Creating Moves to Opportunity: Experimental Evidence on Barriers to Neighborhood Choice*

Peter Bergman, Columbia University
Raj Chetty, Harvard University and NBER
Stefanie DeLuca, Johns Hopkins University
Nathaniel Hendren, Harvard University and NBER
Lawrence F. Katz, Harvard University and NBER
Christopher Palmer, MIT and NBER

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Abstract

Low-income families in the United States tend to live in neighborhoods that offer limited opportunities for upward income mobility. One potential explanation for this pattern is that families prefer such neighborhoods for other reasons, such as affordability or proximity to family and jobs. An alternative explanation is that they do not move to high-opportunity areas because of barriers that prevent them from making such moves. We test between these two explanations using a randomized controlled trial with housing voucher recipients in Seattle and King County. We provided services to reduce barriers to moving to high-upward-mobility neighborhoods: customized search assistance, landlord engagement, and short-term financial assistance. The intervention increased the fraction of families who moved to high-upward-mobility areas from 14% in the control group to 54% in the treatment group. Families induced to move to higher opportunity areas by the treatment do not make sacrifices on other dimensions of neighborhood quality and report much higher levels of neighborhood satisfaction. These findings imply that most low-income families do not have a strong preference to stay in low-opportunity areas; instead, barriers in the housing search process are a central driver of residential segregation by income. Interviews with families reveal that the capacity to address each family's needs in a specific manner – from emotional support to brokering with landlords to financial assistance – was critical to the program's success. Using quasi-experimental analyses and comparisons to other studies, we show that more standardized policies – increasing voucher payment standards in high-opportunity areas or informational interventions – have much smaller impacts. We conclude that redesigning affordable housing policies to provide customized assistance in housing search could reduce residential segregation and increase upward mobility substantially.

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I Introduction

Recent research has established that children's outcomes in adulthood vary substantially across neighborhoods and that moving to better neighborhoods earlier in childhood significantly improves children's outcomes (Chetty, Hendren, and Katz, 2016; Chetty and Hendren, 2018; Chyn, 2018; Laliberté, 2018). Yet the vast majority of low-income families in the United States, including those receiving Housing Choice (Section 8) Voucher assistance from the government, live in low-opportunity neighborhoods (Mazzara and Knudsen, 2019; Metzger, 2014). This pattern prevails even though many families live near areas with similar or lower rental costs that historically have produced much better economic outcomes for children (Chetty, Friedman, Hendren, Jones, and Porter, 2018). Why don't more low-income families take advantage of these options and move to opportunity? More broadly, what explains the segregation of low-income families into high-poverty, low-opportunity neighborhoods in many cities?

We test between two competing explanations for this phenomenon. One potential explanation is that low-income families prefer to stay in low-opportunity areas because these neighborhoods have other valuable amenities, such as shorter commutes, proximity to family and community, or greater racial and ethnic diversity. An alternative explanation is that low-income families do not move to high-opportunity areas because of barriers, such as a lack of information, frictions in the search process (e.g., a lack of credit or liquidity), or a reluctance among landlords to rent to them. Distinguishing between these two explanations is important for understanding the drivers of residential segregation as well as for designing affordable housing policies to address any barriers that limit moves to opportunity.[1]

We test between these explanations using a randomized controlled trial with 421 families who were issued Housing Choice Vouchers (costing $1,510 per month in rental assistance, on average) in the Seattle and King County area between April 2018 and April 2019. The families in this sample are first-time voucher recipients with relatively low incomes (the average household income is $19,600) and are predominantly headed by single parents. In collaboration with the Seattle and King County Housing Authorities, we designed the Creating Moves to Opportunity (CMTO) intervention to reduce the constraints and frictions such families may face when trying to move to high-opportunity neighborhoods.

Working with the Seattle and King County Housing Authorities, we defined high-opportunity

[1] An extensive literature in sociology and economics has studied this question over the past fifty years. We discuss how the present paper contributes to this literature at the end of the introduction.

neighborhoods as Census tracts that have historical rates of upward income mobility in approximately the top third among tracts in the Seattle and King County area, drawing on data from the Opportunity Atlas. On average, children who grow up in low-income (25th percentile) families in high-opportunity areas earn about 13.9% ($6,800 per year) more as adults than those who grow up in low-opportunity areas in families with comparable incomes. Historically, fewer than 20% of voucher recipients in Seattle and King County have leased units in high-opportunity areas.

