Transportation as a Barrier to Education Access: Evidence from Chicago Public Schools

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Abstract

This project investigates whether transportation services are barriers to attending high-quality schools in districts with "school choice". We will rigorously study connections between urban transportation infrastructure and disparities in education access across income and race. The project will consist of two steps. First, we present preliminary findings that document substantial heterogeneity in transportation time from home to the nearest high-performing school, using data on public transportation travel times from Google Distance Matrix. We find that lower-income families face longer travel times to the nearest high-performing school in Chicago. Second, we investigate the extent to which these differences in transportation services prevent children in disadvantaged communities from attending high-quality schools. We will use travel cost in a discrete choice model applied to ranked school choice data to recover parental preferences for school quality, transportation costs, and other school characteristics. These parameters will be used to estimate how low-income student demand for high-performing schools would change under counterfactual transportation policies such as free student access to public transportation and express bus routes from low-income neighborhoods to high-performing schools.

The proposed research will use data housed at NBER under a data use agreement between Chicago Public Schools and MIT's Blueprint Labs (formerly SEII); the IRB request for data access is in-progress. The project team consists of Texas A&M faculty member Steven Puller (who uses structural methods in public and IO), Stanford PhD student Cecilia Moreira (former RA for Christopher Neilson), and Berkeley PhD student Ini Umosen (education economist working with Chris Walters).

1 Motivation and Project Summary

Many public education systems have embraced school choice policies to improve access to high quality schools. School choice offers the potential to allow parents to send their children to higher-performing schools and to place demand-side pressure on schools to improve quality. School choice policies can take a variety of forms. Many districts have adopted open enrollment that allows parents to choose schools other than their neighborhood school via a centralized assignment system with parents submitting ranked choices.

The success of school competition policies will hinge on the willingness of parents to send their children to schools other than the local neighborhood school. Often the decision to send a child to a non-neighborhood school will involve attending a school that is farther from the family's home. Consequently, transportation is a critical facet of education policy that impacts the degree to which school choice policies improve access to high-quality education.

It is not well-known whether the need for transportation creates a substantial barrier to education access. This can be especially true in large urban districts where traditional yellow-school bus

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services are not provided. Without access to private modes of transportation, many households must rely on existing public transportation infrastructure to get their children to school. However, using the public transportation system to commute to school can pose challenges to families. Commuting to desired schools may involve multiple transfers between buses or the subway. Some of the transfers may occur in neighborhoods that are viewed as unsafe for children. Moreover, the financial cost of using the public transportation system may be binding, especially for the most vulnerable populations.

The literature on school choice has established a distaste for distance – it has been shown in multiple settings that parents tradeoff distance-to-school and school quality (e.g. Abdulkadiroglu, Pathak, Schellenberg, and Walters (2020); Burgess, Greaves, Vignoles, and Wilson (2014); Kapor, Neilson, and Zimmerman (2020)). This tradeoff may be particularly complicated in large urban settings where the network of the public transportation system can create substantially different travel times for homes equidistant from a given school.

In this project, we measure the impact of the transportation system on the ability of households to take advantage of school choice policy. We study this question in the context of Chicago Public Schools (CPS) which has open enrollment, enabling a student to have access to any school in the district. Most recently, CPS adopted a centralized application platform that allows parents to rank preferred schools, and those rankings are used to assign children to schools.

The project proceeds in three steps. First, we use travel time data from Google Distance Matrix and Open Street Maps to document that some demographic groups face substantially different travel times to the high-performing schools in Chicago. Second, we will use these components of transportation cost in a discrete choice logit model where we estimate parental preferences for school attributes. This will allow us to estimate parental distaste for travel costs and how that distaste varies by demographics, which is a necessary input to design transportation policies that improve education access for underprivileged populations. Finally, we will use the estimated preference parameters to estimate student demand for schools under counterfactual transportation policies. If households of certain demographics are particularly sensitive to the monetary cost of travel, then means-tested policies that cover the public transportation fare may incentivize households to attend high-quality schools that are further from home. Alternatively, a strong distaste for time spent commuting suggests that express busing policies that transport students from low-income neighborhoods to high-quality schools may be effective at improving access.

