

HONOURING OF TRANSFERS: EQUITY EVALUATION OF TRANSIT POLICIES IN CROSS-BOUNDARY TRIPS

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EXECUTIVE SUMMARY

The COVID-19 pandemic has highlighted the difference in transit travel patterns between “choice riders” and transit reliant riders. During the pandemic, and for the years following it, transit reliant riders, who typically work in essential jobs and were of lower socioeconomic status, continued riding transit. In contrast, choice riders transitioned to work from home. To make the current system more equitable, we propose changes to eliminate the burden of double fares, which are felt by large portions of equity-seeking individuals who commute between suburbs to essential service and manufacturing jobs instead of commuting to downtown Toronto. We found that a policy of cross honouring transfers between the TTC and Miway will lead to a 36% increase in access to opportunities for equity-seeking residents in Toronto and produce an equitable outcome since those equity-seeking residents will benefit more than affluent residents.



1.0 | BACKGROUND

Transportation justice can have a variety of interpretations depending upon the lens through which it is analyzed. An equity lens is vital to help policymakers, planners, designers to understand and serve the needs of transit users. It is, however, important to define the meaning of equity in this case to ensure viable and effective policy recommendations. In general, the concept is surrounding fairness and accessibility to all inhabitants of the city. This includes fair distribution of transportation resources, benefits, costs, programs and services based on the income of riders and its impact on their day-to-day transit life (Campbell, 2019).

1.1 TRANSIT EQUITY

According to our research, transportation justice is divided into two sections: equality, sometimes called horizontal equity, and equity, or sometimes specifically defined as vertical equity (Litman, 2021). These sections include other indicators that can be used to identify equitable practices. Equality aims are treating everybody equally unless justified otherwise for specific reasons and ensuring equal access to a service. For example, policies and regulations are applied equally to all users. In addition, horizontal equity also involves all individuals bearing the costs they impose unless subsidies are provided (Litman, 2021). Equity, on the other hand, includes progressive policies concerning income levels.

Further, the focus of the policies is geared towards benefitting disadvantaged communities. Suppose the aim is to improve the transit equity of a region. In that case, this can be achieved through developmental policies to create transit in less accessible locations, implement special discounts based on income and economic needs, or increasing frequency among services frequented by equity-seeking residents. Our proposal aims to reduce the inequities in the region-wide transit network instead of simply ensuring equal access.

1.2 EQUITY IMPACTS OF COVID-19 ON TRANSIT

The COVID-19 pandemic has undoubtedly heightened the discussion around transit equity. Due to the spread of the virus, countries restricted travel, and municipalities imposed restrictions on the daily mobility of cities. This has impacted the travel behaviours and decisions of daily transit users. The majority of the people using transit during the pandemic only did so either because 1. They did not have access to a private vehicle 2. They had in-person occupations. Transit systems lack in bridging the gap between the lower-income workers and their access to opportunities. This makes transit a civil rights issue - even though transit is a public good that should benefit everyone regardless of age, race and gender.

1.3 IMPACTS OF COVID-19 ON TORONTO TRANSIT RIDERS

To better understand the current situation of equity-seeking groups amidst the pandemic, an interview was conducted with the advocacy organization TTCriders group. The key takeaways from the conversation shed light upon the differences between pre-pandemic and post-pandemic public transit. Before the pandemic, there were crowding delays; however, now, the same problem exists but jeopardizing rider's health and income. Bus bunching was common before the pandemic, however the crowding caused by service cuts has made transit more unreliable and heightened the impact of the pandemic on workers or transit-dependent individuals continuing to ride public transit.

Most importantly, equitable fares are an even bigger concern than pre-pandemic; the economic security of equity seeking residents has decreased, but TTC fares have remained the same. Programs to offset the cost of transit and account for the loss in wages, such as the fair pass program, have the same flaws as a standard monthly pass. Many low income residents cannot pay the upfront cost for a fair pass or even a presto card, and resort to paying cash fares which is more expensive in the long run.

Artificial fare boundaries set by city limits limit the opportunities, such as recreation, health, and education, and employment due to the double fare, as those residents would be deterred by the double fare. In addition, affluent “choice” riders who are able to choose between transit and a car can simply drive across the municipal boundary as their first/last mile solution, then take transit at a park and ride. This means the double fare is a regressive policy that disproportionately hurts low income riders.

While service headways and reliability are a huge concern, TTCriders reports the overarching concern for existing transit users, especially equity seeking riders, is the cost of transit. Therefore, we should be addressing the cost inequities in order to make transit more equitable. Neutralizing the costs would aid in a snowball effect of reducing other problems, such as environmental racism, income, rent, as well.

1.4 REGION WIDE FARE INTEGRATION CASE STUDIES

In current research, equity has been widely assessed throughout the world. Biran analysed equity aspects in transportation through a case study of fare change in Haifa, Israel. Haifa transitioned from a flat fare in the city core with a distance based fare in the surrounding suburbs, to a zone based fare that integrated the fares (Biran et al, 2014). After the change, the cost of using transit was still not equally distributed, but it made the first steps to addressing equity since vulnerable communities benefited the most from the change. Vulnerable communities in Haifa, like Toronto, were located in more remote regions of the metro area, and incur higher cost before the change due to their distance traveled and the number of paid transfers (Biran et al, 2014).

A similar study on transit equity was done to assess Alameda-Contra Costa Transit Districts five fare proposals introduced for public consultation during 2005 in Oakland, California. This paper analysed these proposals and their impacts on different subsectors of riders on the basis of equity, revenues generated and price elasticities of ridership due to change in price (Nuworsoo et al, 2009). The five proposals discussed were namely, 1. “pay per ride”, 2. “raise fares and transfer fees”, 3. “raise fares with two free transfers”, 4. “retain existing structure and add weekly pass” and 5. “pay per ride but retain youth pass”(Nuworsoo et al, 2009). After analysing the statistics and survey, overall, the proposals with flat fares per ride were least equitable as low income riders, youth and minority groups made the majority of the ridership statistics (Nuworsoo et al, 2009). Proposals with similar fares and transfers for an extra small fee were most favourable.

1.5 TRANSIT RIDERSHIP CHARACTERISTICS

As outlined above, the COVID-19 pandemic has affected equity-seeking and dependent transit riders in multiple ways, especially essential workers with limited commuting options. Within transportation planning, policies relating to vertical equity are often overlooked in favour of new infrastructure to meet economic and environmental goals (Grengs, 2002; Golub et al., 2013; Manaugh et al., 2015). One area that can be explored to provide equity to these types of riders is suburb-to-suburb transit trips. Using the Transportation Tomorrow Survey (TTS), a household travel survey that captures five percent of the GTHA, approximately 18,000 cross-boundary transit trips across the Toronto-Mississauga border are made each day, with 16,862 being made strictly by municipal transit agencies, roughly 93.6 percent (Data Management Group, 2016). Looking closer at transit riders, we find a large majority making suburb-to-suburb trips are transit-dependent, with the average number of vehicles per adult being 0.25 (Data Management Group, 2016). In comparison, the average number of vehicles per adult of car drivers making similar trips is 0.81 (Data Management Group, 2016). Finally, approximately 19 percent of transit riders making these trips are equity-seeking, which we defined as riders with a household income of less than \$40,000 per year (Data Management Group, 2016).

