the City government, and the RTA are responsible for more broad-based thinking and decision-making that affects the overall mobility network. Within these three entities there are also differences in objectives that could be resolved to create a clearer vision for Chicago. For example, while CDOT might have a bias towards Divvy, which is only usable for a portion of able-bodied citizens, RTA might have a bias towards the suburban residents that Metra and Pace serve. The City government might be concerned with politics and optics. If these entities could come together to forge a unified vision for the Superpass with clear metrics to achieve, then it is likely that decision-making would be more efficient.

Keeping these groupings in mind, below is a discussion of the considerations for each of the metrics shown previously in Table 6-2 and Table 6-4 that can be used to narrow down to a mutually acceptable Superpass.

### *Price*

The upfront cost of the Superpass would determine who can afford it or not, which has equity implications. Even if a high Superpass cost is matched with a high number of TNC rides included and thus a low per-ride cost, the sunk cost itself can exclude many. The political establishment would be cautious of this issue and the optics of offering a pass for the wealthy.

### *Divvy Inclusion*

Divvy of course would care about its inclusion in the Superpass, and so would CDOT and the City because they are the owners of the system. They would also care because if they want to promote active mobility in the city then they would include Divvy. However, the CTA might not have a strong opinion about its inclusion. While they are attempting to integrate Divvy with the Ventra app, Divvy's inclusion is not central to the CTA's primary objectives and goals. In fact, Divvy might even hurt the CTA's ridership, especially with short trips during warmer months. Further, the inclusion of Divvy appears to significantly reduce Superpass interest (given that buyers usually do not want bundles that include components they will likely never use), which reduces revenue and pass sales for all stakeholders.

### *Number of TNC Rides to Include*

The TNC operator would be interested in increasing this number as it helps it capture market share from its competitors, but of course while still maintaining an acceptable revenue and profit level. It is difficult to say whether revenue or profit is more important to the TNC operator, as we have seen them hemorrhage money in order to capture market share. The TNC operator would be constrained, however, by its ability to provide for the increasing number of rides because of supply-side constraints. However, given the fact that most TNC drivers drive for more than one platform, greater demand and chances of income from a particular TNC will switch over drivers to that platform, thereby increasing its supply.

### *Percent Change in CTA 30-Day Pass Holders*

The public sector entities are generally interested in maximizing this metric, as more people in a pass product means a boost for public transit and all the positive externalities associated with it. These entities include the CTA, CDOT, the City, RTA, and Metra. The public sector might want to see a minimum increase in the pass sales and that will narrow down the plausible passes as a result.

### *Percent Change in CTA Revenue*

The CTA is probably the main stakeholder concerned about this as it generally cannot afford to increase its subsidy levels. However, it is widely understood that while public transit should not waste taxpayer money, it will never exist without a minimum level of public subsidy public subsidy because its mission is to correct for or minimize externalities of private mobility and provide for those without other options. Thus, the revenue metric is important to make sure the CTA does not lose money on the initiative rather than being used as a target metric.

### *Percent Change in TNC Industry Rides*

Even though the scenarios that maximize TNC industry rides are the same ones that maximize the TNC operator rides, the TNC operator is unlikely to care much about the overall impact on the industry because the industry has fierce competition. This metric would be important for the public

sector, most likely the City, who must keep track of system-wide impacts. There might be a policy that the Superpass cannot increase TNC industry rides, which are TNC rides overall, by more than a certain percentage. These stipulations could still allow the specific operator to increase their ride percentage while keeping the overall ride increase low, as the operator would simply capture existing TNC rides on competitor platforms by the Superpass buyers.

#### *Percent Change in TNC Operator Rides*

The specific TNC operator would care the most about the projected growth in their rides as this has a direct impact on their market share capture. This metric would not necessarily matter much to the public sector as they really care most about the system-wide impacts. It would be more of a leveraging tool by using the projected increase in the TNC operator's market share to get them to accept a pass favorable to the public sector.

#### *Percent Change in TNC Industry Revenue*

This would again be a metric mainly useful for the public sector. There might be a policy that the Superpass should not lead to an increase in revenue for TNCs overall by a certain percentage, so that there is no perception that the public sector is offering a lucrative deal to an industry that has caused harm to public transit, road congestion, and the taxi industry.

#### *Percent Change in TNC Operator Revenue*

This metric will again be important to the TNC operator as it decides which Superpass would be acceptable to it. This can be useful for policymakers as they would also want to know and predict which Superpasses are likely to find favor with the TNC.

#### *TNC Revenue per Ride*

This metric would be important to the TNC operator as it has a direct impact on its profit from the pass. The operator has a certain cost of providing rides which is unknown but it would impact its profit margin given a fixed income per ride. Given the volatility of rideshare prices and the propensity to offer deep discounts to frequent users, it can be assumed that earning short term profit on each specific shared 5-mile ride might not be a TNC's most important objective in the face of capturing greater market share or of securing a partnership such as this with one of the largest public transit operators in the US. This metric can also be a useful narrowing condition for the public sector if they want to keep the pass affordable to more people.

### 6.5.1 Non-Metra Superpass Illustrative Example

Given all the different metrics and stakeholders, there are many uncertainties as to how the Superpass might eventually come to be. To make sense of all that has been presented, an illustrative example can be illuminating. A sequence of steps can be imagined where stakeholders negotiate to narrow down scenarios at each step of the process.

1. With the Non-Metra pass, one can imagine that CDOT might have a bigger role to play and might insist on the inclusion of Divvy so as to promote a holistic mobility system. It might also promote Divvy because it owns the system and so has a special interest in its success. This narrows down the options from 32 to 10 immediately.

2. CDOT might further stipulate that they do not want to see a greater than 5% increase in TNC rides due to this pass. Thus, the TNC industry column can be culled to where the percent increase in overall TNC rides is under 5%. This reduces 3 more scenarios.
3. At this point, the CTA might enter the discussion and want to maximize its 30-day pass sales, which would be 16%. However, this scenario leads to a 10% increase in TNC operator (Lyft) revenue, which it does not accept.
4. At this point, the CTA allows its projected pass holder increase to fall from 16% as initially demanded to 12.5%, which would allow Lyft's revenue to grow by 23% and rides to grow by 37%. This scenario is number 25, which is the CTA 30-day pass + 5 TNC rides + Divvy for \$145. Note that this was none of the stakeholders' optimal scenario from Table 6-5, but in the end it might satisfy everyone enough to pass through. This leads to a \$6 per ride income for the TNC and actually reduces the overall TNC industry income by 2% and only increases industry rides by 3%, which CDOT is happy with.

Table 6-6 shows the impacts of the selected Superpass. Divvy makes a large gain in pass sales and revenue, as does the TNC operator, while at the same time limiting the system-wide impacts of the TNC industry as a whole.

Table 6-6: Projected Impacts of CTA 30-Day Pass + Divvy + 5 Lyft Rides for \$145

Stakeholder	Metric	Outcome	90% Confidence Interval
CTA	Pass Sales	+12.5%	[6.2%, 24%]
	Revenue	+2.4%	[1.1%, 5.3%]
Divvy	Pass Sales	+151%	[90%, 253%]
	Revenue	+61%	[34%, 110%]
TNC Operator	Ride Growth	+37%	[21%, 63%]
	Revenue	+23%	[13%, 39%]
TNC Industry	Ride Growth	+2.7%	[1.4%, 5.5%]
	Revenue	-1.8%	[-1.2%, -2.2%]

It is important to note that the selected pass is only 1 of several that could have been approved. For example, if Lyft had been amenable to a 10% increase in revenue because it is seeking to capture market share rather than revenue through this pass, then scenario number 23 could have been approved. That would have been the CTA 30-day pass + Divvy + 2 TNC rides for \$127, which would have increased CTA's 30-day passes by 16%, their revenue by 3%, and Lyft rides by 18%.

Another scenario would have been if Divvy was not included. It is clear that the inclusion of Divvy reduces CTA passes sold, and it might be able to override CDOT's request for Divvy's inclusion. We can look at the simple case of just deducting the Divvy portion of the Superpass selected above through the negotiation process. The impacts and comparison of this selected pass, CTA 30-day pass + 5 Lyft rides for \$135, is shown in Table 6-7.

Table 6-7: Projected Impacts of CTA 30-Day Pass + 5 Lyft Rides for \$135

Stakeholder	Metric	With Divvy	Without Divvy (-\$10)
CTA	Pass Sales	+12.5%	+23.2%
	Revenue	+2.4%	+4.8%
Divvy	Pass Sales	+151%	+0%
	Revenue	+61%	+0%
TNC Operator	Ride Growth	+37%	+62%
	Revenue	+23%	+39%
TNC Industry	Ride Growth	+2.7%	+5.8%
	Revenue	-1.8%	-1.8%

### 6.5.2 Metra Superpass Illustrative Example

We can next look at an illustrative example outlining the negotiation steps for the creation of a hypothetical Metra Superpass.