This paper will contribute to the literature on the efficacy of school choice. There is mixed evidence that school choice policies are effective at improving student achievement. In studies that find positive cognitive gains, heterogeneous effects are often documented by student ability (Angrist et al., 2013; Campos and Kearns, 2020) and socioeconomic status (Barrow et al., 2020; Hastings and Weinstein, 2008). Limitations to the effectiveness of school policies in improving academic outcomes may arise if parental preferences for schools are not aligned with school quality (Abdulkadiroglu et al., 2020; Burgess et al., 2014). In urban districts where public transportation is a key mode of school transit, the apparent lack of preference for quality schools may be confounded by poor access to transportation. Much of the literature does not explicitly incorporate the time and dollar cost of travel. Nevertheless, there is emerging evidence that the role of transportation is first-order important (Hastings et al., 2008; Dustan and Ngo, 2018).

These findings suggest that a choice model explicitly accounting for transportation costs would allow policymakers to better understand parental response to choice policies and to estimate the impact of counterfactual transportation policies.

2 Chicago Public Schools: Institutions and Data

Chicago Public School (CPS) District is the third largest district in the U.S.. This economically and racially diverse district primarily educates minority students – 46% of enrolled students are Hispanic, 36% are African-American, and 11% are white. Bilingual students comprise 19% of the overall student body and 76% of them qualify for free/reduced price lunch.

GoCPS, the district's centralized application platform, launched in 2017. The GoCPS platform is a one-stop-shop for households to learn about all participating schools. The platform provides detailed information about the schools and programs offered so that households can make informed choices about their rankings. The platform allows for students to apply to high schools by ranking up to 20 "choice" programs and 6 "selective-enrollment" programs. Students receive a single best offer to the highest-ranked program for which they qualify and for which seats are available. GoCPS uses a Deferred Acceptance algorithm to assign students to schools. There are 24 top rated schools, referred to as "Level 1+" schools, and our initial analysis will study whether transportation is a barrier to access to these "Level 1+" schools.

Data: We will combine administrative data on school choice applications from Chicago Public Schools with several transportation metrics obtained from Google Distance Matrix and Open Street Maps. We have assembled the travel data and we are in the process of seeking NBER IRB approval to access the Chicago Public School (CPS) data housed at NBER. For the travel data, we use Google Distance Matrix to calculate the travel time from each census block group to each school on the public transportation system, arriving to school on a weekday at 8am. The CPS data include detailed information on students and on the programs to which they apply. Student-level data include details on the students' current academic achievement, application data, and demographics. Application data include each student's program rankings, offers received, offers rejected/accepted and the observed enrollment for each student. The application behavior provides revealed preference data to allow us to estimate preference parameters in a discrete choice model.

3 Descriptive Evidence of Transportation Barriers to Access

To motivate how transportation may be a barrier to access, we first document the heterogeneity in travel time to highly-ranked schools from different neighborhoods in Chicago. Using Google Distance Matrix, we calculate travel time between each census block group and each Level 1+ school.[1]

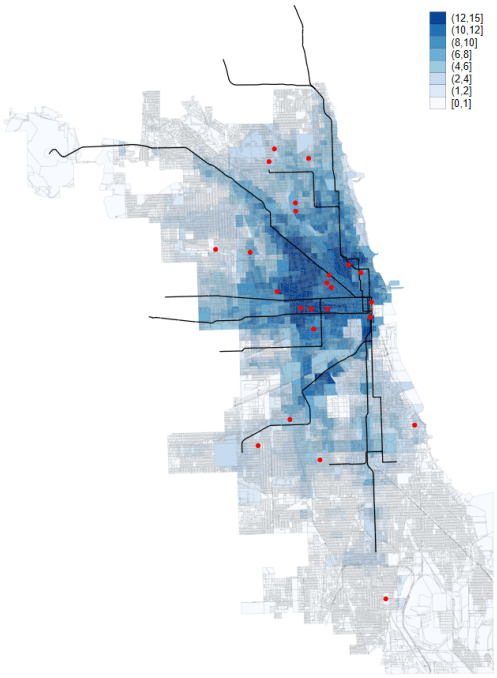
As measured by public transit time, some census blocks are very near to Level 1+ schools while others are very distant. 21% of census block groups are within 15 minutes of a highly-ranked school, however 18% of census blocks do not have a single Level 1+ school even within 40 minutes of one-way public transit time. This suggests that there is significant heterogeneity in the ease of travel to high-performing schools for households dependent upon public transportation.