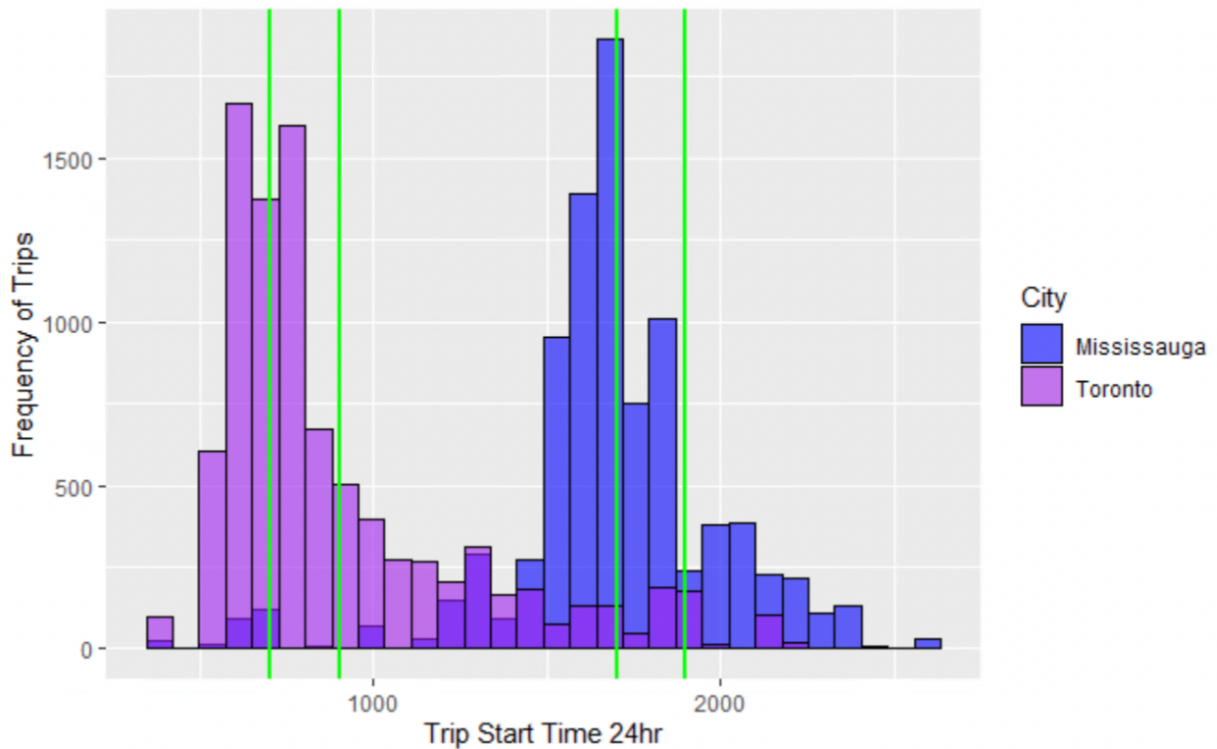


Figure 1: Frequency of transit trips between Toronto and Mississauga by origin city

Using the TTS, we can also analyze the characteristics of these suburb-to-suburb transit trips. Starting with trip purpose, we find that 73 percent of trips are being made from home to work or vice versa, confirming that essential workers are making most suburb-to-suburb transit trips (Data Management Group, 2016). In addition, the distribution of trip start times (Figure 1) also confirms this notion, as many trips start before or in the earlier peak work travel windows, another indication of early shift work. Moreover, we also observe that most trips from Toronto to Mississauga occur in the morning peak hours, and trips from Mississauga to Toronto occur in the evening peak hours, meaning most of these trips are by Toronto residents working in Mississauga (Data Management Group, 2016). This pattern is also seen when looking at the spatial distribution of transit trips across the Toronto-Mississauga border. When looking at the distribution of trips from

Toronto to Mississauga, Figures 2 and 3, the trip origins are dispersed through many residential neighbourhoods, mostly on the western side of Toronto and downtown core. Conversely, the trip destinations are concentrated into three major employment lands: Pearson internal airport and gateway employment lands along Highway 401, Square One, and Dixie and Dundas near Dixie GO Station. From Mississauga to Toronto, we see that this pattern is flipped with trip origins occurring in these employment lands and trip destinations located throughout residential zones.

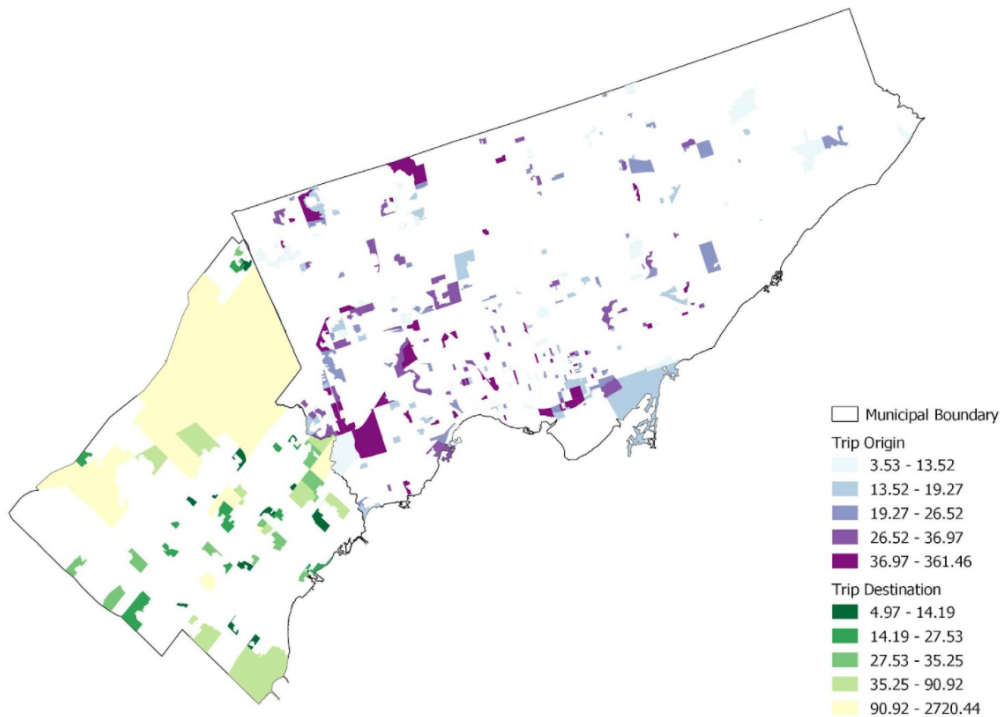


Figure 2: Distribution of suburb to suburb transit trips from Toronto to Mississauga