In collaboration with our partners, we provided a program consisting of three components – customized search assistance, landlord engagement, and short-term financial assistance – to help families in the treatment group find and lease units in high-opportunity areas. The total cost of the program was about $2,600 per family.[2] Search assistance was provided by a non-profit group and included information about high- opportunity areas, assistance in preparing rental documents, guidance in addressing issues in a family's credit and rental history, and help in identifying available units and connecting with landlords in high-opportunity areas. On average, the non-profit staff spent about seven hours working with each family. The non-profit staff also engaged directly with landlords in opportunity areas to encourage them to lease units to CMTO families and expedite the lease-up process. Landlords who leased to CMTO families were additionally offered an insurance fund for damages to the unit above and beyond the security deposit. Finally, financial assistance included funds, administered by the program staff, for security deposits and application fees, averaging $1,100 per family. Importantly, all families in the treatment group had the option to use their housing voucher in *any* neighborhood within the housing authorities' jurisdictions (although CMTO services were only provided in high-opportunity areas).[3]

The CMTO treatment increased the share of families who leased units in high-opportunity neighborhoods by 40.0 percentage points (s.e. $= 5.2$ pp, $p < 0.001$), from 14.3% in the control group to 54.3% in the treatment group.[4] We find similarly large treatment effects on moves to high-

[2]This $2,600 figure is the up-front cost of the program services; it excludes downstream costs incurred in the form of higher housing voucher payments that were incurred by housing authorities because treatment group families moved to more expensive neighborhoods. See Section III.C for details.

[3]This element of neighborhood choice is the critical distinction between CMTO and the Moving to Opportunity (MTO) experiment implemented in the 1990s, which *required* that families in the experimental group move to low-poverty Census tracts to receive a voucher. Studies of the MTO experiment have shown that families who moved to higher-opportunity areas as required by the experimental treatment had improved mental health and well-being and better economic outcomes for their children (Kling, Liebman, and Katz, 2007; Chetty, Hendren, and Katz, 2016; Ludwig, Duncan, Gennetian, Katz, Kessler, et al., 2012). The focus of the CMTO experiment is on why families receiving vouchers without such requirements typically do not live in such areas.

[4]These and all other estimates reported in this version of the paper are based on 274 families issued vouchers between April 13, 2018 and December 31, 2018, using data on lease-up outcomes up to June 24, 2019. A few of these families are still searching for housing and 146 additional families were issued vouchers after December 31, 2018, so the interim estimates reported in this version of the paper may differ slightly from the final estimates when the study

opportunity areas across several subgroups, including racial minorities, immigrant families, and the lowest-income households in the sample. CMTO changed *where* families moved, not *whether* they moved at all with a Housing Choice Voucher: in both the treatment and control groups, approximately 85% of families leased a unit somewhere using their housing vouchers. The fact that families are able to use their vouchers to find housing at similar rates even without CMTO services shows that the program did not induce families to move to high-opportunity areas simply to use their vouchers; rather, it expanded families' neighborhood choice sets.

Families in the treatment group moved to a variety of Census tracts across the Seattle and King County area: the 77 families in the treatment group who moved to a high-opportunity area now live in 35 different tracts. There is no evidence that treatment group families bunched at the upward mobility threshold used to define a "high-opportunity" area; some families moved to the highest-upward-mobility neighborhoods in Seattle and King County. Families who moved to high-opportunity areas chose neighborhoods whose characteristics are representative of high-opportunity areas overall, which tend to have lower poverty rates, higher shares of two-parent families, slightly lower shares of non-white residents, and lower population density.

In a post-move survey of a randomly selected subset of families, 67.9% of families in the treatment group report being "very satisfied" with their new neighborhood, compared with 33.3% in the control group. Families who moved to high-opportunity areas do not appear to have made sacrifices on other observable neighborhood amenities, such as distance to their prior location or proximity to jobs, nor in the quality of the unit they rent, as measured by its size, age, or other characteristics. This may be because Seattle and King County had a tiered payment standard for vouchers that offered higher payments for more expensive neighborhoods (a policy introduced independently of the CMTO experiment), allowing families to access more expensive units in high-opportunity areas. Indeed, the average monthly rent was $195 higher for families assigned to the CMTO treatment group than the control.

Our experimental results imply that most low-income families do not have a strong preference to stay in low-opportunity areas; rather, barriers to moving to high-opportunity areas play a central role in explaining neighborhood choice and residential sorting patterns. Explaining our findings with a frictionless model in which neighborhood choices are determined purely by preferences would require that a large group of families happen to be close to indifferent between low- and high-opportunity areas. In particular, our treatment effect estimates imply that 45% of families

is completed.

must have a willingness to pay (WTP) to live in a low-opportunity area between $0 and $2,600 (the cost of the CMTO program). This is implausible both because we find uniformly large treatment effects across subgroups and because the marginal families induced to move to high-opportunity areas by the intervention report much higher levels of neighborhood satisfaction after moving. A more plausible explanation of the data is that many low-income families have strong preferences to move to high-opportunity areas, but are prevented from doing so by barriers in the search process. Such barriers could potentially be captured in a reduced-form manner by incorporating sufficiently large housing search costs into the model (e.g., Wheaton, 1990; Kennan and Walker, 2011), but unpacking what these search costs are is critical for understanding how one can reduce these costs and help families find housing in their preferred neighborhoods.

