The effect of public transportation fare subsidies on mobility and socioeconomic outcomes: Pre-analysis plan

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Abstract

Public transportation fares are often unaffordable for low-income riders. This pre-analysis plan describes the analysis of an experiment that provided public transportation fare subsidies to 9,574 working-age residents of Allegheny County, Pennsylvania who receive Supplemental Nutrition Assistance Program (SNAP) benefits. Study participants were randomly assigned to receive either a 0%, 50%, or 100% discount on all Pittsburgh Regional Transit (PRT) bus and light rail trips for 12 months. Study outcomes will include public transportation use, transportation mode substitution, earnings and labor supply, health care utilization, self-reported measures of well-being, and spatial mobility as measured by cell phone GPS data.

Keywords — Transportation, Experiment, Public Transit, Spatial Mismatch

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1 Introduction

Advocates across the United States have called for reduced-price or free public transportation fares in recent years. Supporters of fare relief policies argue that lower fares will reduce car use and increase access to job opportunities and overall mobility. Several cities have enacted some form of means-tested public transportation subsidies (e.g. New York, Seattle, Portland, Los Angeles), while others (e.g. Boston, Denver) are considering these policies. Despite the growing interest in transit fare subsidies, little is known about the effects of these policies on low-income populations. In this project, we will work with the Allegheny County Department of Human Services (ACDHS) and Pittsburgh Regional Transit (PRT) to estimate the effect of subsidized public transportation on SNAP benefit recipients in one large U.S. county.

Urban economic theory considers mobility to be critical for residents to take advantage of the agglomeration effects of cities (Combes and Gobillon, 2015; Glaeser and Kahn, 2004). The theory of spatial mismatch also posits that geographical segregation, whereby low-income residents live farther away from job opportunities, causes persistent poverty (Kain, 1992; Ihlanfeldt and Sjoquist, 1998). Much of the work on spatial mismatch focuses on the expansion of public transit infrastructure (Gobillon et al., 2007) or access to a personal automobile (Blumenberg and Pierce, 2017; Raphael and Rice, 2002). There is little evidence, however, on how reducing the fares for existing public transit systems affects the economic lives of the urban poor. This question warrants attention given the increasing popularity of free or reduced-price fare policies.

A small literature tests the effects of public transportation fare subsidies using randomized experiments. One of the first such studies, Phillips (2014) finds evidence that a short-term transportation subsidy in Washington D.C. increases job search intensity for the recently unemployed, with suggestive evidence that this effect translates to decreased unemployment duration. More recent field experiments by Brough et al. (2022) in Seattle and Rosenblum (2020) in Boston find evidence of an increase in mobility as a result of subsidized public transportation fares. Rosenblum (2020) also finds a significant increase in the number of self-reported trips to health care appointments.

Our study aims to build upon this literature in several ways. First, we are offering fare subsidies that last for a full 12 months. Second, we will combine survey data with detailed administrative data, farecard transaction data, and mobile phone GPS data. Third, our experiment includes two treatment arms in addition to a status quo control group. One treatment arm receives a 50% subsidy, while the other receives a 100% subsidy. This will also allow us to measure the difference between a half-off fare discount and completely

free rides. There is mounting evidence that consumers value free products over and above the monetary cost (Shampanier et al., 2007). The 100% subsidy also reduces the costs associated with having to load a farecard with money, such as information and time costs. Fourth, ACDHS has recruited 9,574 adult participants. This larger sample size will allow us to detect effects that are well within the range of estimates found in prior literature.

Our study is based in Allegheny County, Pennsylvania. With a population of over 1.2 million, Allegheny County is the second largest county in the state. The county contains the city of Pittsburgh and its surrounding suburbs. Allegheny County contains an extensive public transportation network that includes buses, a light rail system, two funicular railways, and approximately 19 miles of grade-separated, traffic-free busways. The study was designed in collaboration with two local government agencies, ACDHS and PRT. ACDHS provides human services to approximately 200,000 Allegheny County residents per year. ACDHS is funding the fare subsidies and plans to use the results from this experiment to inform the design of a permanent transportation subsidy program for disadvantaged residents of Allegheny County. In particular, the results of our experiment will help inform ACDHS's decision-making regarding the amount of the subsidy and which groups of residents should be targeted. As the public transportation agency for Allegheny County, PRT supplied the discounted farecards (called "ConnectCards") that are being used in the study.