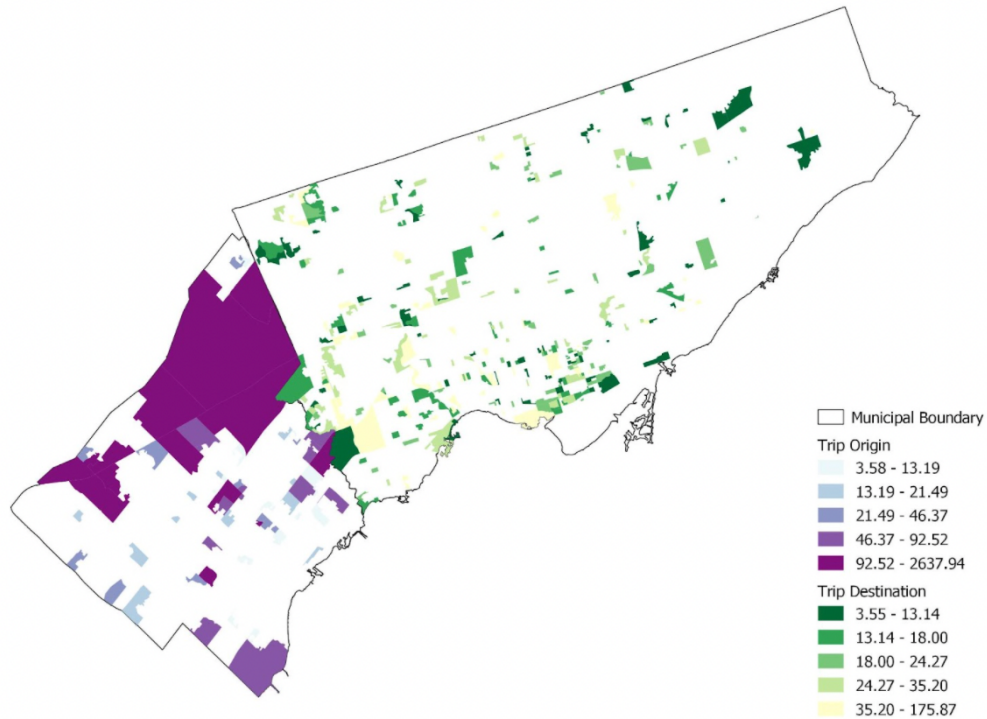


Figure 3: Distribution of suburb to suburb transit trips from Mississauga to Toronto

Finally, using the TTS and OpenTripPlanner, we can visualize the travel time distribution of suburb-to-suburb trips for these transit riders compared to if their trip was made by car instead. Looking at Figures 4 and 5, we see that the minimum travel time for transit is approximately 25 minutes, with roughly 50 percent of trips being completed just over the 80-minute mark. When comparing if the trips were made by car instead, we see the minimum travel time is 15 minutes less than transit, with roughly 50 percent of trips being completed in roughly 30 minutes, 50 minutes less than transit.

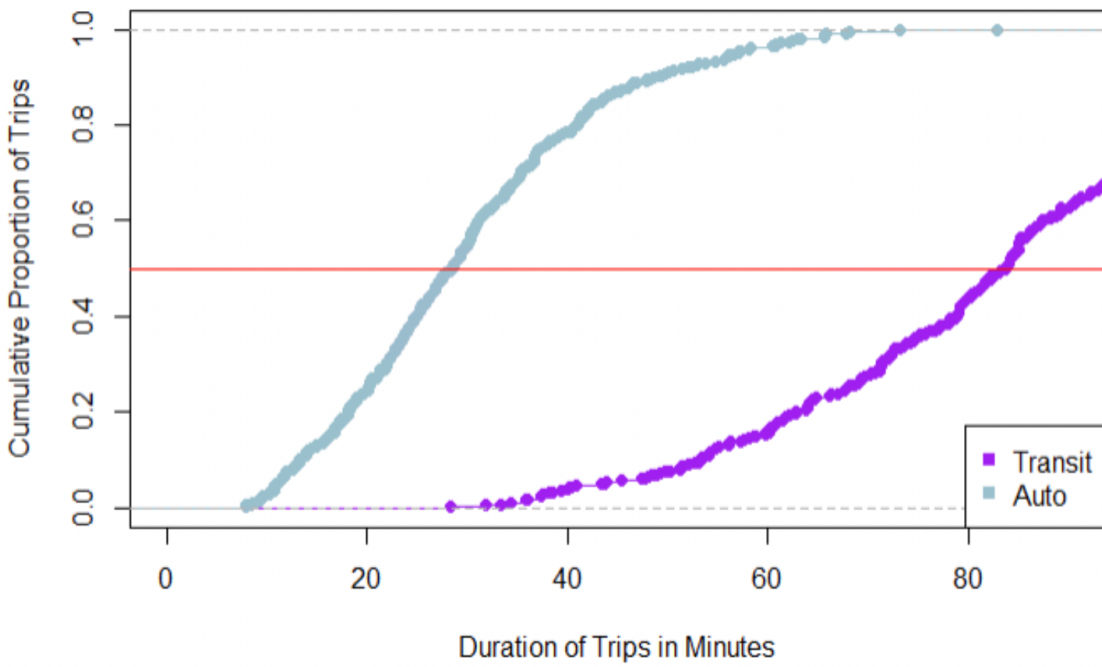


Figure 4: Travel Time Distribution from Toronto to Mississauga

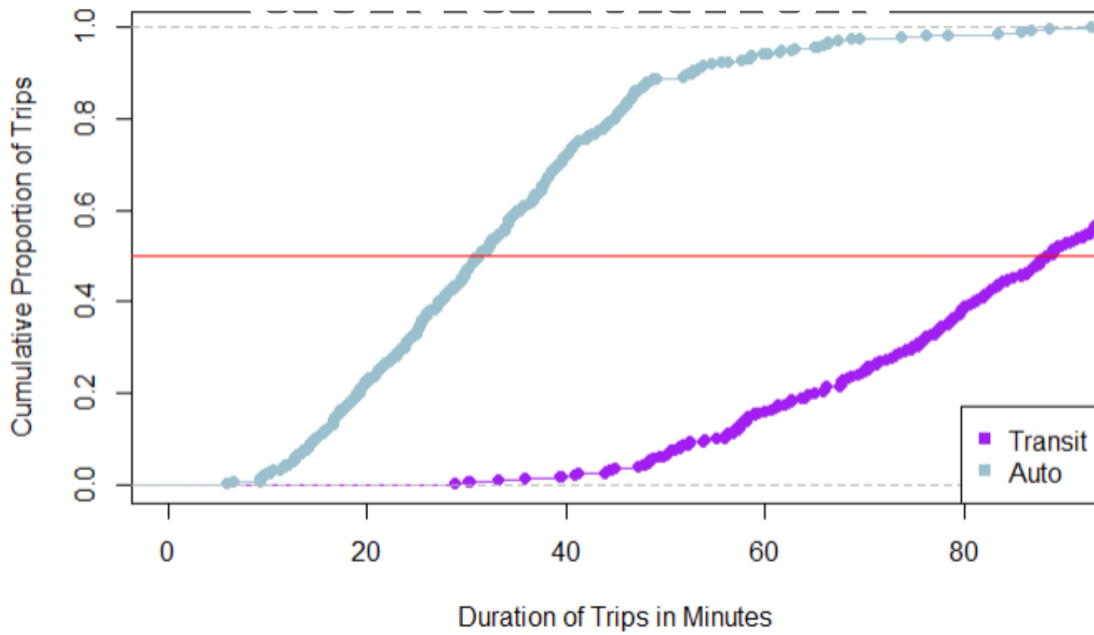


Figure 5: Travel Time Distribution from Mississauga

2.0| PROBLEM DEFINITION

With the data and perspectives shared in the background, we determined that riders crossing the Toronto-Mississauga border are generally essential workers from Toronto taking local transit to Mississauga's employment lands for jobs; a sizable chunk of those being low-income jobs. These in-person and essential jobs contributed to the fact that these equity-seeking riders were still using public transit. At the same time, the pandemic and work-from-home policies deterred white-collar commuters from making transit trips. With work from home policies for white-collar jobs becoming the new normal, cities should refocus their transit agencies to benefit essential workers. Our proposal identifies one approach to address this.