1. Divvy has a more difficult time getting included because CDOT is not as heavily involved to lobby for it. Further, given the composition of Metra riders, bikeshare may not be something they want included in their mobility menu. Thus, Divvy inclusion is dropped, which narrows the scenarios from 32 to 22.
2. Then, the RTA might stipulate that the Superpass not lead to an increase in TNC industry rides of more than 5%. This further reduces the options from 22 to 13.
3. Then, out of equity concerns the price of the Metra Superpass is not allowed to be more than \$50 more than the price of the Link-up pass, so this eliminates the 4 options costing more than \$105. We are now left with 9 scenarios.
4. Lyft presents its demand to not receive less than \$6 per 5 mile shared ride it provides. This eliminates 2 more scenarios.
5. The CTA presents its basic demand that it get a minimum 20% increase in its pass sales, which leaves 6 scenarios.
6. Among these scenarios, the TNC operator is allowed to maximize its increase in rides, which selects scenario 10, giving it an 31% increase. Scenario 10 would be the CTA Metra Link-up pass + 7 TNC rides for \$97.

The impacts of scenario 10 are summarized in Table 6-8.

Table 6-8: Projected Impacts of CTA Metra Link-up Pass + 7 Lyft Rides for \$97

Stakeholder	Metric	Outcome	90% Confidence Interval
CTA	Pass Sales	+23%	[12%, 64%]
	Revenue	-1.3%	[-1.3%, 1.3%]

Divvy	Pass Sales	+0%	[0%, 0%]
	Revenue	+0%	[0%, 0%]
TNC Operator	Ride Growth	+31%	[14.4%, 89.4%]
	Revenue	+18%	[7.5%, 56%]
TNC Industry	Ride Growth	+4.6%	[2%, 15%]
	Revenue	-0.6%	[-1.3%, 3.6%]

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# Chapter 7 Conclusion

## 7.1 Summary of Findings

### 7.1.1 Chapter 2

Chapter 2: The Case for Partnerships with New Mobility found:

- The public sector has a role to provide mobility for all and uphold mobility as a right.
- There have been many varied partnerships between the public sector and new mobility, most of which have centered around first / last mile connectivity or have included some public subsidy for providing trips.
- The public sector must be innovative in the face of future disruptions to the mobility network, and regulation and partnering with new mobility services might be a way to not only take on future challenges, but also a way to fill service gaps and better ensure mobility for all.

### 7.1.2 Chapter 3

Chapter 3: The Case for Bundled Mobility Passes found:

- The principals of commodity bundling could be applied to mobility through MaaS because the different components of a mobility bundle act as complements to each other insofar as they together substitute personal vehicle use. Regulations can be imposed on MaaS designs to prevent cannibalization of public transit from the other services included (i.e., first/last mile use provisions).
- The CTA has seen a fall in its pass market share due to the price hike of the pass vis a vis the single-ride fare, the rollout of the Ventra app that makes it easier to pay-as-you-go, and the conversion of non-commute discretionary trips from the CTA to new mobility services. Thus, the CTA should find new ways to increase its pass market share.



- Most MaaS examples globally contain public transit as a base, and when on-demand rides have been included there has been a distance limit and sometimes users can pay a flat fare per on-demand ride.
- There are many mobility services in Chicago, which creates the environment necessary for there to be a benefit from aggregation into MaaS.
- The public sector should be involved with MaaS because:
  - The traditional transit pass does not fully meet all mobility needs;
  - They should move to prevent monopolization of new mobility into conglomerates;
  - They should prevent the arbitrage of the monthly pass and the capture of surplus from those who underuse it.

### 7.1.3 Chapter 4

Chapter 4: The Case for Working with Employers found:

- Overall 84% of respondent companies would be or might be interested in a bundled CTA pass that they could offer to their employees.
- Metra, TNCs, and Divvy were the top three modes that companies wished to see bundled in mobility passes.
- Larger companies were more likely to exhibit interest in the mobility pass, likely due to more parking pressure and a greater institutional emphasis on TDM measures.
- A revenue model forecasting the impacts of an integrated mobility pass on a major hospital's employee base estimated that a CTA + Metra bundle where the CTA component costs just \$15 could be revenue neutral for the CTA and still lead to an increase in pass sales.

### 7.1.4 Chapter 5

Chapter 5: Bundled Mobility Pass Choice Model found:

- Overall, all-else equal, the Non-Metra and Metra Superpasses were preferred by respondents over their current travel patterns.
- People overall do not like the inclusion of bikeshare in the Superpass.
- People gain utility from the inclusion of 5 TNC rides in the mobility bundle, but there are diminishing returns after this. Metra Superpass respondents value TNC ride inclusion more than Non-Metra Superpass respondents, but even they begin to get a negative utility with the inclusion of 15 TNC rides.
- Current possession of a CTA 30-day pass makes one more likely to purchase a Superpass.
- The more someone currently spends on transportation the more likely they are to opt for a Superpass.
- People under 35 years of age are more interested in the Superpass.

### 7.1.5 Chapter 6

Chapter 6: Applying Choice Model to Stakeholders found:

- The CTA stands to gain revenue and 30-day pass penetration from the Non-Metra pass.

- The CTA also gains in 30-day pass penetration from the Metra Superpass but does not increase its revenue significantly with the Metra add-on pass without a new revenue-sharing agreement with Metra. Metra and the CTA would need to come together to reduce the price of combined pass in the interest of bringing more people into public transit passes.
- The TNC operator always gains in rides it provides because it can convert rides people take on other platforms to their own, but they can lose revenue in some of the scenarios.
- The gain to the TNC operator heavily depends on what is their starting market share among the rides of the buyers. The lower the starting market share the bigger the gains, which can be leveraged to extract a favorable deal for the public sector. Of course, this is under the assumption that only one TNC operator is selected as the Superpass provider.
- Overall, there are about 32 scenarios for both the Non-Metra and the Metra Superpasses each in which the CTA and TNC operator gain ride market share, while the TNC operator gains revenue and earns at least \$4 per ride it provides.
- Among Non-Metra pass scenarios, the CTA can earn between a 6% to 35% increase in 30-day pass sales and a 1% to 8% jump in revenue. With the Metra pass and current revenue splits, the CTA can realize between a 11% to 36% increase in 30-day pass sales from existing Metra monthly pass holders, and may lose between a 0.1% to 1% of its current Link-up pass revenue.
- The inclusion of Divvy reduces revenue and market share gain for the CTA and TNC operator.
- More TNC inclusion after a certain point does not impact demand for CTA passes much, but might impact TNC operator ride growth. Thus from the CTA's perspective it might be able to allow more rides to be offered in the Superpass if a favorable rate is offered in return. However, other entities such as CDOT and the City might have concerns about the system-wide impacts of increasing TNC rides in the market.
- The competition between TNCs can be leveraged to find scenarios where the TNC operator gains revenue and market share by stealing rides from competitors, while at the same time the overall rides from all providers (the TNC industry) grows by a smaller amount and TNC industry revenue even falls.
- The optimal bundle chosen will eventually be determined by minimum gain thresholds set by the CTA and TNC operator, and by policies mandated by some public sector entity (either the CTA itself, or CDOT, or the Mayor).
- Given some assumptions in how different stakeholders might react during negotiations, a plausible Non-Metra Superpass was identified as the CTA 30-day pass + Divvy + 5 Lyft rides for \$145. This would lead to a pass growth of 12.5% and revenue growth of 2.4% for the CTA. It would lead to large gains in pass and revenue for Divvy. It would also lead to a 37% growth in Lyft's rides among the buyers (assuming it starts with 29% market share), and a 23% revenue growth. At the same time, the TNC industry as a whole would only gain 2.7% in rides and lost 1.8% in overall revenue at that price point.
- For the Metra Superpass, after simulating a negotiation a plausible Superpass was identified as a CTA Metra Link-up pass + 7 Lyft rides for \$97. This would lead to a 23% increase in CTA passes sold but a 1.3% decline in revenue. Lyft would gain 31% in ride growth and 18% in revenue, while the TNC industry would gain only 4.6% in rides and lose 0.6% in revenue.

## 7.2 Recommendations

These recommendations are not only a product of the technical analysis presented in this thesis but also observations made during the experience over the last three years.