ACDHS launched this intervention on November 17th, 2022. Recruitment and enrollment occurred in two phases. During the first phase, 8,217 adult participants were enrolled into the program. On January 26th, 2023, ACDHS expanded the eligibility criteria in order to further increase enrollment. This second phase lasted until 11:59pm on February 12th, 2023 when all enrollment closed. 1,357 adult participants enrolled during the second phase, bringing total adult enrollment to 9,574. See the below sections on Sample, Recruitment, and Enrollment for more information on the enrollment process and eligibility criteria.

At the time of writing this pre-analysis plan, no outcome data has been made available to the researchers, and no data analyses have been conducted.

2 Study design

The experiment has three arms with equal allocation probabilities, randomized at the individual level:

1. The control group, which does not receive any discount on PRT trips
2. The half-off treatment group, which receives a 50% discount on all PRT trips for 12 months
3. The free treatment group, which receives a 100% discount on all PRT trips for 12

months.

Participants were assigned a ConnectCard that is pre-programmed with the appropriate fare discount level. The ConnectCards for participants in the 0% and 50% subsidy groups contain $10 of preloaded fare value to encourage use of the card. Once this initial $10 balance runs out, participants in the 0% and 50% subsidy groups must load their own fare product onto the card in order to continue using it. The 50% group ConnectCards automatically apply a 50% discount to any stored cash or timed pass that is loaded onto the card, with the exception of an annual pass. For context, a single PRT ride normally costs $2.75. The 50% subsidy group pays only $1.35 per ride. A 31-day unlimited ride pass normally costs $97.50, and costs $48.75 for the 50% subsidy group. The ConnectCards for the 100% subsidy treatment arm are programmed to allow unlimited free-fare taps on all PRT vehicles. Participants with these free-fare cards do not need to load any cash or timed pass onto the card.

2.1 Sample

During the first phase of enrollment, applicants had to meet the following criteria to participate in the study:

1. Lives in Allegheny County, PA
2. Is between 18 and 64 years old
3. Was receiving SNAP benefits in Pennsylvania at any point in September 2022
4. Is not already receiving a PRT fare discount through their school or employer
5. No other 18 to 64 year-old in the applicant's SNAP benefit case is already enrolled in the study

The study is limited to SNAP recipients because they represent a substantial share of low-income residents in the Pittsburgh area and the wider United States. This population is also readily accessible to ACDHS and lends itself to a simple eligibility verification process using administrative SNAP data. We limit eligibility to only one 18 to 64 year-old person per SNAP benefit case in order to prevent treatment spillovers that may arise if participants from the same household are assigned to different study arms.

ACDHS receives SNAP registration data from the Pennsylvania Department of Human Services (PADHS) with a two-month delay. Due to this administrative process, ACDHS cannot verify real-time SNAP beneficiaries. As a result, when the program launched in November 2022, eligibility was restricted to those who were receiving SNAP benefits in

September 2022. In January 2023, ACDHS expanded the SNAP criterion to include participants who were receiving SNAP benefits between the months of September 2022 and November 2022, using the latest SNAP registration data from PADHS. This expansion was implemented to boost enrollment in the program. No other changes to the eligibility criteria were enacted. During this second phase of enrollment starting on January 26th, 2023, applicants had to meet the following criteria to participate in the study:

1. Lives in Allegheny County, PA
2. Is between 18 and 64 years old
3. Was receiving SNAP benefits in Pennsylvania at any point between 9/1/2022 and 11/30/2022
4. Is not already receiving a PRT fare discount through their school or employer
5. No other 18 to 64 year-old in the applicant's SNAP benefit case is already enrolled in the study

Applicants were also given the option to enroll children in their SNAP benefit case between the ages of 6 and 17 years old. If an enrolled participant selected this option, they received additional ConnectCards for each of the 6 to 17 year-old children in their SNAP benefit case. These additional cards contained the same fare discount that the adult was assigned to receive. ACDHS chose to include children in the study in order increase the benefits of the intervention for the adult, recognizing that parents often bring along their young children when riding public transportation. A fare subsidy for only the adult may not yield much improvement in transportation affordability if their children still must pay full fare.