One obstacle we identified is the double fare essential workers pay when crossing the municipal border. Our analysis will explore what benefits arise if the double fare is removed and whether this change will lead to an equitable outcome. We will also determine the best policy to address this artificial travel barrier and implement steps to eliminate the double fare.

3.0| METHODOLOGY

3.1 INTERVIEWS

We conducted three interviews to consider perspectives of both industry professionals and activists. The interviews were loosely structured; we had a predefined list of questions but deviated when necessary.

Table 1: List of Interview Subjects

Name(s)	Organization	Purpose
Larissa England	Metrolinx	<ul style="list-style-type: none"> • Fare integration implementation • Models of fare integration
Ketheesakumaran Navaratnam Hayden Poon	TTC Riders	<ul style="list-style-type: none"> • Concerns of current TTC riders and pandemic challenges • Equity issues in the current TTC network • Fare equity concerns of riders
Jenny Knezevic Phil Orr	Metrolinx	<ul style="list-style-type: none"> • Quantification of equity analysis • Accessibility analysis benefits and weaknesses

3.2 ANALYTICAL METHODOLOGY

To determine the effect of removing the double fare and enabling free transfers between transit agencies, we conducted an accessibility analysis using the concepts of generalized cost and value of time.

The concept of accessibility in transportation can reach various destinations in space (Páez et al., 2012). For example, a house in Toronto’s downtown core would have higher transit accessibility to potential employment due to the proximity of employment and availability of transit in the area.

Various ways of measuring accessibility exist; however, we chose an isochrone-based measure to measure the change in accessibility from implementing free transfers between municipalities. Isochrone measures count the cumulative number of opportunities within a certain threshold of travel time from an origin (Wickstrom, 1971). These opportunities could be the number of jobs, number of grocery stores, or number of schools (Deboosere & El-Geneidy, 2018). Unlike gravity or utility measures, isochrone based measures do not weigh opportunities by proximity if they are within the threshold, so a school 30 minutes away would be equally as accessible as a school 15 minutes away if a 1 hour travel time threshold was chosen (Handy & Niemeier, 1997). However, this measure is easy to understand by the general public and does not use abstract units. For example, we can say 100,000 jobs are located within 45 minutes of an origin instead of saying an origin has an accessibility score of 15.

In our analysis, we chose jobs as the measure for the opportunity. Jobs has been chosen for many previous accessibility studies (Allen & Farber, 2019; Deboosere & El-Geneidy, 2018; Foth et al., 2013; Karner, 2018), since they are the most significant destination residents travel to in their daily lives, and influence the attractiveness of an area (Owen & Murphy, 2020). In addition, the number of jobs accessible can explain other opportunities, such as health and groceries, since there is a relationship between the number of jobs in an area and the location of other essential services (Deboosere & El-Geneidy, 2018).

Jobs numbers were taken from the 2016 Transportation Tomorrow Survey (TTS), a travel survey conducted at the 5% sample where respondents report details of all trips taken in a day for their respective households. While the TTS does ask respondents for household income, other demographic data such as race data were not collected. For this study, we define equity-seeking transit riders as riders who have a household income below \$40,000 to work within the limitations of the TTS data. However, we recognize that this definition is too limited and would ideally include race, immigration status, age etc.

We initially used a 1 hour travel time threshold as our baseline scenario. We used the concept of generalized cost and value of time to test the effects of removing the double fare. Generalized cost allows for the conversion between cost and travel time, using a number for how much an individual values their time (Abdelwahab, 2020; Lee, 2019; Neudorf, 2014). For our study, we set the value of time to \$14.35/hour, which matches the minimum wage in Ontario, similar to the value used by the University of Toronto Data Management Group of \$14/hour (Abdelwahab, 2020). Therefore, removing the double fare and implementing free transfers between Mississauga and Toronto means residents would be willing to travel an additional 17 minutes for Toronto to Mississauga trips (77 minute travel time threshold), and 14 minutes for Mississauga to Toronto trips (74 minute travel time threshold), for a TTC and Miway fare of \$3.25, and \$4.00 respectively. These thresholds would be used for the scenario where double fares are eliminated, and there are free transfers across the boundary, with Toronto to Mississauga trips paying only \$3.25 and Mississauga to Toronto trips paying only \$4.00, instead of the current \$7.25.

We used OpenTripPlanner, an open-source routing tool, to calculate transit travel times between Toronto and Mississauga. We used TAZ zones as the origin and destinations, July 2021 Openstreetmap data for the underlying road network, and the July 2021 GTFS feed for the TTC and Miway for scheduling data. Travel between Toronto and Mississauga was chosen as a case study due to computation limitations for this study. Computation limitations also limited the analysis to using a single departure time, representing the morning rush hour. In total, routing all origin and destinations through OpenTripPlanner took approximately 36 hours on a quad-core machine. If given more time for the analysis, more departure times would be chosen to see the effect across the day, including the evening rush hour, mid-day, evening, and overnight periods.

3.3 LIMITATIONS

While this method would show how outlying areas of the region would gain accessibility, the accessibility analysis would not capture the increase in trips for areas close to the border. Those users would presumably be willing to cross the boundary for short trips to basic services now that the double fares are removed. However, our method assumes they are already not deterred from accessing those opportunities in the base case.

In addition, we cannot capture the increase in ridership removing the double fares would stimulate or the change in modes. An example would be users who drive to a subway station as their first-mile solution from Mississauga. Some users would be willing to switch to transit with the lower fare. The accessibility analysis would only capture increases in opportunity and not the increase in ridership and whether the opportunities translate into actual rides.

4.0 | RESULTS

4.1 LOW-INCOME HOUSEHOLDS AND EMPLOYMENT DISTRIBUTION OF TORONTO AND MISSISSAUGA

Large clusters of low-income households in Toronto are located in northern Etobicoke and Scarborough between Highway 401 and Kingston Road. There are smaller clusters in Etobicoke and York along Weston road, Thorncliffe Park and Flemingdon Park, and scattered throughout the downtown core. Low-income households in Mississauga are located near the border with Toronto, and around Mississauga city center, with the outlying areas and communities near the lake being more affluent.