1. **Recognize the Potential:** At the outset, this thesis recommends that the CTA and all mobility-related policymakers take heed of the potential of integrated mobility passes to increase pass sales, increase revenue, increase strength of mobility network against personal car ownership, and increase relations with employers and their employees.
2. **Select One TNC Operator:** The results of the scenario testing showed by selecting just one TNC operator to supply the rides in the Superpass, competition between different operators can be leveraged to open up more favorable scenarios for the public sector. For example, a specific TNC operator might realize a great benefit in terms of ride growth and revenue from its participation in the Superpass while not creating a large impact in the overall number to TNC rides taken by Superpass buyers.
3. **Implement a Pilot:** Because the impacts on travel behavior are unknown, it is recommended that the Superpass be first piloted on small target populations who travel enough to potentially warrant a 30-day pass but do not use pass products as much as would be expected of them. A pilot is desirable because if the inclusion of TNCs leads to a large increase in TNC use, the impact on mobility system congestion will be contained to the pilot population.
4. **Customizable Superpass Design:** It is recommended that depending on what the goals of the Superpass are, Divvy's inclusion be a customizable addition (i.e., optional opt in) because its inclusion may reduce pass purchase overall in the population. However, if the goal is to promote bicycling then it should be kept in.
5. **Mobility Governance Change:** To implement this Superpass, a third party might be required to broker the negotiation between different parties while at the same time keeping society's interests in mind. This entity could be one not only tasked with the implementation of the Superpass, but one that also takes a holistic view on transportation policy. A similar idea has already been directly recommended by the report of the Mayor's task force, which proposed the creation of a Chief Mobility Officer who would be responsible for coordinating transport policy and mobility providers. It could also include broader fare policy planning responsibilities that could direct the development and implementation of new, integrated fare product offerings (and the associated revenue sharing agreements) among all three Chicago area service boards, while leaving the pricing of individual pay-per-use trips to the service providers.

## 7.3 Looking Towards Implementation

While this thesis primarily presents information useful for planning an integrated mobility pass, throughout the three years of the project there have been some lessons learned regarding implementation. No matter how much planning is done, the manner in which the Superpass is implemented will ultimately determine its success on the ground.

### 7.3.1 Pilot Phase

This thesis has repeatedly asserted the need for a pilot phase before a firm policy is made towards the Superpass. This was recommended with the understanding that this is a new concept that has not yet been tried out in the US and hence there are many unknowns that can be better understood in a low-risk pilot. These unknowns include obtaining revealed preference for passes, travel behavior impacts, and a better understanding of stakeholder opinions and reactions to the pass. Implementing the Superpass through a pilot also enables the implementing agency to circumvent some regulations pertaining to RFPs, allowing them to directly approach an employer or TNC operator with whom chances of a successful pilot are more likely. A 3 to 6 month pilot should first be undertaken, for which there should be a before and after survey of user travel behavior that is hopefully backed up by their actual use data of the CTA and TNCs. Based on this panel survey, on the actual purchases of the pass and use amounts of TNCs, and on the ultimate revenue gains for all parties involved, a more informed design of the Superpass can be launched to other employers or to sections of the public in a more widespread manner.

### 7.3.2 Regulations for Operators

Public-private partnership can be a way to enable regulation. The private player gets a benefit through partnering with the public sector and likely trust between the two entities would also grow, in response to which the public sector can impose regulations if the private player wishes to partner. There are many regulations that the public sector can apply to mobility modes that are part of the Superpass that it perhaps could not enforce otherwise. These can apply not only to the TNC operator, but also the bikeshare operator, carshare operator, or any other partnering mode. A selection of these regulations are as follows:

1. **Service Area:** If an operator is in a joint pass with the CTA, then geographic equity would mandate that service areas should be contiguous between all operators.
2. **Background Checks:** Ensuring background checks of TNC drivers has been a controversial topic in some cities (e.g., Austin), and to ensure safety for users and to align taxi and TNC regulation, thorough background checks can be mandated.
3. **Accessibility for Disabled:** ADA compliance is integral to ensuring mobility equity for all. Already, there have been partnerships on the basis of ADA-compliant paratransit provision in other cities, and so this can be a stipulation imposed on any TNC wanting to take part in the Superpass.
4. **Data Sharing:** Data sharing rules can apply to all mobility operators that take part in the Superpass. Already, Chicago has the most comprehensive data sharing framework for TNC operations, and with the Superpass data even more insights can be drawn from user multimodal behavior.
5. **Route Choice:** Other ideas that can be applied in the future are mandating only first / last mile connections at some stations, mandating that at some hours TNCs cannot use certain high-bus density corridors, etc.

### 7.3.3 Choosing the TNC Operator

The TNC operator that is chosen will have a large bearing on the success of the Superpass. The relationship between the public sector and TNCs has often been strained, and so selecting an operator with whom there can be a workable relationship will be of utmost importance. Chapter 6 presented the TNC operator impacts assuming a starting market share of 65%, but the lower the starting market share is the greater the benefit is for the operator. Thus, a smaller market share TNC would stand to gain more from the Superpass, which might lead to greater cooperation and amenability to regulations and stipulations set by the public sector. As of now, that would suggest that Via or Lyft would be better options, but to name a specific TNC operator would be to defeat the purpose of creating a generalizable framework for the creation of a Superpass. Keeping in mind the results of this thesis can help a policymaker design a Superpass under future conditions in which different TNC operators might exist, or in which the public sector provides its own TNC-like demand-responsive service.

### 7.3.4 Choosing Other Mobility Services to Add

The Superpass discussed in this thesis has included CTA bus and rail, Metra commuter rail (though not included in the price), bikeshare, and TNCs. However, there are other mobility services currently in Chicago and ones that may exist in the future. These include other forms of bike or scooter share, water taxi, roundtrip and one-way carsharing, and autonomous vehicle-based services. Policymakers will need to create a balance of modes included in the Superpass, as including more modes makes the bundle more multimodal but can also have travel behavior and sustainability impacts that are not yet fully understood. When asked what other modes they would wish to see in the Superpass, two-thirds said none, but about 12% each said carsharing and electric scooters, and 7% said dockless bikeshare.

### 7.3.5 Other Features to Include

Other features that can be included in the Superpass platform are:

- **Gamification:** Allow the tracking of mobility patterns and impacts (VMT, CO2 emissions, calories burned) and provide incentives to induce a change in this behavior.
- **Rating system of trips:** After each TNC trip both the driver and the passenger rate each other. This has been one of the incentives to maintain good service. A rating system targeted for each trip not only increases customer feedback and ultimately customer satisfaction for the transit agency, but it helps pinpoint trips that have lower ratings.

### 7.3.6 Choosing Who is Offered Superpass

Choosing who to offer the Superpass to initially will be an important decision to make for several reasons. This thesis has advocated for the rollout of a pilot phase first in order to get more accurate demand data and to also measure impacts on travel behavior. Thus, the initial target population should be one that is easy to pilot with and to collect data from. This is why this thesis has also argued for the launch of the initiative through employers, preferably ones with many employees. Deciding on which employers to target, of course, will be the challenge. It should be ones that have a robust management structure in place that can implement such an initiative and

communicate closely with employees. It should also be one where there is a mix of commute modes (including driving), so that the impact of the Superpass on a broad range of commuters can be measured. It should also be an employer that is looking to actively promote sustainable mobility among employees, either to meet internal sustainability goals or to reduce parking pressure. Finally, the Superpass should be offered to a range of types of employers—there should be geographic and income diversity among the employees surveyed, which is a function of the employers chosen. Indeed, one of the major concerns raised by the CTA to the project was that this will be viewed as an elitist initiative, offering a special package only to those wealthy enough to afford it. The optics of a project play a major role in its perception and success, and so care should be taken to choose pilot participants that can represent a diverse range of experiences and travel behaviors.

### 7.3.7 Choosing Who Implements

Choosing who implements the pass is perhaps the most central question. Chapter 3 argues for a public sector-led MaaS initiative, but the public sector itself has several players. While this research was conducted under CTA sponsorship, during the course of the project it was clear that the CTA perhaps cannot be expected to take on the mantle of implementing a holistic pass when its primary concern are CTA buses and trains. The following are potential public-sector players related to mobility:

1. CTA
2. CDOT
3. Mayor's Office (specifically, the Office of Business and Consumer Affairs)
4. RTA
5. Some sort of CTA + Metra conglomerate, which the RTA could manage
6. Other regional planning organizations, such as CMAP and MPC
7. A new authority responsible for handling holistic mobility in Chicago or Chicagoland region, similar to TfL.

The implementing agency must be able to take a step back from any single mode to design a pass that will improve overall mobility in the city and give people convenient options. To that effect, it could be argued that the CTA would have a bias towards its own service or that CDOT might have a bias towards Divvy inclusion, when many people do not feel comfortable biking. To take on future challenges from new modes (i.e., autonomous vehicles) or from increasing population, the implementing agency of an integrated pass that hopes to be the centerpiece of urban mobility cannot be influenced by any one particular mode. A simple example of this is that it may take an external agency to propose changes to CTA functioning to handle new challenges rather than this change coming from within the CTA. The CTA is already burdened with ensuring the efficient operation of its buses and trains, and so long-range strategic planning that takes into account the changing mobility landscape and changing user behavior may be better left with another authority, one that might also be better equipped to implement the Superpass.

## 7.4 Future Research

With each question this thesis attempted to answer appeared several other unanswered questions worth exploring. The following is a list of some avenues of future research related to the exciting prospect of an integrated mobility pass.