To understand the barriers families face and the mechanisms through which CMTO addressed them, we conducted 110 in-depth (on average, two hour) interviews with a stratified random sample of families in the treatment and control groups during and after their move. Many families reported that they had limited time and resources to search for housing, as they were facing challenges such as domestic violence, mental health conditions, or holding multiple jobs while caring for children as single parents. Families identified five key mechanisms through which the CMTO program helped them move to opportunity: providing emotional support, increasing interest in moving to a high-opportunity neighborhood, streamlining the search process by helping prepare "rental resumes" and identifying interested landlords, providing direct brokerage services and representation with landlords, and providing crucial and timely assistance for auxiliary payments that could prevent a lease from being signed. The qualitative interviews show that the CMTO program's ability to respond to each family's specific needs and circumstances was critical to the program's impact. Service utilization was highly heterogeneous across families, with some families relying heavily on search assistance, while others used more financial assistance or took advantage of direct landlord referrals.

Consistent with the importance of customized services, we find that CMTO increased access to high-opportunity neighborhoods substantially more than other more standardized policies with similar goals. One prominent approach, termed Small Area Fair Market Rents, is to provide financial incentives to help families move to higher-opportunity neighborhoods by offering higher voucher payment standards in higher-rent ZIP codes within a metro area (HUD, 2016). The King County Housing Authority implemented such a policy in March, 2016. Using a quasi-experimental difference-in-differences design comparing voucher recipients in Seattle vs. King County, we find

that King County's change in payment standards had little or no impact on the rate of moves to high-opportunity areas, with an upper bound on the 95% confidence interval of a 7.7 pp increase – an order of magitude lower than the effects of CMTO. We also study a policy introduced by the Seattle Housing Authority that increased payment standards specifically in high-opportunity neighborhoods (as designated for the CMTO experiment). Again, we find it had a much smaller impact on the rates of moves to high-opportunity areas. Indeed, only 20% of voucher recipients with children moved to high-opportunity areas even after these changes in payment standards were implemented. These findings show that financial incentives are insufficient to induce moves to opportunity by themselves (although they may be necessary to facilitate such moves through CMTO-style programs, especially in expensive housing markets).[5]

Another alternative to customized housing search assistance is to provide information in a lower-cost, more standardized manner. Schwartz, Mihaly, and Gala (2017) report results from a randomized trial showing that short-run financial incentives and light-touch counseling had little impact on the rate of moves to higher opportunity areas in Chicago. Bergman, Chan, and Kapor (2019) randomized the provision of information to families about the quality of schools associated with rental units on a website commonly used by voucher holders. The information intervention resulted in moves to units with slightly better neighborhood schools, but had a much smaller impact on neighborhood quality than CMTO. In our data, we find that CMTO greatly increased the fraction of families who stayed in high-opportunity areas even among those who were living in high-opportunity neighborhoods when they applied for vouchers, and so were presumably informed about those areas. Furthermore, 72% of families felt "good" or "very good" about moving to an opportunity neighborhood even at the point of the baseline survey, before the CMTO intervention began. These results all suggest that information alone does not drive CMTO's impacts and is unlikely to greatly increase moves to opportunity areas by itself.

From a policy perspective, our results imply that redesigning affordable housing programs to facilitate more moves to opportunity could have substantial impacts on residential segregation and intergenerational income mobility. Using data from Chetty, Friedman, Hendren, Jones, and Porter (2018), we estimate that moving at birth from a low- to high-opportunity area (and staying there throughout childhood) would increase the average low-income child's undiscounted lifetime household income by $210,000 (10.4%). More broadly, given that low-income families do not

[5]Of course, there are many potential goals of affordable housing beyond increasing upward mobility for children, such as providing safe and stable shelter or shorter commutes. Small area fair market rents could be valuable in achieving these other objectives; our results do not speak to such considerations.

have strong preferences for low-opportunity neighborhoods, and are willing to move to higher-opportunity neighborhoods, our results provide support for increasing the availability of affordable housing in higher-opportunity areas through other policies such as the Low Income Housing Tax Credit, project-based units, or changes in zoning regulations.

Although our findings are encouraging for mobility programs that facilitate residential choice, three important caveats should be kept in mind. First, we do not yet have evidence on whether families who move to high-opportunity areas stay in those areas. Surveys conducted on average six months after families moved show that families in the treatment group are significantly *less* likely to report a desire to move again, but we need to follow families over time to estimate persistence. Second, general equilibrium effects could potentially dampen the causal impacts of neighborhoods when families move in or out of them.[6] In practice, the families in CMTO came from a wide variety of neighborhoods and, as noted above, moved to a wide variety of different areas. This dispersion suggests that CMTO (or even scaled-up versions of the program) will not change the characteristics of any neighborhood sufficiently to dampen the benefits of moving to higher opportunity areas. Moreover, most of the families who moved to a high-opportunity area in the CMTO program would have moved to some other neighborhood even absent these services, implying that CMTO does not have any incremental effect on destabilizing the neighborhoods where families were initially living.