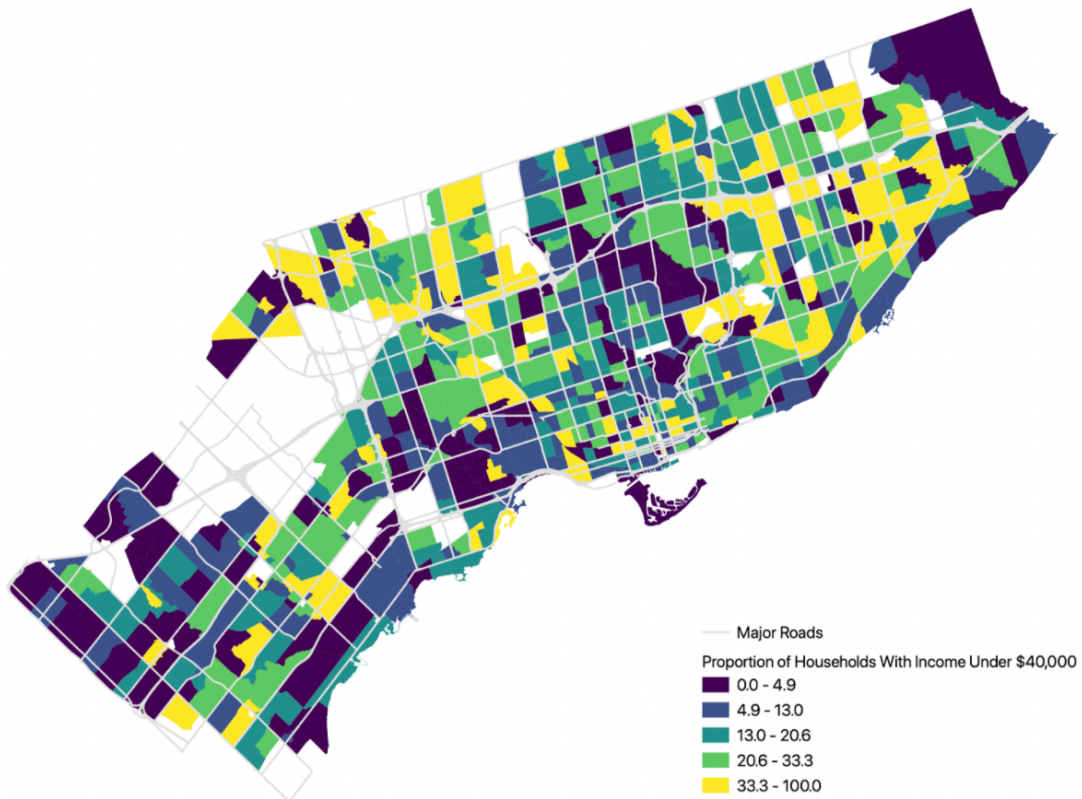


Figure 6: Proportion of households with household income below \$40,000 by Traffic Analysis Zone

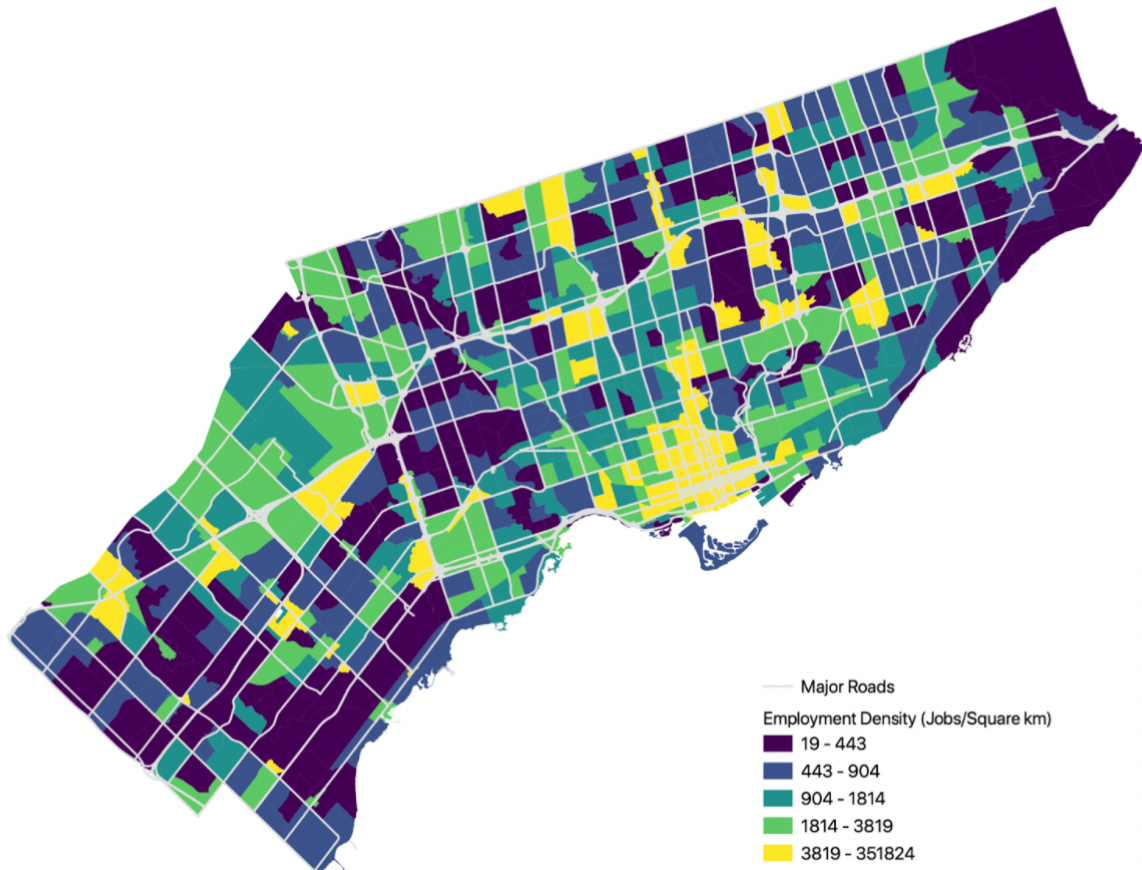


Figure 7: Employment density in Toronto and Mississauga

Employment in Toronto is concentrated around the downtown core, with smaller cores near Scarborough Centre, North York Centre, along Don Mills Road, Dufferin North, Yorkdale, and Sherway Gardens. Mississauga’s employment clusters are at the Airport Corporate Centre, Mississauga City Centre, Meadowvale centre, and Gateway centre at Hurontario and 401.

4.2 MUNICIPALITY WIDE RESULTS

For trips originating from Toronto to Mississauga in the morning rush hour, we found that by removing the double fare, there would be a 29.6% increase in reachable jobs. For travel from Mississauga to Toronto, a lower increase of 20.8%, suggesting more of Toronto’s employment zone was already reachable from Mississauga using a 1-hour threshold.

We defined equity-seeking neighbourhoods as TAZ zones with a proportion of households under \$40,000 household income in the 4th quartile or above the 75th percentile. For Toronto, this encompassed zones with more than 28.3% of households with household incomes below \$40,000. This number was 27.4% for Mississauga. Then we determined the increase in jobs reachable for these equity-seeking neighbourhoods.

Equity-seeking neighbourhoods had a 36.0% increase in reachable jobs for Toronto to Mississauga trips, higher than the citywide average. However, for Mississauga to Toronto trips, the increase in reachable jobs among equity-seeking neighbourhoods was 14.6%, less than the citywide average.

Table 2: Increase in reachable jobs by removing the double fare in the morning rush hour

	Toronto to Mississauga Trips (%)	Mississauga to Toronto Trips (%)
Citywide Origins	29.6%	20.8%
Equity Seeking Neighbourhoods Origins	36.0%	14.6%

4.3 RESULTS BY QUARTILE

We also produced results by quartile instead of solely the 4th quartile. Table 3 presents the quartile definitions for the proportion of households with incomes under \$40,000, with each quartile having the same number of zones.