1. Impact that switching from public transit pay-per-use to using a pass product has on travel behavior: The foundation for the predicted benefits of the Superpass is that it hopes to push PPU spenders into a pass product so that public transit becomes the zero marginal cost option and can boost ridership. The revealed change as a result of Superpass implementation would prove or disprove this assumption.
2. Impact of MaaS on travel behavior: While the Superpass launch hopes to increase pass sales and revenue for the public transit agency, little is known on the actual travel behavior change of an individual who is given a bundle of different options. Do users become more multimodal, less car-dependent, and reduce carbon emissions? How much of a degree of self-selection is there? Do people sell cars or put off purchasing a new car as a result of their participation in MaaS? These individual travel behavior changes are then important for understanding system-wide impacts of MaaS. This can be studied through a before and after comparison of a pilot phase of the Superpass.
3. Linking integrated pass with first/last mile connectivity: Identifying where and how first and last mile partnerships could happen between the CTA and TNCs/microtransit was an initial objective of the overall research that led to this thesis. Eventually, the Superpass was proposed as a holistic mobility solution where people make the buying decision based on their overall monthly spending and mobility. It does not directly deal with the concept of first and last mile connectivity, even though there is potential for partnership in this area. An interesting pathway for future research can be how first and last mile connectivity can be enhanced through the Superpass itself. This could happen through regulation on when and where TNC rides could be called from or destined for, or special fares for first/last mile connecting trips. Data from such experiments could also be grounds for modification of existing public first and last mile service from rail or heavy rail stations.
4. Superpass impact on TNC use behavior: While one proposed future research pathway is to examine the impact of the Superpass on public transit use behavior, policymakers would also be interested on its impact on TNC or any on-demand service. Choice models can be applied to predict under which circumstances people use the TNC rides they are given as part of the Superpass. The before and after use of TNCs can be compared as a result of the Superpass, and whether having a finite number to use up in a month increases or tapers TNC use.
5. Institutional analysis of mobility governance: The future challenges of mobility may require a rethink on how urban mobility is governed and regulated. The creation of an integrated pass that pairs public transit with private services raises questions about whether current mobility governance is appropriately structured to launch such a pass and more generally handle future competition and innovation from new services.
6. Public sector launch of its own on-demand service: Depending on the results of tying together on-demand rides with a public transit pass, the public sector might consider launching its own on-demand service to complement fixed route mass transit to fulfill more

travel needs of people. The Superpass could give new insights to trigger such an investigation.



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# Appendix A: Qualtrics Employee Survey Questionnaire

## Chicago Employee Survey

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Start of Block: Current Travel Behavior and Expenses

Q1.1 You are invited to participate in a web-based online survey regarding bundled fare products that the Chicago Transit Authority (CTA) is considering offering. Your responses may help us learn more about customer preferences when it comes to bundled mobility passes in the Chicago region so that we may create transportation partnerships that make travel in Chicago more seamless and convenient. This research is being conducted by the CTA in partnership with the Massachusetts Institute of Technology (MIT).

The survey should take less than 10 minutes to complete. You may refuse to take part in this survey or exit at any time without penalty. This survey does not collect identifying information such as your name, email address, or IP address. Therefore, your responses will remain anonymous. If you have read the above and agree to participate please select the appropriate option below:

- I am over 18 years of age and agree to participate in this survey (4)
- I do not wish to participate (5)

*Skip To: End of Survey If You are invited to participate in a web-based online survey regarding bundled fare products that... = I do not wish to participate*

---

Q101 Where do you work?

Name of Company (e.g., CTA): (1)

Address (e.g., 567 W Lake St.): (2)

---

*Display This Question:*

*If Where do you work? , Name of Company (e.g., CTA): Is Not Displayed*

Q1.2 What is the name of the company you work for? (Please include the branch/office location if there are multiple locations for your company.)

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Q1.3 For the next few questions, please think about your **journey to and from work**.

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Q1.4 How do you typically commute to and from work?

- Take public transportation for at least part of the journey (935)
  - Drive personal vehicle alone the whole way (936)
  - Drive or ride with others (carpool) the whole way (937)
  - Uber, Lyft, or Via the whole way (938)
  - Chicago Taxi the whole way (944)
  - Personal bicycle the whole way (939)
  - Divvy bikeshare the whole way (940)
  - Walk the whole way (941)
  - Work from home (942)
  - Other, please specify (e.g., dockless bikeshare): (943)
- 
- 

*Display This Question:*

*If How do you typically commute to and from work? = Take public transportation for at least part of the journey*

Q1.5 Which public transportation services do you use in your typical commute? (Please select all that apply if your typical commute journey includes more than one service.)

- CTA rail (the "L") (1)
  - CTA bus (2)
  - Metra commuter rail (3)
  - Pace bus (4)
  - Other, please specify: (5)
- 

*Display This Question:*

*If Which public transportation services do you use in your typical commute? (Please select all that... = Metra commuter rail*

Q1.6 Which Metra fare zone does your commute fall under?

- A (one-way \$4.00, monthly \$116.00) (1)
  - B (one-way \$4.25, monthly \$123.25) (2)
  - C (one-way \$5.50, monthly \$159.50) (3)
  - D (one-way \$6.25, monthly \$181.25) (4)
  - E (one-way \$6.75, monthly \$195.75) (5)
  - F (one-way \$7.25, monthly \$210.25) (6)
  - G (one-way \$7.75, monthly \$224.75) (7)
  - H (one-way \$8.25, monthly \$239.25) (8)
  - I (one-way \$9.00, monthly \$261.00) (9)
  - J (one-way \$9.50, monthly \$275.50) (10)
  - Don't know/can't remember (13)
-



Q1.7 Please indicate how you commuted from home TO work for the last 3 working days.  
 (Select only one response for EACH of the three columns.)

	Last working day (1)	Two working days ago (2)	Three working days ago (3)
Drive alone the entire way (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walk + public transit the entire way (2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Drive alone + public transit (3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dropped off by friend or family + public transit (4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Uber, Lyft, Via, or taxi + public transit (5)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bicycle + public transit (6)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Carpooled (7)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Uber, Lyft, or Via the whole way (8)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chicago Taxi the whole way (12)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bicycle the whole way (9)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walk the whole way (10)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Did not commute to work (11)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q1.8 Please indicate how you commuted FROM work to home for the last three days. (Select only one response for EACH of the three columns.)

	Last working day (1)	Two working days ago (2)	Three working days ago (3)
Same as my commute TO work that day (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Drive alone the entire way (2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walk + public transit the entire way (3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Drive alone + public transit (4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dropped off by friend or family + public transit (5)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Uber, Lyft, Via, or taxi + public transit (6)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bicycle + public transit (7)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Carpooled (8)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Uber, Lyft, or Via the whole way (9)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chicago Taxi the whole way (13)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bicycle the whole way (10)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walk the whole way (11)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Did not commute to work (12)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

---

Page Break

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Q1.9 For the next few questions, please now consider your travel in **general** in the Chicago area (**both** work and non-work trips).

Q1.10 Which of the following transportation modes have you used at anytime in the last 3 months in the Chicago region? (Please select **ALL** that apply.)

- Driven a vehicle alone (13)
  - CTA rail (14)
  - CTA bus (15)
  - Metra rail (16)
  - Pace bus (17)
  - Personal bicycle (19)
  - Divvy bikeshare (18)
  - Dockless bikeshare (27)
  - Uber, Lyft, or Via (20)
  - Chicago Taxi (26)
  - Carpooled or Vanpooled (25)
  - Carshare (e.g., Zipcar, Getaround, Maven, etc.) (21)
  - Employer Shuttle (22)
  - Chicago water taxi (23)
  - Other, please specify: (24)
-

---

Display This Question:

*If Which of the following transportation modes have you used at anytime in the last 3 months in the... != Divvy bikeshare*

Q87 Do you use Divvy bikeshare during warmer months?

Yes (1)

No (3)

---

Q1.11 About how often do you use these modes of transportation?