Finally, it remains to be seen whether the findings reported here for the Seattle and King County area generalize to other housing markets. On the one hand, Seattle and King County are tight housing markets in which high-opportunity areas have little affordable housing, suggesting treatment effects could be even larger elsewhere. On the other hand, Seattle may be a market that is conducive to opportunity moves, as it bans source-of-payment discrimination and has other characteristics that may make it easier for lower-income families to find housing in higher-opportunity areas. We hope that other public housing authorities will be able to build on the lessons learned in Seattle and test similar programs elsewhere, perhaps in the context of the Housing Choice Voucher Mobility Demonstration.

This paper builds on an extensive literature in sociology and economics that has analyzed the role of preferences versus structural barriers as causes of segregation (e.g., Schelling, 1971; Kain and Quigley, 1975; Massey and Denton, 1987; Sampson, 2012; Sharkey, 2013; Krysan and Farley, 2002;

[6] Galiani, Murphy, and Pantano (2015), Davis, Gregory, and Hartley (2018), and Davis, Gregory, Hartley, and Tan (2017) provide state-of-the-art analyses of such general equilibrium effects.

Krysan and Crowder, 2017). Much of this work has focused on racial segregation, highlighting the importance of forces such as discrimination (Yinger, 1995; Turner, Santos, Levy, Wissoker, Aranda, et al., 2013) and a lack of information (Krysan and Bader, 2009) in producing segregation despite African Americans' preferences for living in more integrated neighborhoods (e.g. Charles, 2005; Emerson, Chai, and Yancey, 2001). A smaller body of work has examined the drivers of socioeconomic segregation (e.g., Reardon and Bischoff, 2011), which is our primary focus here. Our contributions to this literature are (1) establishing experimentally that barriers have substantial causal effects on neighborhood choice among low-income families; (2) characterizing the barriers at play, showing in particular that they extend beyond racial discrimination, a lack of information, or a lack of financial liquidity and instead involve deeper psychological and sociological constraints; and (3) demonstrating that these barriers can be reduced through feasible modifications of existing government programs.

The paper is organized as follows. Section II briefly summarizes a set of facts on the geography and price of opportunity in Seattle and King County that motivate our intervention. Section III provides institutional background on the housing voucher program and describes our intervention and experimental design. Section IV describes the data we use for our analysis. Section V reports the main experimental results and interprets their implications using a stylized model of neighborhood choice. Section VI presents qualitative evidence on mechanisms. In Section VII, we compare the effects of CMTO to other more standardized policies, including changes in payment standards and informational interventions. Section VIII concludes.

II The Geography and Price of Opportunity in Seattle

In this section, we summarize four facts on the geography and price of opportunity that motivate our intervention.[7]

First, children's rates of upward income mobility vary substantially across nearby tracts. Figure 1a plots upward income mobility by census tract in King County (which includes the city of Seattle and surrounding suburbs) using data from the Opportunity Atlas (Chetty, Friedman, Hendren, Jones, and Porter, 2018). The map shows the average household income percentile rank at age 35 for children who grew up in low-income (25th percentile) families in the 1978-1983 birth cohorts.[8]

[7] We establish these facts using data from Seattle and King County here, but the same four facts hold systematically in other metro areas across the country.

[8] Children are assigned to tracts in proportion to the number of years they spent growing up in that tract until age 23; see Chetty, Friedman, Hendren, Jones, and Porter (2018) for further details.

There is substantial variation in upward mobility across tracts: the (population-weighted) standard deviation of children's mean income ranks in adulthood across tracts within King County is 4.7 percentiles (approximately $5,175, or 10.3% of mean annual income for children with parents at the 25th percentile).

Second, much of the variation in upward mobility across neighborhoods is driven by the *causal effects* of childhood exposure rather than sorting. Recent studies have established that moving to high-upward-mobility ("high-opportunity") neighborhoods improves children's outcomes in adulthood in proportion to the amount of time they spend growing up there. These studies, summarized in Appendix Figure 1, use research designs ranging from random assignment of vouchers (Chetty, Hendren, and Katz, 2016) and quasi-experimental estimates based on variation in the age of children at the time of the move (Chetty, Friedman, Hendren, Jones, and Porter, 2018; Laliberté, 2018) to demolitions of public housing projects (Chyn, 2018). They find that approximately two-thirds of the observational variation in upward mobility across tracts is due to causal effects of place.