PRT offers an existing 50% discount for riders with physician-certified medical disabilities. The study application form asked applicants whether they already receive this disability discount from PRT. Applicants who reported receiving this discount were still allowed to participate and were treated the same as all other applicants in the random assignment. However, they were not provided ConnectCards if they were assigned to the 0% or 50% subsidy arms. Instead, they were advised to continue using their existing disability farecard.

The ACDHS program enrolled a total of 9,574 adults (age 18 to 64, each from a separate SNAP benefit case) and 4,949 children ages 6 to 17, for a total sample size of 14,523 individuals.[1]

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[1]ACDHS excluded children under age 6 and adults over age 64 from the study because these age groups already receive free PRT fares. PRT also offers an existing half-fare program for children ages 6 to 11, but this program has a very low take-up rate among age-eligible children in Allegheny County.

2.2   Recruitment

Starting on November 17th 2022, ACDHS recruited participants by sending text messages to Allegheny County residents who met the age and SNAP eligibility criteria according to administrative records. The texts were sent using contact information that ACDHS had on file. The messages directed interested residents to a website where they could apply to the study. The text message recipients who did not apply after the initial outreach were sent one reminder text to apply two months after recruitment began. After the eligibility criteria were expanded on January 26th, 2023 (see the Sample section for details), ACDHS recruited newly eligible residents via text message. In addition, applicants who were previously deemed ineligible but became eligible with the expanded SNAP criteria were informed of the change via text and encouraged to reapply.

Advertisements for the program were also posted inside PRT buses and on the Transit smartphone app.

2.3   Enrollment

Individuals enrolled in the study by visiting https://discountedfares.alleghenycounty.us. Applicants first signed a consent form and then completed a short application, followed by a baseline survey. The application asked for demographic information as well as the individual's social security number. These details were used to verify eligibility automatically by cross-referencing the application with ACDHS administrative data.

The baseline survey was mandatory; individuals could not enroll in the program without completing it. Before starting the survey, the application emphasized that the answers to the baseline survey do not affect the random assignment outcome in any way. After completing the survey, applicants who were deemed eligible were randomized into the three experimental arms using a pre-generated sequence of random numbers (0, 1 or 2). The randomization used equal allocation probabilities across the three arms with no stratification. Participants were informed immediately about their eligibility and their assigned experimental arm.

In the application, participants indicated whether they wished to receive their Connect-Card by mail or pick up their card in person. For those who chose mail delivery, ACDHS mailed the card within approximately one week of the person's enrollment. These participants therefore received their card in the mail approximately 2 weeks after their date of enrollment. Participants who chose to pick up their card in person received a text message notification when their card was ready to be picked up. Cards were ready to be picked up within approximately one week of the person's enrollment.

The ConnectCards in the 50% and 100% subsidy arms will be automatically deactivated

365 days after the specific card number was linked to the participant in the ACDHS program database. This card linkage occurred roughly three days after the person enrolled in the study. Assuming that participants received their cards 14 days after enrollment on average, this means that participants will have access to an active fare subsidy for about 358 days.

3 Data sources

3.1 Active data collection

Baseline survey

All participants completed a mandatory baseline survey when they applied to the fare subsidy program. The survey asked questions about the applicant's demographics, level of education, employment status, and travel behavior.

Travel diaries

We are using a text message chatbot to administer travel diary surveys to participants at routine intervals after random assignment. The survey asks participants five questions about their travels and whereabouts from the previous day:

1. "Did you use a car for any trips yesterday?" (*Participant responds with 'Y' or 'N'*)
2. "Did you use the bus/light rail for any trips yesterday?" (*Participant responds with 'Y' or 'N'*)
3. "Did you walk/bike for any trips yesterday?" (*Participant responds with 'Y' or 'N'*)
4. "Including all of these modes of transit (car, bus, light rail, walking, and biking), how many places did you go yesterday?" (*Participant responds with a number between 0 and 100*)
5. "Here are reasons you may have left your house yesterday. Type all that apply separated by a space. (e.g., type 'a b' in one msg if you went to work & school). a) Work b) School c) Groceries d) Leisure e) Healthcare f) Social services g) Other h) I didn't leave." (*Participant responds with appropriate letters*).