Next, we explore how this variation in travel time differs across locations in the city and how this disproportionately impacts certain populations. Figure I shows the distribution of the number of Level 1+ schools within 40 minutes on public transportation. This figure shows that the neighborhoods with access to the most high-performing schools tend to be in the higher income neighborhoods in the northside and a few neighborhoods south of the Loop that lie close to 'L'

[1] For this preliminary analysis, we focus only on the highest ranked schools and the public transit mode. We plan to expand the analysis to study other high quality schools as well as driving time using Open Street Maps.

lines that head into the Loop. Many of the lower-income neighborhoods on the south side do not have access to many high-performing schools.

Figure I: Number of Level 1+ Schools within 40 Minutes on Public Transit



Long transit times to the high-performing schools are likely to disproportionately affect lower-income populations for whom the top schools are a vehicle to upward mobility. The correlation between block group income and transit time to the nearest Level 1+ school is -0.15. And if it is important to have access to more than one top school due to capacity constraints, the low-income neighborhoods face even longer transit times. The correlation between income and transit time to the second-nearest and third-nearest Level 1+ school is -0.24 and -0.28, respectively.

4 Access to High-Quality Schools Under Counterfactual Transportation Policies

In order to assess the magnitude of these transportation barriers, we use a model-based empirical strategy to estimate the extent to which transportation costs inhibit parents from sending their children to high-performing schools. We will use a discrete choice logit model applied to ranked school choice data from the GoCPS platform. Parents' rankings of their most preferred school provide revealed preference information on how they tradeoff different school quality characteristics against distance and transportation costs. CPS uses the Deferred Acceptance algorithm which is strategy-proof so that parents have incentives to reveal their true preferences in their rankings (Abdulkadiroglu and Sonmez (2003)).

Under this model, households choose the school for each child that maximizes utility. The utility of child i attending school j is a function of both household and school characteristics:

$$U_{ij} = \beta_k q_j - \lambda_k d_{ij} - \alpha_k p_{ij} + \eta_k x_j + \xi_j + \epsilon_{ij} \quad (1)$$

School quality q_j is captured by a metric used in Chicago Public Schools called SQRP, which is saliently displayed on the GoCPS platform. This metric captures a variety of dimensions of quality including growth in test scores, graduation rates, college enrollment rates, and attendance rates. Distance, d_{ij}, captures the commute time while p_{ij} captures transportation costs between household i and school j. x_j is a vector of school characteristics that we observe, and ξ_j captures school characteristics that are unobervable to us but observable to parents. ϵ_{ij} is distributed independent and Type I extreme value.

Preferences may be heterogeneous across the population, so we allow preferences for school characteristics (β), distance (λ), and price (α) to vary by socioeconomic status k and race. It is important to allow for heterogeneous preferences because the literature suggests that low- and high-SES households may tradeoff factors such as quality and distance differently (Abdulkadiroglu, Pathak, Schellenberg, and Walters (2020)). We will estimate the model via maximum likelihood.

The empirical variation that allows us to estimate the preference parameters is generated by several factors. First, the highest quality schools are not uniformly distributed across Chicago but tend to be concentrated outside of the south side where more low-income census blocks are located. Second, a household's location in the transportation network generates significant variation in travel time with households closer to subway ('L') stations tending to have shorter transport times than households relying on bus service. One identification concern is that households with different education preferences sort into neighborhoods with shorter commute time to high quality schools.

4.1 Counterfactuals

Counterfactual 1: Free Public Transit for Students: One policy that has been implemented in many urban districts is to provide free public transportation for K-12 students. The Chicago Transit Authority offers subsidized rates to students, but anecdotal evidence suggests that these costs are still a financial burden for low-income households. Using the estimated model parameters, we can simulate how each household's school rankings changes under a policy that offers free transportation to all K-12 students ($p_{ij} = 0$) or a policy that targets subsidies only to low-income households.

Counterfactual 2: Express Buses between Low-Income Neighborhoods and Top-Ranked Schools

Next we consider a policy that creates a bus service that runs in the morning and afternoon between targeted low-income neighborhoods and certain high-quality schools. To simulate demand under this counterfactual, we will replace the public transit travel time with the time it would take for an express bus to travel on this route. In order to find the travel time for the express bus, we use the drive time on Open Street Maps modified to reflect rush hour. In general, drive times are substantially faster than travel times on existing public transit. We plan to identify "school deserts" – neighborhoods that face large transportation costs due to the neighborhood's proximity to the Level 1+ schools and location in the transportation network. We will estimate the increase in number of students who would prefer Level 1+ schools if there existed strategically targeted express bus services.

Conflict of Interest Statement: Each collaborator declares that they have no relevant or material financial interests that relate to the research described in this proposal.