Table 3: Quartile definitions for the proportion of households with incomes under \$40,000

Quartile	Toronto Origins	Mississauga Origins
First	0.0% - 7.9%	0.0% - 2.8%
Second	7.9% - 16.8%	2.8% - 13.3%
Third	16.8 - 28.3%	13.3% - 27.4%
Fourth	28.3% - 100%	27.4% - 100%

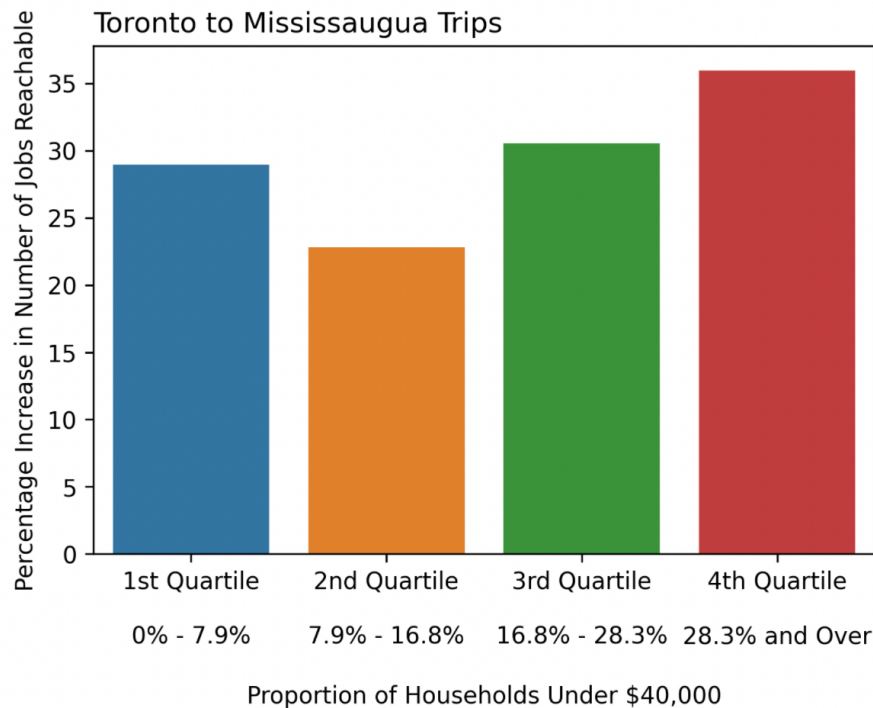


Figure 8: Increase in reachable jobs by quartile for Toronto to Mississauga

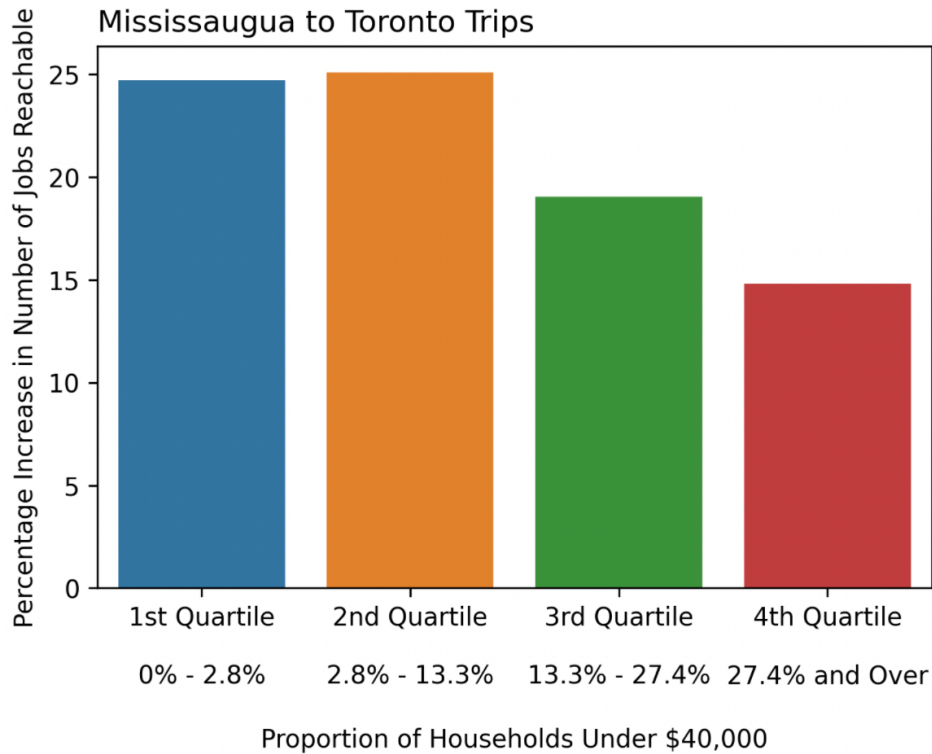


Figure 9: Mississauga to Toronto in the morning rush hour

For Toronto to Mississauga trips, the benefits increase starting from the 2nd quartile, which shows that removing double fares would produce an equitable response, as the households with the lowest incomes would benefit the most. However, for Mississauga to Toronto, the benefits decrease as the proportion of low-income households increases. Overall, removing double fares would still be equitable since more trips originate from Toronto than Mississauga in the morning rush hour. This equitable outcome is also expected to be seen for riders returning to Toronto in the evening rush hour.