Follow-up surveys

We will administer follow-up surveys at 6 months, 12 months, and 15 months after the participant's enrollment date. The 12-month survey will correspond to the end of the participant's active subsidy period. The 15-month survey will measure outcomes three months after the end of the intervention period. These surveys will supplement our extensive

administrative data with self-reported information on labor market experiences, financial stability, and measures of well-being, among other topics of interest.

Smartphone GPS data

We will ask study participants to send us their Google Maps location history data from their smartphone at regular intervals for up to 18 months after random assignment. This data contains highly detailed information on a person's spatial mobility as measured from their phone, including timestamped locations, travel patterns, and estimated modes of travel for each movement spell.

Qualitative interviews

In addition to the follow-up surveys, ACDHS plans to conduct a limited number of semi-structured, longer-form interviews with study participants. The interviewees will be purposively chosen from the full study sample in order to represent diverse demographic characteristics, life situations, and study outcomes. We will qualitatively code the interviews and extract key themes in order to gain richer insights into participants' experiences and provide context that may shed light on the mechanisms behind the observed treatment effects.

3.2   Administrative data

ConnectCard Transaction Data

PRT will provide ConnectCard transaction data. This data reports the date and time of each ConnectCard tap, and the type of fare product used to pay for the ride (e.g. stored cash, weekly pass, monthly pass). The data will cover all ConnectCards that were issued in the experiment, as well as the existing cards held by the study participants who receive a disability fare discount and thus did not receive a new card for the study.

The PRT transaction data by itself does not indicate the location where a ConnectCard was used to board a PRT vehicle. However, PRT uses a third-party vendor to combine its farecard transaction data with real-time vehicle location data to estimate the transit stop where the ConnectCard was used to board a PRT vehicle. This data contains the date and time of the ConnectCard tap, as well as the name of the PRT stop or station where the tap occurred, the latitude-longitude coordinates of the stop, and the name or number of the PRT route being traveled.

Unemployment insurance records

We will measure our primary labor market outcomes using Pennsylvania unemployment insurance (UI) wage and benefit records. ACDHS receives this data on a quarterly basis through an intergovernmental data-sharing agreement with the PA Department of Labor and Industry. The UI records will cover nearly all study participants and capture all UI-eligible employment in Pennsylvania. The data reports an individual's total pretax earnings for each of their places of employment in a calendar quarter, along with the employer's name, address, and NAICS code. A separate UI data file contains the total amount of UI benefits, if any, that the individual received in each calendar quarter.

Health care claims

We will measure participants' health care utilization using administrative claims and encounter data. ACDHS has complete health care claims data for Medicaid recipients in Allegheny County, including physical health, behavioral health, and pharmacy claims. We will use this data to measure utilization of various types of health care for the subset of study participants who are on Medicaid, such as emergency department visits, inpatient stays, and primary care visits. We will also use the claims data to construct measures of a person's health status and quality of care for managing chronic conditions such as type II diabetes.

In addition to Medicaid claims, ACDHS also receives private health insurance claims data for a subset of Allegheny County residents through a data-sharing agreement with UPMC, the largest health insurance provider in the county. We will use this data to supplement the Medicaid claims and gain a more complete picture of health care utilization among the study sample.

ACDHS service records

We will use ACDHS administrative records to measure study participants' involvement in a vast array of public services in Allegheny County, including SNAP, Temporary Assistance for Needy Families (TANF), Supplemental Security Income (SSI), Medicaid, Section 8 housing, public housing, Head Start, child welfare services, foster care, the local court system, the Allegheny County Jail, mental health and substance use treatment, homelessness services, and more.[2]

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[2]See here for more information on ACDHS data holdings.

Pittsburgh Public School records

ACDHS receives complete administrative data from Pittsburgh Public Schools, which is the largest public school district in Allegheny County. The data includes information on student enrollment, attendance, course grades, disciplinary measures, and scores on the Pennsylvania System of School Assessment (PSSA) standardized tests. We will use this data to measure academic outcomes for youth study participants.

Community College of Allegheny County records

ACDHS receives data for all students enrolled at Community College of Allegheny County (CCAC). The data includes information on the student's enrollment date, enrollment status (full time versus part time), degree program and course of study, number of credits attained, graduation date, overall GPA, and GPA per semester. We will use this data to measure academic outcomes for the subset of study participants who attend this institution.