	Rarely in the last 3 months (1)	1 to 2 days per month (2)	1 to 3 days per week (3)	4 to 5 days per week (4)	6 to 7 days per week (5)
<p><i>Which of the following transportation modes have you used at anytime in the last 3 months in the... = Driven a vehicle alone</i></p> <p>Drive alone (1)</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<p><i>Which of the following transportation modes have you used at anytime in the last 3 months in the... = CTA rail</i></p> <p>CTA rail (2)</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<p><i>Which of the following transportation modes have you used at anytime in the last 3 months in the... = CTA bus</i></p> <p>CTA bus (3)</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<p><i>Which of the following transportation modes have you used at anytime in the last 3 months in the... = Metra rail</i></p> <p>Metra rail (4)</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<p><i>Which of the following transportation modes have you used at anytime in the last 3 months in the... = Pace bus</i></p> <p>Pace bus (5)</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<p><i>Which of the following transportation modes have you used at anytime in the last 3 months in the... = Personal bicycle</i></p> <p>Personal bicycle (7)</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<p><i>Which of the following transportation modes have you used at anytime in the last 3 months in the... = Divvy bikeshare</i></p> <p>Divvy bikeshare (6)</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<p><i>Which of the following transportation modes have you used at anytime in the last 3 months in the... = Dockless bikeshare</i></p> <p>Dockless bikeshare (15)</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = Uber, Lyft, or Via*

Uber, Lyft, or Via (8)

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = Chicago Taxi*

Chicago Taxi (13)

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = Carpooled or Vanpooled*

Carpool or Vanpool (14)

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = Carshare (e.g., Zipcar, Getaround, Maven, etc.)*

Carshare (e.g., Zipcar, Getaround, Maven, etc.) (9)

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = Employer Shuttle*

Employer Shuttle (10)

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = Chicago water taxi*

Chicago water taxi (11)

*If Which of the following transportation modes have you used at anytime in the last 6 months in the... Other, please specify: Is Not Empty*

Other (12)



Q1.12 Approximately how much money **per month** do you spend on each of the following?

*(Note: If you use any CTA + Pace joint pass, indicate the amount of that pass in both the CTA*

*and Pace categories, as we will ask you your pass type later on. If you use these two services without a pass, simply enter how much you spend on each of them individually.)*

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = Driven a vehicle alone*

Personal vehicle (insurance, gas, maintenance, fines) (1)

▼ \$0 (1) ... More than \$300 (11)

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = Driven a vehicle alone*

Parking (meter payments, city parking sticker) (2)

▼ \$0 (1) ... More than \$300 (11)

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = CTA rail*  
*Or Which of the following transportation modes have you used at anytime in the last 3 months in the... = CTA bus*

CTA bus and/or rail (3)

▼ \$0 (1) ... More than \$300 (11)

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = Metra rail*

Metra rail (4)

▼ \$0 (1) ... More than \$300 (11)

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = Pace bus*

Pace bus (5)

▼ \$0 (1) ... More than \$300 (11)

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = Personal bicycle*

Personal bicycle (maintenance) (7)

▼ \$0 (1) ... More than \$300 (11)

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = Divvy bikeshare*

Divvy bikeshare (6)

▼ \$0 (1) ... More than \$300 (11)

*Which of the following transportation modes have you used at anytime in the last 3 months in the... = Dockless bikeshare*

Dockless bikeshare (14)

▼ \$0 (1) ... More than \$300 (11)

Which of the following transportation modes have you used at anytime in the last 3 months in the... = Uber, Lyft, or Via

Uber, Lyft, or Via (8)

▼ \$0 (1) ... More than \$300 (11)

Which of the following transportation modes have you used at anytime in the last 3 months in the... = Chicago Taxi

Chicago Taxi (12)

▼ \$0 (1) ... More than \$300 (11)

Which of the following transportation modes have you used at anytime in the last 3 months in the... = Carpoled or Vanpoled

Carpool or Vanpool (13)

▼ \$0 (1) ... More than \$300 (11)

Which of the following transportation modes have you used at anytime in the last 3 months in the... = Carshare (e.g., Zipcar, Getaround, Maven, etc.)

Carshare (e.g., Zipcar, Getaround, Maven, etc.) (9)

▼ \$0 (1) ... More than \$300 (11)

Which of the following transportation modes have you used at anytime in the last 3 months in the... = Chicago water taxi

Chicago water taxi (10)

▼ \$0 (1) ... More than \$300 (11)

If Which of the following transportation modes have you used at anytime in the last 6 months in the... Other, please specify: Is Not Empty

#{Q1.10/ChoiceTextEntryValue/24} (11)

▼ \$0 (1) ... More than \$300 (11)

---

Q84 About how much do you spend per month on transportation overall within the Chicagoland region?

▼ \$0 (1) ... More than \$300 (20)

---

Q102 About how many CTA rides do you usually take per month (bus and rail)? Please count trips in which you make a transfer as a single ride. To make this easier, you could think about how many rides you might take in a week, and multiply up to a month.

▼ 0 (1) ... More than 70 rides (16)

*Display This Question:*

*If About how many CTA rides do you usually take per month (bus and rail)? Please count trips in whic... != 0*

Q103 About what percent of your CTA rides are on rail (versus bus)? For trips that involve a transfer between bus and rail, please count it as a rail ride.

▼ 100% on rail (no CTA rides on bus) (1) ... 0% on rail (all CTA rides on bus) (13)

*Display This Question:*

*If Which of the following transportation modes have you used at anytime in the last 3 months in the... = Uber, Lyft, or Via*

Q1.13 How many Uber, Lyft, or Via rides do you usually take **per month**?

▼ 0 (1) ... More than 40 rides per month (34)

*Display This Question:*

*If Which of the following transportation modes have you used at anytime in the last 3 months in the... = Uber, Lyft, or Via*

Q1.14 For about what fraction of those rides did you request a shared ride (UberPool, Lyft Line, and all Via rides)?

- None (1)
- Under 20%, but still some rides were shared (2)
- About 20% to 40% (3)
- About 40% to 60% (4)
- About 60% to 80% (5)
- More than 80%, but not all (6)
- All of them (7)

---

*Display This Question:*

*If Which of the following transportation modes have you used at anytime in the last 3 months in the... = Uber, Lyft, or Via*

Q85 About how much do you spend per month on Uber, Lyft, or Via in the Chicagoland region?

▼ \$0 (1) ... More than \$175 (25)

---

*Display This Question:*

*If How many Uber, Lyft, or Via rides do you usually take per month? , 0 Is Displayed*

*And How many Uber, Lyft, or Via rides do you usually take per month? != 0*

Q96 Generally, for what trip purposes do you use Uber, Lyft, or Via in the Chicagoland region?  
(Select ALL that apply.)

- Go to or from social activities (4)
  - Commute to or from work (5)
  - Connect to or from public transit (7)
  - Go to or from work-related meetings (8)
  - Go to or from grocery shopping (9)
  - Go to or from non-shopping errands (11)
  - Go to or from healthcare services / appointments (12)
  - Go to and from airport (13)
  - Other, please specify: (14)
- 

*Display This Question:*

*If Which of the following transportation modes have you used at anytime in the last 3 months in the... = Divvy bikeshare*

*Or Do you use Divvy bikeshare during warmer months? = Yes*

Q1.15 About how many Divvy rides do you take per month during the months when you ride?

- None (1)
- 1 to 5 rides (2)
- 6 to 10 rides (3)
- 11 to 15 rides (4)
- 16 to 20 rides (5)
- More than 20 rides (6)

---

*Display This Question:*

*If Which of the following transportation modes have you used at anytime in the last 3 months in the... = Divvy bikeshare*

*Or Do you use Divvy bikeshare during warmer months? = Yes*

Q1.16 Have you currently purchased a Divvy annual pass?

- Yes (4)
- No (5)

---

*Display This Question:*

*If Have you currently purchased a Divvy annual pass? = No*

*Or Do you use Divvy bikeshare during warmer months? = Yes*

Q86 About how much do you spend per month on Divvy during the months when you ride?

▼ \$0 (1) ... More than \$16 (10)



Q79 Do you own at least one bicycle?

- Yes (1)
  - No (2)
- 

Q1.17 Are you comfortable riding a bicycle on Chicago city streets?

- Yes (1)
  - Somewhat (2)
  - No (3)
- 

Q1.18 How many motor vehicles (cars, motorbikes, vans, etc.) does your household own or lease that you have available to use?

- 0 (1)
  - 1 (2)
  - 2 (3)
  - 3 (4)
  - 4 or more (5)
- 

*Display This Question:*

*If Which of the following transportation modes have you used at anytime in the last 3 months in the... = Driven a vehicle alone*

*Or Which of the following transportation modes have you used at anytime in the last 3 months in the... = Carpooled or Vanpooled*

*Or How many motor vehicles (cars, motorbikes, vans, etc.) does your household own or lease that you... != 0*

Q1.19 On average in the last 3 months, how many miles per month do you estimate you have personally driven a vehicle?

- 0 miles per month (1)
- 50 miles or less per month (11)
- 100 miles per month (2)
- 250 miles per month (3)
- 500 miles per month (4)
- 750 miles per month (5)
- 1000 miles per month (6)
- 1250 miles per month (7)
- 1500 miles per month (8)
- 1750 miles per month (9)
- 2000 or more miles per month (10)

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Page Break

Q78 The following section will ask questions about hypothetical mobility bundles that the CTA might offer in the future. One type of pass under consideration is a CTA monthly pass plus bikeshare and/or rideshare services as add ons. The other type of pass is a Metra monthly pass plus the CTA and bikeshare and/or rideshare services as add ons. Please indicate which of these two types of passes you would hypothetically prefer.