4.3 RESULTS BY ZONE

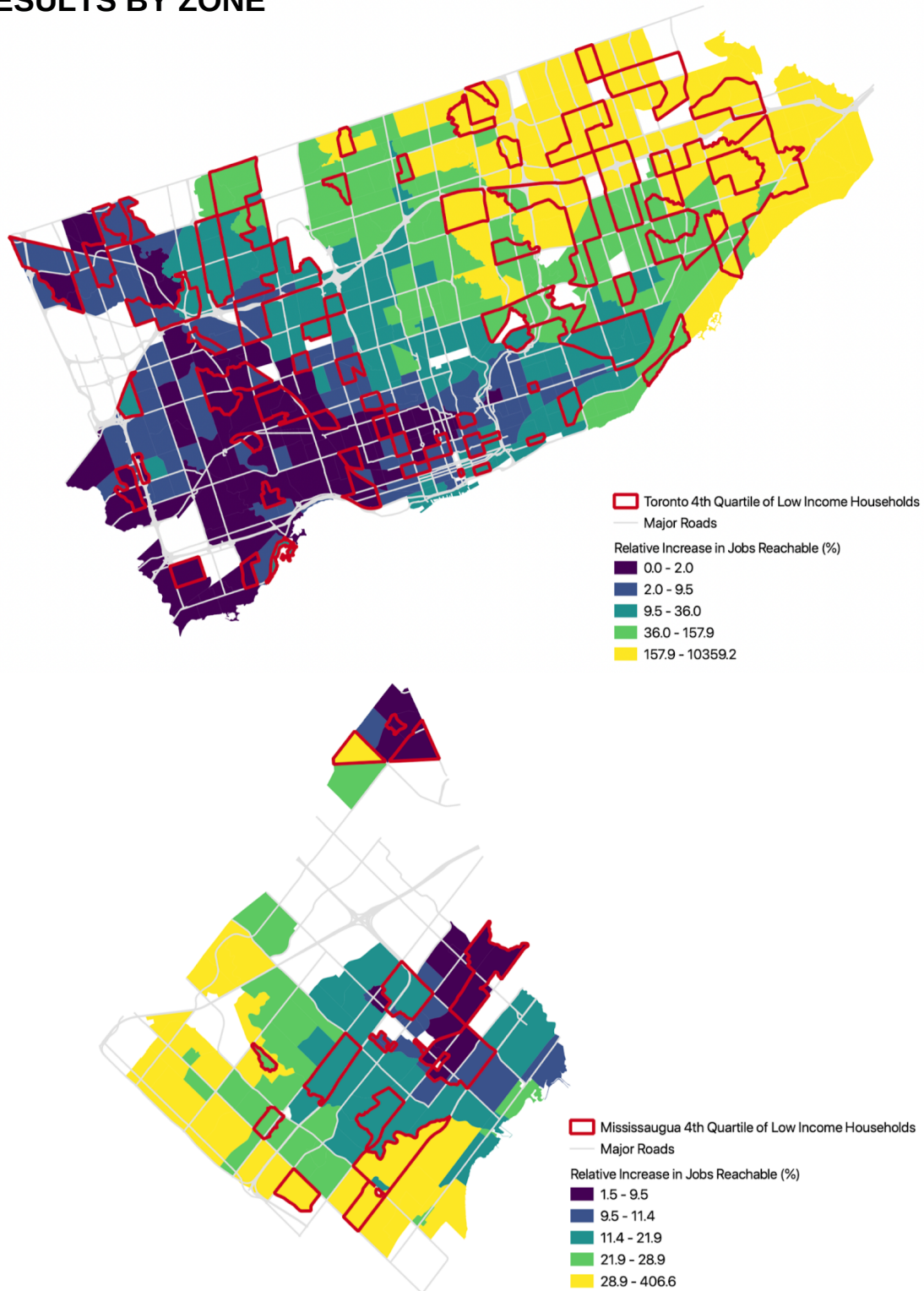


Figure 10: Percentage increase in the number of reachable jobs by origin zone for Toronto (top) and Mississauga (bottom) in the morning rush hour. Red outlines equity-seeking neighbourhoods

We can see in Figure 10 that the distribution of the benefits is not uniform across the two cities. For trips starting in Toronto, Scarborough has the greatest percentage increase in reachable jobs with the removal of double fares. While North York also saw a large increase in reachable jobs (Appendix A), many neighbourhoods in Scarborough could not reach jobs in Mississauga in the original scenario of customers paying a double fare, which contributed to a large relative increase. Because many of these neighbourhoods were defined as equity-seeking neighbourhoods, this contributed to Toronto seeing an equitable outcome if double fares were removed.

For Mississauga, the trends are reversed. Much of the equity-seeking neighbourhoods in Mississauga already have generally good connectivity to jobs in Toronto and are close to the Toronto border, so the benefit is experienced in outlying and more affluent neighbourhoods of Mississauga.

4.4 SENSITIVITY ANALYSIS

Isochrone-based accessibility analyses are sensitive to the threshold value used for the isochronal cutoff (Handy & Niemeier, 1997). We also conducted the analysis using different initial threshold values to ensure the results show the same trends no matter the cutoff. The same value of time amount was kept for this analysis.

Table 4: Sensitivity analysis of the benefit of removing a double fare using different cutoff values

Initial cutoff value (minutes)	Toronto to Mississauga Trips		Mississauga to Toronto Trips	
	Citywide Increase (%)	Equity Seeking Neighbourhoods Increase (%)	Citywide Increase (%)	Equity Seeking Neighbourhoods Increase (%)
30	37.0	39.4	42.1	30.0
60	29.6	36.0	20.8	14.7
90	13.4	15.6	8.6	4.9
120	1.5	1.8	0.6	0.3

The results in Table 4 show the same trends as the analysis involving a 60 minute cutoff time. For trips from Toronto to Mississauga in the morning rush hour, removing a double fare will produce an equitable outcome no matter the cutoff, as the increase is always higher for equity-seeking neighbourhoods. This would manifest in Scarborough equity-seeking neighbourhoods being able to reach jobs and services in Mississauga. In contrast, previously they would be deterred by a combination of the travel time and cost making it not worthwhile. Meanwhile, this would not produce an equitable outcome for Mississauga to Toronto trips. However, we cannot ignore the fact that equity-seeking neighbourhoods, who typically use transit more, will still benefit from this removal of double fares.

5.0 | RECOMMENDATION

As seen from our results, removing a double fare would positively benefit both TTC and MiWay riders by making more jobs readily accessible for equity-seeking riders due to the willingness to travel further based on the concept of generalized cost and value of time. For a proposed policy to be effective, we feel that it must meet the following three objectives.

First, can the policy recommendation be scaled up? While our project solely focuses on cross-boundary trips across the Toronto-Mississauga border, the recommendation should have the ability to be utilized in other areas of the GTHA with relative ease. Second, while municipal transit agencies must prioritize their transit network and ridership, the proposed policy recommendation should encourage collaboration between municipal transit agencies within the GTHA. Finally, the proposed recommendation should implement the concept of vertical equity where a priority is placed on communities in need, in this case, equity-seeking riders and essential workers. In addition, the COVID-19 pandemic has shown the inequalities within the sphere of transportation, with many asking how to make our cities and transportation system more equitable. In order to take advantage of this rare opportunity, the recommended policy must be able to be implemented quickly with few planning and policy roadblocks. For this reason, smaller policy changes were considered rather than a larger-scale regional transit plan, such as creating a zone fare system like in Vancouver, which requires a region-wide transit agency.

5.1 HONOURING OF TRANSFERS

Our first policy recommendation that meets all policy objectives listed above is honouring transfers between the Toronto-Mississauga border. This essentially means free transfers when switching from a TTC bus to a MiWay bus and vice versa. A transit rider travelling from Toronto to Mississauga would only pay \$3.25 instead of \$7.25. Moreover, a transit rider travelling from Mississauga to Toronto would pay \$4.00 instead of those mentioned above \$7.25.

While this recommendation still allows municipal transit agencies to set fares as they see fit, it invites collaboration between agencies. In addition, the policy of honouring transfers between municipalities already exists between some municipal transit agencies in the GTHA; for example, transfers between Brampton Transit and MiWay are free. Providing additional evidence and scalability (Callan, 2020). Finally, as seen in the previous section, the removal of paying an additional fare of \$4.00 when transferring into Mississauga or \$3.25 for Toronto provided a positive increase in the number of reachable jobs due to the ability to travel further. As seen in figure 9, Toronto to Mississauga riders from equity-seeking communities saw a 35 percent increase in the number of reachable jobs. In comparison, Mississauga to Toronto riders saw a 15 percent increase. Moreover, riders would see these benefits in their return home from work possibly resulting in other positive effects such as trip chaining, the additional travel between two anchors such as work and home, due to the reduced economic penalty for transferring between municipal boundaries.

6.0| IMPLEMENTATION

For the TTC and surrounding 905 transit agencies to honour each other's fares, they would need to agree. Honouring transfers would inevitably affect the fare revenue of individual transit agencies. Since revenue is often intertwined with service planning and operations, there would need to be negotiations to sort out revenue and service changes. Suppose this agreement allows for other agencies to pick up passengers in Toronto. In that case, the TTC may need to negotiate with its union as it is currently prohibited by the collective bargaining agreement to contract out operations in any way (Spurr, 2018).