Third, low-income families are concentrated in lower-opportunity neighborhoods. Even among families that receive rental assistance from the government in the form of housing vouchers, 76% of families in Seattle and King County live in tracts with below-median levels of upward mobility. Figure 1a illustrates this fact by showing the 25 most common locations where families with housing vouchers moved between 2015 and 2017; families are clustered in lower-opportunity tracts (red colors) even though there are often much higher-opportunity tracts nearby.

Fourth, the segregation of low-income families into low-opportunity areas is not simply explained by differences in the price of housing between low- and high-opportunity neighborhoods. Figure 1b plots the upward mobility measure shown in Figure 1a against median rent for a two-bedroom apartment in each tract, using data from the 2012-2015 American Community Survey (ACS) to measure rents. Neighborhoods with higher upward mobility are slightly more expensive: the (low-income count-weighted) correlation between rents and upward mobility is 0.25 within King County. However, there is considerable variation in upward mobility even conditional on rent. Figure 1b highlights the most common tracts where voucher holders lived prior to our experimental intervention and shows that many families could potentially move to "opportunity bargain" neighborhoods that would improve their children's outcomes without having higher rents.[9]

These four facts motivate our central questions: Why don't more low-income families, especially

[9]Moreover, the housing authorities offer tiered payments standards such that families receive more rental assistance if they find housing in a more expensive area, further reducing the effective cost of housing in high-opportunity neighborhoods.

those receiving housing vouchers, move to opportunity? Do families prefer lower-opportunity areas because they have other advantages (e.g., a shorter commute to work or proximity to family)? Or do they prefer higher-opportunity neighborhoods, but face barriers that limit access to such areas? If families face such barriers, how can we intervene to help families live where they would like to live?

III Intervention and Experimental Design

In this section, we describe our intervention and experimental design. We begin by providing some institutional background on the Housing Choice Voucher (HCV) program. We then discuss our definition of high-opportunity neighborhoods, the services offered in the Creating Moves to Opportunity program, and the design of the randomized controlled trial.

III.A Background on the Housing Choice Voucher Program

The HCV program provides rental assistance to 2.2 million families in the United States each year, with a total program cost of approximately $20 billion annually (see Collinson, Ellen, and Ludwig (2015) for a comprehensive description of the program). The program is overseen at the federal level by the U.S. Department of Housing and Urban Development (HUD), but is administered by local Public Housing Authorities (PHAs). In this study, we work with two PHAs: the Seattle Housing Authority (SHA), which issues vouchers that can be used in the city of Seattle, and the King County Housing Authority (KCHA), which issues vouchers that can be used in the rest of King County, excluding the cities of Seattle and Renton.[10] Both KCHA and SHA are among a small number of PHAs who participate in HUD's Moving to Work program, which gives them greater flexibility in making program changes, such as setting up a mobility program, than typical PHAs.

The HCV program is targeted at low-income families. To be eligible for a voucher from SHA and KCHA, families must have household income below 80% of Area Median Income (AMI).[11] In line with national patterns, more families meet this criteria than the number of vouchers available. The PHAs address this problem by using a lottery to assign families positions on a waiting list. Families who are homeless or who have incomes below 30% of AMI are given priority on the waitlist.

[10] Vouchers from both SHA and KCHA may be ported out to use in other areas if they meet certain requirements; this occurs relatively infrequently in practice.

[11] Families must also meet certain additional requirements, such as having children or meeting certain age requirements. The full set of requirements are available here for SHA and here for KCHA.

In practice, virtually all families who actually receive vouchers fall well below the 30% AMI cutoff, which corresponds to $29,900 for a family of 3. In Seattle and King County, the typical family who received a voucher during our experiment had been on the waitlist for about 1.5 years.

Families eligible for the HCV program are required to contribute 30 to 40% of their annual household income toward rent and utilities. They then receive a housing subsidy that covers the difference between a unit's listed rent and the family's contribution, up to a maximum amount known as the Voucher Payment Standard. In SHA and KCHA, the maximum monthly voucher payments for a two-bedroom unit were $2278 and $2110, respectively.[12]

Once families are issued a voucher, they typically have 4 to 8 months to use the voucher to lease a unit; if the voucher is not used by that point, it is issued to another family. To use a voucher, families must find an interested landlord whose unit passes a quality inspection conducted by the PHA. After leasing, families remain eligible for the voucher they received indefinitely as long their income remains below eligibility thresholds.

III.B Defining Opportunity Areas

The first step in our intervention is to designate which areas are "high-opportunity" neighborhoods. Using the Opportunity Atlas data on upward mobility in Figure 1a, we define high-opportunity neighborhoods as Census tracts that have upward mobility in approximately the top third of the distribution across tracts within Seattle and King County.[13] We then adjust these definitions to (1) create contiguous areas and (2) account for potential neighborhood change.[14] We create contiguous areas by including census tracts that fall below the "high opportunity" threshold according to raw Opportunity Atlas measures but are surrounded by other high-opportunity areas and excluding high-opportunity census tracts that are surrounded only by lower-opportunity neighborhoods.