- Prefer a pass with CTA plus other add ons (no Metra included) (1)
- Prefer a pass with Metra plus the CTA and other add ons (Metra included) (2)

End of Block: Current Travel Behavior and Expenses

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Start of Block: Non Metra Group 1

Q2.1 The CTA is considering offering a new fare product that would include its monthly pass and other mobility options. In the following questions, you will be presented with two hypothetical mobility bundles and their prices. Please indicate whether or not you would purchase either of the two bundles if they were offered in the real world. These questions will help the CTA understand your preferences and offer improved products for its customers.

Assume that each ride provided by UberPOOL/LyftLine/Via in this bundle would be limited to **under 5 miles in the Chicagoland area** and do not roll over to the next month.

Further, if Divvy bikeshare is included in the bundle, it means you would have unlimited 30-minute Divvy trips for the month.

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Page Break

Q2.2 (1/6) Would you purchase either of these monthly transportation bundles?

- CTA monthly pass + 5 UberPOOL/LyftLine/Via rides for \$130 (1)
- CTA monthly pass + Divvy bikeshare for \$112 (2)
- I would choose neither of these options and would continue with my current spending and commuting habits (3)

---

Page Break

Q2.3 (2/6) Would you purchase either of these monthly transportation bundles?

- CTA monthly pass + 10 UberPOOL/LyftLine/Via rides for \$155 (1)
  - CTA monthly pass + Divvy bikeshare + 5 UberPOOL/LyftLine/Via rides for \$140 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

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Q2.4 (3/6) Would you purchase either of these monthly transportation bundles?

- CTA monthly pass + Divvy bikeshare + 15 UberPOOL/LyftLine/Via rides for \$165 (1)
  - CTA monthly pass + 10 UberPOOL/LyftLine/Via rides for \$145 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

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Q2.5 (4/6) Would you purchase either of these monthly transportation bundles?

- CTA monthly pass + 5 UberPOOL/LyftLine/Via rides for \$130 (1)
  - CTA monthly pass + Divvy bikeshare + 15 UberPOOL/LyftLine/Via rides for \$200 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

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Q2.6 (5/6) Would you purchase either of these monthly transportation bundles?

- CTA monthly pass + 5 UberPOOL/LyftLine/Via rides for \$136 (1)
  - CTA monthly pass + Divvy bikeshare for \$110 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

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Q2.7 (6/6) Would you purchase either of these monthly transportation bundles?

- CTA monthly pass + Divvy bikeshare + 10 UberPOOL/LyftLine/Via rides for \$172 (1)
  - CTA monthly pass + 15 UberPOOL/LyftLine/Via rides for \$170 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

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Display This Question:

If (1/6) Would you purchase either of these monthly transportation bundles? = I would choose neither of these options and would continue with my current spending and commuting habits

And (2/6) Would you purchase either of these monthly transportation bundles? = I would choose neither of these options and would continue with my current spending and commuting habits

And (3/6) Would you purchase either of these monthly transportation bundles? = I would choose neither of these options and would continue with my current spending and commuting habits

And (4/6) Would you purchase either of these monthly transportation bundles? = I would choose neither of these options and would continue with my current spending and commuting habits

And (5/6) Would you purchase either of these monthly transportation bundles? = I would choose neither of these options and would continue with my current spending and commuting habits

And (6/6) Would you purchase either of these monthly transportation bundles? = I would choose neither of these options and would continue with my current spending and commuting habits

Q87 What are your reasons for lack of interest in the passes? (Please select ALL that apply.)

- I do not use public transit enough for an unlimited pass to be worth it. (1)
- I do not use services like Uber, Lyft, and Via enough for these passes to be worth it. (3)
- I am potentially interested, but the prices shown were too high. (2)
- I am potentially interested, but the 5-mile restriction on rideshare trips was too small. (5)
- Free Response: (4) \_\_\_\_\_

Display This Question:

If What are your reasons for lack of interest in the passes? (Please select ALL that apply.) , I do not use public transit enough for an unlimited pass to be worth it. Is Not Displayed

Q92 Do you think you would be more likely to purchase a monthly public transit pass if such passes were offered?

- Definitely yes (1)
  - Probably yes (2)
  - Might or might not (3)
  - Probably not (4)
  - Definitely not (5)
- 

Q97 Are there any other transport modes that you would like to see bundled in such a pass that might make you more likely to purchase it? (Select all that apply.)

- No (1)
- Yes, carsharing (e.g., car2go, Maven, Zipcar, Getaround) (4)
- Yes, dockless bikeshare (2)
- Yes, dockless e-scooters (3)
- Other: (6) \_\_\_\_\_

End of Block: Non Metra Group 1

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Start of Block: Non Metra Group 2

Q3.1 The CTA is considering offering a new fare product that would include its monthly pass and other mobility options. In the following questions, you will be presented with two hypothetical mobility bundles and their prices. Please indicate whether or not you would purchase either of the two bundles if they were offered in the real world. These questions will help the CTA understand your preferences and offer improved products for its customers.

Assume that each ride provided by UberPOOL/LyftLine/Via in this bundle would be limited to under 5 miles in the Chicagoland area and do not roll over to the next month.

Further, if Divvy bikeshare is included in the bundle, it means you would have unlimited 30-minute Divvy trips for the month.

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Page Break

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Q3.2 (1/6) Would you purchase either of these monthly transportation bundles?

- CTA monthly pass + Divvy bikeshare + 5 UberPOOL/LyftLine/Via rides for \$155 (1)
  - CTA monthly pass + 10 UberPOOL/LyftLine/Via rides for \$185 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

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Q3.3 (2/6) Would you purchase either of these monthly transportation bundles?

- CTA monthly pass + Divvy bikeshare for \$115 (1)
  - CTA monthly pass + Divvy bikeshare + 15 UberPOOL/LyftLine/Via rides for \$200 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

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Q3.4 (3/6) Would you purchase either of these monthly transportation bundles?

- CTA monthly pass + Divvy bikeshare + 10 UberPOOL/LyftLine/Via rides for \$170 (1)
  - CTA monthly pass + Divvy bikeshare for \$110 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

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Q3.5 (4/6) Would you purchase either of these monthly transportation bundles?

- CTA monthly pass + Divvy bikeshare + 10 UberPOOL/LyftLine/Via rides for \$155 (1)
  - CTA monthly pass + 15 UberPOOL/LyftLine/Via rides for \$185 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

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Q3.6 (5/6) Would you purchase either of these monthly transportation bundles?

- CTA monthly pass + 10 UberPOOL/LyftLine/Via rides for \$125 (1)
  - CTA monthly pass + Divvy bikeshare + 15 UberPOOL/LyftLine/Via rides for \$140 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

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Q3.7 (6/6) Would you purchase either of these monthly transportation bundles?

- CTA monthly pass + 15 UberPOOL/LyftLine/Via rides for \$185 (1)
  - CTA monthly pass + Divvy bikeshare for \$112 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

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Display This Question:

If (1/6) Would you purchase either of these monthly transportation bundles? = I would choose neither of these options and would continue with my current spending and commuting habits

And (2/6) Would you purchase either of these monthly transportation bundles? = I would choose neither of these options and would continue with my current spending and commuting habits

And (3/6) Would you purchase either of these monthly transportation bundles? = I would choose neither of these options and would continue with my current spending and commuting habits

And (4/6) Would you purchase either of these monthly transportation bundles? = I would choose neither of these options and would continue with my current spending and commuting habits

And (5/6) Would you purchase either of these monthly transportation bundles? = I would choose neither of these options and would continue with my current spending and commuting habits

And (6/6) Would you purchase either of these monthly transportation bundles? = I would choose neither of these options and would continue with my current spending and commuting habits

Q88 What are your reasons for lack of interest in the passes? (Please select ALL that apply.)

- I do not use public transit enough for an unlimited pass to be worth it. (4)
- I do not use services like Uber, Lyft, and Via enough for these passes to be worth it. (5)
- I am potentially interested, but the prices shown were too high. (6)
- I am potentially interested, but the 5-mile restriction on rideshare trips was too small. (7)
- Free Response: (8) \_\_\_\_\_

Display This Question:

If What are your reasons for lack of interest in the passes? (Please select ALL that apply.) , I do not use public transit enough for an unlimited pass to be worth it. Is Not Displayed

Q93 Do you think you would be more likely to purchase a monthly public transit pass if such passes were offered?

- Definitely yes (1)
  - Probably yes (2)
  - Might or might not (3)
  - Probably not (4)
  - Definitely not (5)
- 

Q98 Are there any other transport modes that you would like to see bundled in such a pass that might make you more likely to purchase it? (Select all that apply.)

- No (1)
- Yes, carsharing (e.g., car2go, Maven, Zipcar, Getaround) (2)
- Yes, dockless bikeshare (3)
- Yes, dockless e-scooters (4)
- Other: (5) \_\_\_\_\_

End of Block: Non Metra Group 2

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Start of Block: Metra Group 1

Q4.1 The CTA is considering offering new fare products that you can add on to a monthly Metra pass, which would include the CTA monthly pass in addition to certain other mobility options. In the following questions, you will be presented with two hypothetical mobility bundles and their prices. Please indicate whether or not you would purchase either of the two bundles if they were offered in the real world. These questions will help the CTA understand your preferences and offer improved products for its customers.