This policy would lead to an overall loss in revenue for the agencies. However, on the grand scheme, the loss would be relatively lower than the increased access for essential workers, employment and overall access to opportunities for lower-income households. We conservatively ballparked that honouring transfers between the TTC and 905 agencies would be tens of millions of dollars and can easily be funded without large tax or fare increases. We suggest that the provincial government subsidize the loss of revenue as it would be appropriate for Metrolinx's mandate of promoting an integrated transit network and would not be unprecedented as the provincial government directly subsidized transit operations until 1998 (Troian, 2020). This would also make the municipal transit agencies more willing to agree.

7.0 | CONCLUSION

Unlike the downtown core, where access to employment by local transit is excellent, access to neighbouring municipalities through suburb-to-suburb local transit is severely lacking. This inequality in transit service was highlighted even more by the COVID-19 pandemic, where many of the workers making these trips continued to take transit through lack of commuting options. In contrast, many of us had the opportunity to work from home or take alternative modes (Palm et al., 2021). Our research exploring the concept of transit equity with regards to suburb-to-suburb trips between the Toronto-Mississauga border and can be summarized accordingly:

1. Many local transit trips between Toronto and Mississauga are made by Toronto residents living in Toronto's inner suburbs, who work in various employment lands, mostly around Pearson international airport.
2. The removal of a double-fare would increase the access to opportunities between Toronto and Mississauga transit trips and the equity of suburb-to-suburb transit trips using the concept of generalized travel cost and value of time.
3. The honouring of transfers between the TTC and MiWay would foster collaboration between both municipalities, build on the concept of vertical equity, and could be implemented quickly with the possibility of further integration within the GTHA.

The COVID-19 pandemic has shown the inequalities within the transportation sphere, with many asking how to make our cities and transportation systems more equitable. The removal of the double fare helps to address the social, spatial and economic barriers to suburb-to-suburb travel to create a more equitable and effective transit network.

REFERENCES

- Abdelwahab, B. (2020). *Ridesharing and Social Inclusion: The Role of Ridesharing in Improving Job Access for Disadvantaged Populations* [Thesis, Univeristy of Toronto]. <http://hdl.handle.net/1807/103558>
 - Allen, J., & Farber, S. (2019). Sizing up transport poverty: A national scale accounting of low-income households suffering from inaccessibility in Canada, and what to do about it. *Transport Policy*, 74, 214–223. <https://doi.org/10.1016/j.tranpol.2018.11.018>
 - Biran Nahmias, Bat-hen & Sharaby, Nir & Shiftan, Yoram. (2014). Equity Aspects in Transportation Projects: Case Study of Transit Fare Change in Haifa. *International Journal of Sustainable Transportation*. 8. 10.1080/15568318.2012.758525.
 - Callan, I. (2020). Could fare integration fix the GTA's transit woes and help meet carbon targets?. The pointer. <https://thepointer.com/article/2020-12-13/could-fare-integration-fix-the-gta-s-transit-woes-and-help-meet-carbon-targets>
 - Campbell, D. (2019, November 8). What does transportation equity mean? U of t researcher on why it's too important to ignore. University of Toronto News. <https://www.utoronto.ca/news/what-does-transportation-equity-mean-u-t-researcher-why-it-s-too-important-ignore>.
 - Data Management Group. (2016). *Transportation Tomorrow Survey*. [Data set].
 - Deboosere, R., & El-Geneidy, A. (2018). Evaluating equity and accessibility to jobs by public transport across Canada. *Journal of Transport Geography*, 73, 54–63. <https://doi.org/10.1016/j.jtrangeo.2018.10.006>
 - Foth, N., Manaugh, K., & El-Geneidy, A. M. (2013). Towards equitable transit: Examining transit accessibility and social need in Toronto, Canada, 1996–2006. *Journal of Transport Geography*, 29, 1–10. <https://doi.org/10.1016/j.jtrangeo.2012.12.008>
 - Handy, S. L., & Niemeier, D. A. (1997). Measuring Accessibility: An Exploration of Issues and Alternatives. *Environment and Planning A: Economy and Space*, 29(7), 1175–1194. <https://doi.org/10.1068/a291175>
 - Lee, J. (2019). Exploring the Accessibility Gap: Quantifying Transport Disadvantage in the City of Toronto [Master's Thesis, UWSpace]. <http://hdl.handle.net/10012/14817>
-

REFERENCES

- Litman, T. (2021, April 21). Evaluating Transportation Equity Guidance for Incorporating Distributional Impacts in Transportation Planning. Victoria Transport Policy Institute. <chrome-extension://efaidnbnmnnibpcajpcgclclefindmkaj/viewer.html?pdfurl=https%3A%2F%2Fwww.vtpi.org%2Fequity.pdf&clen=2072245&chunk=true>.
 - Miller, M. (2020). Empty TTC. BlogTO. <https://www.blogto.com/city/2020/08/ttc-refusing-restore-service-regular-levels/>.
 - Neudorf, J. (2014). Understanding Accessibility, Analyzing Policy: New Approaches for a New Paradigm [Master's Thesis, UWSpace]. <http://hdl.handle.net/10012/8759>
 - Nuworsoo, C., Golub, A., & Deakin, E. (2009). Analyzing equity impacts of transit fare changes: Case study of Alameda-Contra Costa Transit, California. *Evaluation and program planning*, 32(4), 360–368. <https://doi.org/10.1016/j.evalprogplan.2009.06.009>
 - O'Neil, L. (2019). Ttc Bus Presto. BlogTO. <https://www.blogto.com/city/2019/11/presto-users-will-soon-be-able-pay-go-bus-their-phones/>.
 - Owen, A., & Murphy, B. (2020). Access Across America: Transit 2019.
 - Páez, A., Scott, D. M., & Morency, C. (2012). Measuring accessibility: Positive and normative implementations of various accessibility indicators. *Journal of Transport Geography*, 25, 141–153. <https://doi.org/10.1016/j.jtrangeo.2012.03.016>
 - Palm, M., Allen, J., Liu, B., Zhang, Y., Widener, M., & Farber, S. (2021). Riders Who Avoided Public Transit During COVID-19: Personal Burdens and Implications for Social Equity. *Journal of the American Planning Association*, 1–15. <https://doi.org/10.1080/01944363.2021.1886974>.
 - Puhakka, V. (2020). Ttc. TorontoStar. <https://www.thestar.com/opinion/contributors/2020/11/16/rapidto-isnt-living-up-to-the-name.html>.
 - Spurr, B. (2018, October 29). TTC blocked from contracting out transit operations as arbitrator ends contract dispute. Toronto Star.
 - Troian, D. (2020). TTC Subsidy Period 2014—2020 (2020 Operating Budget Briefing Note). City of Toronto.
 - Wickstrom, G. V. (1971). Defining balanced transportation—a question of opportunity. *Traffic Quarterly*, 25(3). <https://thepointer.com/article/2020-12-13/could-fare-integration-fix-the-gta-s-transit-woes-and-help-meet-carbon-targets>
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APPENDIX

Appendix A - Absolute Increase in Reachable Jobs