We address neighborhood change by evaluating whether the historical measures of upward mobility in the Opportunity Atlas – which are constructed using data for children who grew up in these areas in the 1980s and 1990s – are good predictors of opportunity for children growing up in those areas today. Chetty, Friedman, Hendren, Jones, and Porter (2018) examine the serial correlation of upward mobility measures across cohorts. They find that rates of upward mobility

[12] In recent years, both SHA and KCHA have adopted tiered payment standards that offer higher payments in more expensive areas to enable families to move to more expensive neighborhoods.

[13] The measures we used were from a preliminary version of the Opportunity Atlas and hence do not exactly match the statistics shown in Figure 1a, which are drawn from the publicly available Opportunity Atlas data released in October 2018.

[14] We also excluded three tracts that already had a larger concentration of voucher holders, suggesting that barriers to HCV recipients moving to these areas were already low.

are generally quite stable over time and that historical mobility is more predictive of future mobility than typical contemporaneous proxies for opportunity, such as poverty rates. That said, there are certain parts of Seattle, especially near the center of the city, which have gentrified dramatically in the past ten years and could potentially have very different outcomes today. To evaluate the impacts of this change, we examine the test scores of low-income (free-lunch-eligible) students living in these areas, a plausible leading indicator of upward income mobility. The test-scores of *low-income* students did not change significantly in these areas (although average test scores, pooling all income groups, increased as higher-income families moved in). We conclude based on this analysis that the historical Opportunity Atlas measures provide good predictors of opportunity for low-income families even in these changing neighborhoods.[15] Based on these and other qualitative analyses by the housing authorities, we chose to proceed with the designations largely based on the Opportunity Atlas data.

Figure 2a shows the final set of Census tracts that were designated as "high opportunity" (in the dark shading) after this process. These definitions of high-opportunity areas differ from previous definitions used by SHA and KCHA as well as other practitioners and researchers. Most prior studies define "high-opportunity" areas based on proxies such as the availability of jobs, transit access, crime rates, poverty rates, etc. In contrast, we directly define high-opportunity areas as places where low-income children have had good outcomes historically. We focus on *children* because prior work has shown that neighborhoods have the largest impacts on children's rather than adults' economic outcomes. We focus on their *outcomes* rather than proxies for those outcomes because prior work has shown that observable characteristics such as poverty rates capture only about 50% of the variation in upward mobility across areas.

Figure 2b shows why this distinction matters in practice. The left panel replicates the Opportunity Atlas data from Figure 1a, while the right panel shows the Kirwan Opportunity Index, a commonly used index constructed by combining education, health, and economic indicators. The two measures have a (population-weighted) correlation of 0.30, leading to several important differences between them. For example, the Kirwan index ranks the entire Central District and parts of the Ballard neighborhood as high-opportunity areas (given their proximity to jobs), yet these neighborhoods have historically had some of the lowest rates of upward mobility in Seat-

[15]Of course, there is no guarantee that this will be the case in other areas where neighborhoods have changed substantially. The Opportunity Atlas data provide a good starting point for predicting upward mobility (which is inherently unobservable) for the current generation of children, but should ideally be complemented with more recent data and qualitative judgment on a case-by-case basis to settle on final definitions of opportunity neighborhoods.

tle. Conversely, there are several areas, such as the eastern part of Kent in King County and the Northeastern part of Seattle, which rate poorly according to the Kirwan Index but offer high rates of upward income mobility for low-income children. Such areas often excel on other dimensions that are correlated with upward mobility, such as measures of social capital and family stability, which are typically not incorporated into traditional measures such as the Kirwan index. Using the Opportunity Atlas to define high-opportunity areas yields predicted impacts on upward income mobility that are nearly 40% larger than what one would have obtained if one identified the same number of high-opportunity tracts based on the Kirwan index or poverty rates. Moreover, neighborhoods that have high rates of upward mobility despite appearing worse on observable dimensions tend to have lower rents (Chetty, Friedman, Hendren, Jones, and Porter, 2018), which means that our designation of high-opportunity areas identifies more affordable neighborhoods than traditional Kirwan-type indices. Our approach to identifying high-opportunity neighborhoods may therefore allow our intervention to have larger treatment effects.

III.C The Creating Moves to Opportunity Intervention

In collaboration with our research team, the Seattle and King County Housing Authorities developed a suite of services designed to facilitate moves to high-opportunity neighborhoods, building on formative fieldwork conducted by our partners and lessons from prior mobility and housing search assistance programs such as the Baltimore Regional Housing Program (DeLuca and Rosenblatt, 2017), the Abode Program in San Mateo, and other programs (see Table 2 of Schwartz, Mihaly, and Gala, 2017). The service model includes three components summarized in Figure 3a: search assistance, landlord engagement, and short-term financial assistance.