Assume that each ride provided by UberPOOL/LyftLine/Via in this bundle would be limited to **under 5 miles in the Chicagoland area** and do not roll over to the next month.

Further, if Divvy bikeshare is included in the bundle, it means you would have unlimited 30-minute Divvy trips for the month.

These questions assume you have bought a monthly pass for the Metra zone that your commute falls under, which you may have indicated was **Zone**  $\{Q1.6/ChoiceGroup/SelectedChoices\}$ . If you did not indicate a zone (i.e., you currently might drive to work), you will be asked below to select the zone pass that you would most likely purchase. Details about the zone passes are listed [here](#) on Metra's website.

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*Display This Question:*

*If Which Metra fare zone does your commute fall under? , A (one-way \$4.00, monthly \$116.00) Is Not Displayed*

Q81 Please select which Metra zone pass you would buy initially (which makes sense with your commute).

- A (\$116.00 monthly) (1)
- B (\$123.25 monthly) (2)
- C (\$159.50 monthly) (3)
- D (\$181.25 monthly) (4)
- E (\$195.75 monthly) (5)
- F (\$210.25 monthly) (6)
- G (\$224.25 monthly) (7)
- H (\$239.25 monthly) (8)
- I (\$261.00 monthly) (9)
- J (\$275.50 monthly) (10)
- Don't know (11)

---

Page Break

Q4.2 (1/6) Would you purchase either of these add-on transportation bundles, assuming you have already bought your monthly Metra zone pass?

- CTA monthly pass + 5 UberPOOL/LyftLine/Via rides for \$85 (1)
  - CTA monthly pass + Divvy bikeshare for \$60 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

Q4.3 (2/6) Would you purchase either of these add-on transportation bundles, assuming you have already bought your monthly Metra zone pass?

- CTA monthly pass + 10 UberPOOL/LyftLine/Via rides for \$65 (1)
  - CTA monthly pass + Divvy bikeshare + 5 UberPOOL/LyftLine/Via rides for \$50 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

Q4.4 (3/6) Would you purchase either of these add-on transportation bundles, assuming you have already bought your monthly Metra zone pass?

- CTA monthly pass + Divvy bikeshare + 10 UberPOOL/LyftLine/Via rides for \$120 (1)
  - CTA monthly pass + 5 UberPOOL/LyftLine/Via rides for \$80 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

Q4.5 (4/6) Would you purchase either of these add-on transportation bundles, assuming you have already bought your monthly Metra zone pass?

- CTA monthly pass + Divvy bikeshare + 15 UberPOOL/LyftLine/Via rides for \$100 (1)
- CTA monthly pass + 5 UberPOOL/LyftLine/Via rides for \$65 (2)
- I would choose neither of these options and would continue with my current spending and commuting habits (3)

---

Page Break

Q4.6 (5/6) Would you purchase either of these add-on transportation bundles, assuming you have already bought your monthly Metra zone pass?

- CTA monthly pass + Divvy bikeshare + 15 UberPOOL/LyftLine/Via rides for \$135 (1)
- CTA monthly pass + 10 UberPOOL/LyftLine/Via rides for \$90 (2)
- I would choose neither of these options and would continue with my current spending and commuting habits (3)

---

Page Break

Q4.7 (6/6) Would you purchase either of these add-on transportation bundles, assuming you have already bought your monthly Metra zone pass?

- CTA monthly pass + Divvy bikeshare + 5 UberPOOL/LyftLine/Via rides for \$85 (1)
- CTA monthly pass + 15 UberPOOL/LyftLine/Via rides for \$140 (2)
- I would choose neither of these options and would continue with my current spending and commuting habits (3)

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Page Break

Display This Question:

If (1/6) Would you purchase either of these add-on transportation bundles, assuming you have already... = I would choose neither of these options and would continue with my current spending and commuting habits

And (2/6) Would you purchase either of these add-on transportation bundles, assuming you have already... = I would choose neither of these options and would continue with my current spending and commuting habits

And (3/6) Would you purchase either of these add-on transportation bundles, assuming you have already... = I would choose neither of these options and would continue with my current spending and commuting habits

And (4/6) Would you purchase either of these add-on transportation bundles, assuming you have already... = I would choose neither of these options and would continue with my current spending and commuting habits

And (5/6) Would you purchase either of these add-on transportation bundles, assuming you have already... = I would choose neither of these options and would continue with my current spending and commuting habits

And (6/6) Would you purchase either of these add-on transportation bundles, assuming you have already... = I would choose neither of these options and would continue with my current spending and commuting habits

Q89 What are your reasons for lack of interest in the passes? (Please select ALL that apply.)

- I do not use public transit enough for an unlimited pass to be worth it. (1)
- I do not use services like Uber, Lyft, and Via enough for these passes to be worth it. (2)
- I am potentially interested, but the prices shown were too high. (3)
- I am potentially interested, but the 5-mile restriction on rideshare trips was too small. (4)
- Free Response: (5) \_\_\_\_\_

Display This Question:

If What are your reasons for lack of interest in the passes? (Please select ALL that apply.) , I do not use public transit enough for an unlimited pass to be worth it. Is Not Displayed

Q94 Do you think you would be more likely to purchase a monthly public transit pass if such passes were offered?

- Definitely yes (1)
  - Probably yes (2)
  - Might or might not (3)
  - Probably not (4)
  - Definitely not (5)
- 

Q99 Are there any other transport modes that you would like to see bundled in such a pass that might make you more likely to purchase it? (Select all that apply.)

- No (1)
- Yes, carsharing (e.g., car2go, Maven, Zipcar, Getaround) (2)
- Yes, dockless bikeshare (3)
- Yes, dockless e-scooters (4)
- Other: (5) \_\_\_\_\_

End of Block: Metra Group 1

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Start of Block: Metra Group 2

Q5.1 The CTA is considering offering new fare products that you can add on to a monthly Metra pass, which would include the CTA monthly pass in addition to certain other mobility options. In the following questions, you will be presented with two hypothetical mobility bundles and their prices. Please indicate whether or not you would purchase either of the two bundles if they were offered in the real world. These questions will help the CTA understand your preferences and offer improved products for its customers.

Assume that each ride provided by UberPOOL/LyftLine/Via in this bundle would be limited to under 5 miles in the Chicagoland area and do not roll over to the next month.



Further, if Divvy bikeshare is included in the bundle, it means you would have unlimited 30-minute Divvy trips for the month.

These questions assume you have bought a monthly pass for the Metra zone that your commute falls under, which you may have indicated was Zone  $\{Q1.6/ChoiceGroup/SelectedChoices\}$ . If you did not indicate a zone (i.e., you currently might drive to work), you will be asked below to select the zone pass that you would most likely purchase. Details about the zone passes are listed [here](#) on Metra's website.

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*Display This Question:*

*If Which Metra fare zone does your commute fall under? , A (one-way \$4.00, monthly \$116.00) Is Not Displayed*

Q83 Please select which Metra zone pass you would buy initially (which makes sense with your commute).

- A (\$116.00 monthly) (1)
- B (\$123.25 monthly) (2)
- C (\$159.50 monthly) (3)
- D (\$181.25 monthly) (4)
- E (\$195.75 monthly) (5)
- F (\$210.25 monthly) (6)
- G (\$224.75 monthly) (7)
- H (\$239.25 monthly) (8)
- I (\$261.00 monthly) (9)
- J (\$275.50 monthly) (10)
- Don't know (11)

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Page Break

Q5.2 (1/6) Would you purchase either of these add-on transportation bundles, assuming you have already bought your monthly Metra zone pass?

- CTA monthly pass + 5 UberPOOL/LyftLine/Via rides for \$85 (1)
  - CTA monthly pass + Divvy bikeshare + 10 UberPOOL/LyftLine/Via rides for \$120 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

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Q5.3 (2/6) Would you purchase either of these add-on transportation bundles, assuming you have already bought your monthly Metra zone pass?

- CTA monthly pass + 10 UberPOOL/LyftLine/Via rides for \$80 (1)
  - CTA monthly pass + Divvy bikeshare for \$40 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

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Q5.4 (3/6) Would you purchase either of these add-on transportation bundles, assuming you have already bought your monthly Metra zone pass?

- CTA monthly pass + Divvy bikeshare + 5 UberPOOL/LyftLine/Via rides for \$90 (1)
  - CTA monthly pass + Divvy bikeshare for \$55 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

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Q5.5 (4/6) Would you purchase either of these add-on transportation bundles, assuming you have already bought your monthly Metra zone pass?