4   Outcome measures

4.1   Primary measures

We will estimate treatment effects on the following primary outcome measures for the adult study participants (age 18 and over):

- **UI quarterly earnings:** We will measure participants' total UI earnings in the third calendar quarter after the calendar quarter in which they were randomly assigned. This corresponds to the participant's earnings at roughly eight to twelve months after their date of random assignment, depending on where their random assignment date fell in a calendar quarter.

- **Primary health care visits:** We will measure participants' total number of primary care visits taken in the first nine months after random assignment. We will use a combination of Medicaid claims and UPMC private claims to construct this measure.

4.2   Secondary measures

We will estimate treatment effects on the following secondary outcome measures:

- Transit use and mobility

    - Number of PRT boardings: GPS, travel diary, and ConnectCard data

- Travel mode substitution: GPS and travel diary data

- Spending on transportation: Survey data

- Public transportation fare products: ConnectCard data

- Daily commute time: Survey data

- Geospatial mobility: GPS and travel diary data

- Residential relocation: Survey and administrative data

- Labor market outcomes

  - Probability of employment: UI data and survey data

  - Amount of UI benefits received: UI data

  - Hourly wage: Survey data

  - Job search: Survey data

  - Employment change: UI data and survey data

- Health outcomes

  - Emergency department visits: Medicaid and UPMC claims data

  - Outpatient care visits: Medicaid and UPMC claims data

  - Hospital stays: Medicaid and UPMC claims data

  - Vaccinations: Medicaid and UPMC claims data

  - Prescription fills: Medicaid and UPMC claims data

  - Mental and behavioral health services: Medicaid and UPMC claims data

  - Substance use disorder treatment: Medicaid and UPMC claims data

- Social services involvement

  - Receipt of public benefits – SNAP, TANF, SSI, Medicaid, Section 8 vouchers, child care subsidies, Head Start: ACDHS service records

  - Child welfare system involvement: ACDHS service records

  - Criminal justice system involvement – Allegheny County Jail, Pittsburgh Police arrest or citation, Allegheny County court case defendant: ACDHS service records

- Subjective well-being

- Self-reported mental and physical health: Surveys

- Self-reported financial stability: Surveys

- Self-reported measures of psychological distress, loneliness and social connected-
  ness: Surveys

- Higher education outcomes

  - Community college enrollment dates: CCAC records

  - Community college academic achievement: CCAC records

- Child-only outcomes

  - School attendance: Pittsburgh Public School records

  - Academic achievement: Pittsburgh Public School records

5 Empirical strategy

5.1 Intent to treat effects

We will estimate the effect of public transportation fare subsidies on the above outcomes
using ordinary least squares (OLS) regressions of the form:

$$(1) \qquad Y_i = \beta_0 + \beta_{50\%}(50\% \text{ subsidy})_i + \beta_{100\%}(100\% \text{ subsidy})_i + X_i + \epsilon_i$$

where $(50\% \text{ subsidy})_i$ and $(100\% \text{ subsidy})_i$ are dummy variables for being assigned to the
50% and 100% treatment arms respectively. X_i is an index of baseline covariates that may
be included to increase precision. The coefficients $\beta_{50\%}$ and $\beta_{100\%}$ are the parameters of
interest and represent the estimates of the intent to treat (ITT) effect. We will also test
whether the 50% and 100% subsidy effects are significantly different from each other.

5.2 Local average treatment effects

We will estimate the effect of the fare subsidies among the participants who complied
with their treatment status. In our study context, compliers are control group participants
who do not already receive a disability fare subsidy, and treated participants who take at least
one PRT trip using their assigned ConnectCard during the 12-month intervention period.
We will estimate the local average treatment effect (LATE) using the random assignment

as an instrumental variable that exogenously increases the likelihood of taking a subsidized PRT trip.

5.3   Heterogeneity across baseline subgroups

We will explore heterogeneity in treatment effects across study subgroups defined by baseline characteristics. For this analysis, we extend Equation 1 to include subgroup dummy variables and their interactions with the 50% and 100% subsidy treatment dummies:

$$Y_i = \beta_0 + (50\% \text{ subsidy})_i(\beta_{50\%} + \sum_{k=1}^{K} \delta_{50\%k} Z_{ki}) + (100\% \text{ subsidy})_i(\beta_{100\%} + \sum_{k=1}^{K} \delta_{100\%k} Z_{ki}) + X_i + \epsilon_i$$

where Z_{ki} is a vector of K subgroup dummy variables that are a subset of the covariates in X_i. The $\delta_{50\%k}$ and $\delta_{100\%k}$ coefficients measure the variation in treatment effects across subgroups.