Search assistance services were provided by a non-profit group, which provided "housing navigators" who contacted families via in-person meetings, phone calls, and text messages. The services included: (1) information about high-opportunity areas and the benefits of moving to such areas for families with young children; (2) help in making rental applications more competitive by preparing rental documents and addressing issues in their credit and rental history; and (3) search assistance to help families identify available units, connect with landlords in opportunity areas, and complete the application process. Importantly, these services were tailored to address the specific issues each family faced: for some families, search assistance focused extensively on application preparation and issues such as credit history, while for others they spent much more time on the search process itself. Non-profit staff spent 6.3 hours directly assisting each family on average, spread throughout

the search process from an initial meeting shortly after the family is notified of eligibility for a voucher to the point of lease-up (Figure 3b).

The non-profit staff also engaged directly with landlords in high-opportunity areas by explaining the new program and encouraging them to lease units to CMTO families. Landlords were also offered a damage mitigation (insurance) fund for any damages not covered by the tenant's security deposit (up to a limit of $2,000). Through these interactions, the staff were able to obtain a pre-screened set of listings from landlords who indicated they would be willing to rent their units to voucher holders who met certain criteria. This landlord engagement was an important source of listings for families: connections with landlords facilitated by non-profit staff account for 52% of the moves to opportunity neighborhoods in the treatment group. The staff then helped expedite the lease-up process for landlords through rapid property inspections and streamlined paperwork, serving as a liaison between families, landlords, and housing authorities.

Finally, CMTO families were provided with various forms of short-term financial assistance (liquidity) to facilitate the rental process. This included funds for application screening fees, security deposits, and any other expenses that arose and were standing in the way of lease-up. Importantly, these payments were customized by staff to address the specific impediments a family faced by the non-profit staff. On average, families in the treatment group received $1,070 in such assistance.

Unlike other mobility programs, such as MTO and the Baltimore Housing Mobility Program, which require families to use their vouchers (at least initially) in opportunity areas, families in CMTO could use their housing voucher in *any* neighborhood within their housing authority's jurisdiction.

Program Costs. The cost of the CMTO program was approximately $2,600 per family: $1,070 of financial assistance and $1,500 of labor costs for the services (Table 3). This $2,600 figure is the direct cost of the intervention itself. Because Seattle and King county have tiered payment systems that offer higher voucher payments in more expensive neighborhoods, we estimate that they also incur additional voucher payment costs of $2,800 per year as a result of the treatment group families choosing to move to more expensive neighborhoods (see Section V.D. below). We separate these downstream costs from the cost of program services because they will likely vary substantially across metro areas, depending upon rents and the degree to which payment standards vary across neighborhoods. In future work, it would be useful to analyze how the program could be optimized to support families in moving to less expensive high-opportunity areas ("opportunity bargains") to reduce downstream voucher payment costs.

As another method of scaling the costs of the program, note that the up-front cost of the CMTO program per family who moved to a high-opportunity area is $4,712, which is comparable to previous mobility programs that involve intensive counseling and support. We present a detailed description of these cost calculations, a further breakdown of cost components, and comparisons to the other mobility programs in Appendix B and Appendix Table 1.

III.D Experimental Design

Our sample frame consists of families who were on the waiting list for a voucher from either KCHA or SHA between April 2018 and February 2019. We further limit the sample to families with at least one child below age 15, taking into account both prior evidence that the benefits of moving to high-opportunity neighborhoods are largest for young children and our definition of high-opportunity areas that focuses specifically on children's outcomes.

The randomized trial was implemented by MDRC with J-PAL North America staff providing overall project management. The trial was registered in the AEA RCT Registry in March 2018, began on April 3, 2018, and ended with final voucher issuances on April 26, 2019.[16] Families were first invited to an intake appointment, at which point they were offered the option to participate in the CMTO experimental study by consenting and completing a baseline survey. 90% of families who were identified as eligible on a preliminary basis consented to participate in the study. These families were then randomized (with 50% probability, stratified by PHA) into either the CMTO treatment or control groups. A total of 497 families consented to participate in the experiment of whom 421 met the voucher eligibility requirements and were part of the final experimental sample.

Control group families received the standard services provided by their housing authority, which included a group briefing about how to use the voucher but no specific information about opportunity areas or any search assistance. Treatment group families received the CMTO program described in Section III.C in addition to the briefing and standard support services.