- CTA monthly pass + Divvy bikeshare + 10 UberPOOL/LyftLine/Via rides for \$95 (1)
  - CTA monthly pass + 15 UberPOOL/LyftLine/Via rides for \$105 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

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Q5.6 (5/6) Would you purchase either of these add-on transportation bundles, assuming you have already bought your monthly Metra zone pass?

- CTA monthly pass + 5 UberPOOL/LyftLine/Via rides for \$85 (1)
  - CTA monthly pass + Divvy bikeshare + 10 UberPOOL/LyftLine/Via rides for \$130 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

Page Break

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Q5.7 (6/6) Would you purchase either of these add-on transportation bundles, assuming you have already bought your monthly Metra zone pass?

- CTA monthly pass + Divvy bikeshare + 10 UberPOOL/LyftLine/Via rides for \$80 (1)
  - CTA monthly pass + 5 UberPOOL/LyftLine/Via rides for \$60 (2)
  - I would choose neither of these options and would continue with my current spending and commuting habits (3)
- 

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Display This Question:

If (1/6) Would you purchase either of these add-on transportation bundles, assuming you have already... = I would choose neither of these options and would continue with my current spending and commuting habits

And (2/6) Would you purchase either of these add-on transportation bundles, assuming you have already... = I would choose neither of these options and would continue with my current spending and commuting habits

And (3/6) Would you purchase either of these add-on transportation bundles, assuming you have already... = I would choose neither of these options and would continue with my current spending and commuting habits

And (4/6) Would you purchase either of these add-on transportation bundles, assuming you have already... = I would choose neither of these options and would continue with my current spending and commuting habits

And (5/6) Would you purchase either of these add-on transportation bundles, assuming you have already... = I would choose neither of these options and would continue with my current spending and commuting habits

And (6/6) Would you purchase either of these add-on transportation bundles, assuming you have already... = I would choose neither of these options and would continue with my current spending and commuting habits

Q90 What are your reasons for lack of interest in the passes? (Please select ALL that apply.)

- I do not use public transit enough for an unlimited pass to be worth it. (1)
- I do not use services like Uber, Lyft, and Via enough for these passes to be worth it. (2)
- I am potentially interested, but the prices shown were too high. (3)
- I am potentially interested, but the 5-mile restriction on rideshare trips was too small. (4)
- Free Response: (5) \_\_\_\_\_

Display This Question:

If What are your reasons for lack of interest in the passes? (Please select ALL that apply.) , I do not use public transit enough for an unlimited pass to be worth it. Is Not Displayed

Q95 Do you think you would be more likely to purchase a monthly public transit pass if such passes were offered?

- Definitely yes (1)
  - Probably yes (2)
  - Might or might not (3)
  - Probably not (4)
  - Definitely not (5)
- 

Q100 Are there any other transport modes that you would like to see bundled in such a pass that might make you more likely to purchase it? (Select all that apply.)

- No (1)
- Yes, carsharing (e.g., car2go, Maven, Zipcar, Getaround) (2)
- Yes, dockless bikeshare (3)
- Yes, dockless e-scooters (5)
- Other: (6) \_\_\_\_\_

End of Block: Metra Group 2

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Start of Block: Interaction with Public Transit

Q6.1 The next few questions ask about your use of public transit in Chicago and how you pay for it.

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Q6.2 Do you currently have a CTA Ventra card?

- Yes (1)
  - No (2)
- 

Q6.3 Currently, which fare product do you typically purchase to use CTA services ("L" rail and bus)?

- I do not use the CTA (1)
  - Single-ride ticket (9)
  - Pay-as-you-go from Ventra card tap (2)
  - 30-day CTA/Pace pass (3)
  - 7-day CTA pass (4)
  - 7-day CTA/Pace pass (7)
  - 3-day CTA pass (5)
  - 1-day CTA pass (6)
  - Metra Link-Up pass (8)
-

Q6.4 Which fare product did you typically purchase 1 year ago to use CTA services?

- Same answer as previous question (has not changed in last year) (1)
  - I did not use the CTA then (2)
  - Single-ride fare or pay-as-you-go (either from Ventra card tap or cash payment) (3)
  - 30-day CTA pass (4)
  - 7-day CTA pass (5)
  - 7-day CTA/Pace pass (8)
  - 3-day CTA pass (6)
  - 1-day CTA pass (7)
  - Metra Link-Up pass (9)
- 

Q6.5 How many times in the past 6 months have you purchased a CTA 30-day pass, if at all?

- 0, I have not purchased a CTA 30-day pass in the last 6 months (1)
  - 1 (2)
  - 2 (3)
  - 3 (4)
  - 4 (5)
  - 5 (6)
  - 6 (7)
-

*Display This Question:*

*If Which of the following transportation modes have you used at anytime in the last 3 months in the... = Metra rail*

Q6.6 Which fare product do you typically purchase when using Metra commuter rail?

- I do not use Metra (1)
  - One-way ticket bought at the station (2)
  - One-way ticket bought on Ventra app (3)
  - 10-ride pass (5)
  - Monthly pass (6)
  - Weekend pass (7)
- 

Q6.7 In a typical work month, do you reserve pre-tax income for commuting purposes?

- Yes (1)
  - No, but my employer offers this option (2)
  - No, my employer *does not* offer this option (3)
  - Not aware of this (4)
- 

*Display This Question:*

*If In a typical work month, do you reserve pre-tax income for commuting purposes? = Yes*



Q6.8 How much pre-tax money do you typically reserve per month for commuting purposes?

- \$1 - \$50 (3)
  - \$51 - \$75 (4)
  - \$76 - \$100 (5)
  - \$101 - \$150 (6)
  - \$151 - \$200 (7)
  - \$201 - \$260 (8)
  - I do not reserve pre-tax income for commuting purposes (2)
- 

Q6.9 Do you own or use a smartphone?

- Yes (1)
  - No (2)
- 

*Display This Question:*

*If Do you own or use a smartphone? = Yes*

Q6.10 Have you downloaded the Ventra Mobile App on your phone?

- Yes (1)
  - No, but I am aware of its availability (2)
  - I have not heard of the Ventra Mobile App (3)
-

Q6.11 Have you heard of trip planning/aggregator mobile apps such as Transit App and City Mapper? Do you use any such trip planning apps?

- Yes I have heard of them but do not use them. (1)
- Yes I have heard of them and I use the following trip-planning app(s) (2)  
\_\_\_\_\_
- No I have not heard of them, but I generally use Google Maps for trip planning (4)
- No I have not heard of them. (3)

End of Block: Interaction with Public Transit

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Start of Block: Categorization and Personal

Q7.1 The final few questions ask for some information for survey result categorization purposes. These responses, like all the responses in this survey, will be kept **strictly confidential and anonymous** and are only for statistical analysis purposes.

Q7.2 What is your age?

- 18 to 24 (1)
- 25 to 29 (85)
- 30 to 34 (86)
- 35 to 39 (87)
- 40 to 44 (88)
- 45 to 49 (89)
- 50 to 54 (90)
- 55 to 59 (91)
- 60 to 64 (92)
- 65 to 69 (93)
- 70 or older (94)

---

Q7.3 What is your gender?

- Male (1)
  - Female (2)
  - Prefer not to answer (3)
- 

Q7.4 What is a street intersection near your home location? Please fill in all three.

- Main Street (4) \_\_\_\_\_
  - Cross Street (5) \_\_\_\_\_
  - City (7) \_\_\_\_\_
- 

Q7.5 How close to your home is the nearest public transit stop or station (bus or rail) that you could use to commute to work?

- No public transit near me that I could use to reach work (2)
  - 5 min walk or less (3)
  - 6 - 10 min walk (4)
  - 11 - 15 min walk (5)
  - 16 - 20 min walk (6)
  - More than 20 min walk (7)
-

Q7.6 How many people (including yourself) reside in your current dwelling unit with whom you share income (partners, children, etc.)?

- 1 (1)
  - 2 (2)
  - 3 (3)
  - 4 (4)
  - 5 (5)
  - 6 or more (6)
- 

*Display This Question:*

*If How many people (including yourself) reside in your current dwelling unit with whom you share inc... != 1*

Q7.7 How many of those people are below the age of 16?

- 0 (1)
  - 1 (2)
  - 2 (3)
  - 3 (4)
  - 4 (5)
  - 5 or more (6)
-

Q7.8 Approximately what was your combined pre-tax **household** income in 2018? (This information will remain anonymous and is only for statistical/modeling purposes.)

- Less than \$10,000 (1)
- \$10,000 to \$14,999 (2)
- \$15,000 to \$24,999 (3)
- \$25,000 to \$34,999 (4)
- \$35,000 to \$49,999 (5)
- \$50,000 to \$74,999 (6)
- \$75,000 to \$99,999 (7)
- \$100,000 to \$149,999 (8)
- \$150,000 to \$199,999 (9)
- \$200,000 or more (10)
- Prefer not to answer (11)

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Q77 (Optional) Finally, if you have any comments about the contents of this survey please let us know here.

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End of Block: Categorization and Personal

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