We will analyze variation across the following baseline subgroups of interest:

1. Gender
2. Race
3. Age group
4. Children versus no children in household
5. Employment status (employed versus not employed)
6. Proximity to public transit. This measure is defined as whether the participant lives within the PRT "walkshed", which includes anywhere within a five minute walk of a bus stop or a ten minute walk of a light rail, funicular, or busway station.

Beyond these prespecified groups, we will also use exploratory machine learning inference to assess heterogeneity across groups defined by combinations of baseline characteristics, following the causal forest methods developed in Wager and Athey (2018) and Athey et al. (2019). These methods are relevant to our study setting, because we have access to high-dimensional administrative baseline data, and because ACDHS intends to use the study results to identify groups of residents that would benefit most from future targeted transportation subsidies.

5.4   Effect of mobility on primary outcomes

Assuming that the offer of subsidized PRT fares produces a strong first-stage effect on spatial mobility, we can estimate the effect of increased mobility on our primary socioeco-

nomic outcomes by using the random assignment as an instrument for increased mobility.

5.5 Multiple hypothesis testing

We will structure our primary analysis around a limited set of treatment effect estimates. These estimates are meant to provide a confirmatory assessment of the effects of the fare subsidies, focusing on the above primary outcomes of interest. We will clearly designate all other analyses as exploratory, including the robustness checks and estimates of heterogeneous effects. Given our small number of primary outcomes, we will not adjust any hypothesis tests for multiple testing. We will report unadjusted p-values for all analyses.

References

Athey, S., Tibshirani, J., and Wager, S. (2019). Generalized random forests. *The Annals of Statistics*, 47(2):1148–1178.

Blumenberg, E. and Pierce, G. (2017). The Drive to Work: The Relationship between Transportation Access, Housing Assistance, and Employment among Participants in the Welfare to Work Voucher Program. *Journal of Planning Education and Research*, 37(1):66–82.

Brough, R., Freedman, M., and Phillips, D. C. (2022). Experimental evidence on the effects of means-tested public transportation subsidies on travel behavior. *Regional Science and Urban Economics*, page 103803.

Combes, P.-P. and Gobillon, L. (2015). The empirics of agglomeration economies. In Duranton, G., Henderson, J. V., and Strange, W., editors, *Handbook of Regional and Urban Economics*, volume 5, pages 247–348. Elsevier.

Glaeser, E. L. and Kahn, M. E. (2004). Sprawl and urban growth. In Henderson, J. V. and Thisse, J.-F., editors, *Handbook of Regional and Urban Economics*, volume 4, pages 2481–2527. Elsevier.

Gobillon, L., Selod, H., and Zenou, Y. (2007). The mechanisms of spatial mismatch. *Urban Studies*, 44(12).

Ihlanfeldt, K. R. and Sjoquist, D. L. (1998). The spatial mismatch hypothesis: A review of recent studies and their implications for welfare reform. *Housing Policy Debate*, 9(4).

Kain, J. F. (1992). The Spatial Mismatch Hypothesis: Three Decades Later. *Housing Policy Debate*, 3(2).

Phillips, D. C. (2014). Getting to work: Experimental evidence on job search and transportation costs. *Labour Economics*, 29.

Raphael, S. and Rice, L. (2002). Car ownership, employment, and earnings. *Journal of Urban Economics*, 52(1).

Rosenblum, J. L. (2020). *Expanding access to the city: How public transit fare policy shapes travel decision making and behavior of low-income riders*. PhD thesis, Massachusetts Institute of Technology.

Shampanier, K., Mazar, N., and Ariely, D. (2007). Zero as a special price: The true value of free products. *Marketing Science*, 26(6):742–757.

Wager, S. and Athey, S. (2018). Estimation and inference of heterogeneous treatment effects using random forests. *Journal of the American Statistical Association*, 113(523):1228–1242.