IV Data

This section describes the data we use for the experimental analysis and the quasi-experimental analysis of changes in payment standards. We draw information from several sources: the administrative records of SHA and KCHA, a baseline survey, a service delivery process management system,

[16] From February-May 2018, KCHA and SHA piloted the CMTO program. During this pilot phase, all families with at least one child aged 15 or younger were invited to participate in this pilot and 41 families enrolled.

tract-level and housing-unit-level data from external sources, and post-move followup surveys and interviews that form the basis for our qualitative analysis. After describing these data sources and key variable definitions, we provide descriptive statistics and test for balance across the treatment and control groups.

IV.A Data Sources

Housing Authority Administrative Records. The core data we use comes from the PHAs' internal administrative records. We obtained anonymized data on all families issued vouchers from 2015-2019, including post-voucher-issuance outcomes and family characteristics. The key outcomes we study include whether a household issued a voucher successfully leases a unit using the voucher, in what census tract this lease up occurred, and at what rent. Family characteristics obtained from voucher application forms include gender, race, ethnicity, homeless and disability status, household size, income, and address at time of application.

Baseline Survey. We conducted a baseline survey for all families who enrolled in the CMTO experiment after providing informed consent. We collected information on characteristics including the head of household's primary language, birth country, years in the United States, tenure in the Seattle area, education, current housing status, employment status, employment location and commute length, moving and eviction history, receipt of social services, and child care utilization. In addition, we asked about self-reported assessments of current neighborhood satisfaction, motivations to move, opinions of various neighborhoods, and overall happiness. The baseline survey also included information on children, such as their ages, grade levels, school name, special education participation, school satisfaction, and participation in extracurricular activities. The full baseline survey instrument is available here.

Service Delivery. The service providers used a case management system built by MDRC to record data on interactions with households and landlords in real time. For households, the database includes information on the housing search process, contact with the search assistance staff, and take-up of financial assistance. Data on the housing search process includes information on whether the household made goals and completed several tasks: visiting neighborhoods, looking for housing, contacting property owners, completing rental applications, and preparing to move. Data on contact with housing search assistance staff include the date of each contact, the method of contact, who initiated the contact, the location of the contact, the reason for the contact, whether the contact included rental application coaching or visiting a prospective unit, and how long the meeting lasted.

Records of financial assistance include the amount and type of financial assistance requested and received. Finally, we also collected information on credit, rental, and criminal histories, savings, childcare availability, smoking status, pet ownership, and neighborhood preferences and priorities.

For landlords, the database contains information on landlord characteristics, outreach efforts, and unit availability. We recorded information about each unit referred to a household by a housing locator, including the outcome of any such referrals.

Housing Unit and Tract Characteristics. We obtain information about the characteristics of the units that families rented from rent reasonableness reports (for KCHA), and Zillow, Redfin, Apartments.com, and King County Property records (for SHA). These data on unit characteristics were linked to CMTO households using a unique household identifier. We were able to obtain information on unit characteristics for 77% of the units rented by families in our sample. These data include information on unit size, year built, and appliance availability.

We obtain data on the characteristics of the Census tracts to characterize the origin and destination neighborhoods for each family from several sources. We predict the effect of the treatment on children's outcomes in adulthood using three sets of outcome variables from the Opportunity Atlas (Chetty, Friedman, Hendren, Jones, and Porter, 2018) for children with parents at the 25th percentile of the income distribution: mean household income rank, the incarceration rate, and (for women) the teen birth rate. We measure other Census characteristics such as the poverty rate and racial demographics using the 2013-2017 American Community Survey. Tract-level transit and environmental health indices are drawn from publicly available HUD Affirmatively Furthering Fair Housing (AFFH) data. Test score data by school district are obtained from the Stanford Education Data Archive (Fahle, Shear, Kalogrides, Reardon, DiSalvo, et al., 2017).

Follow-up Survey and Interviews. We conducted in-person interviews between December 20, 2018 and July 19, 2019. We contacted a randomly selected subset of experimental participants, stratifying by PHA (SHA, KCHA), treatment status (treatment, control), and lease up status (leased up, still searching). We overweight families in the treatment group and those still searching for housing to maximize power to learn about mechanisms through which the treatment works during the search process (see Appendix C for details and further information on the design of the qualitative study). At the end of each interview, we asked two questions about their satisfaction with their current neighborhood.

Interviews continue to be conducted as families complete their search process. To date, 110 families have been interviewed, out of 130 who were contacted (a 70% response rate; Appendix

Table 2). 70 of these families had leased up at the point of interview, and thus have post-move neighborhood satisfaction data. 55 of these families are in the treatment group, while 15 are in the control group.

IV.B Baseline Characteristics and Balance Tests

Table 1 presents summary statistics on the baseline characteristics of the CMTO participants and their origin neighborhoods for the overall sample and separately for the control and treatment groups. To have a sufficiently long time window to examine lease-ups after voucher issuance, we use data from vouchers issued on or before December 31, 2018 in Table 1 and throughout our experimental analysis, resulting in a sample of 274 families.

Baseline Characteristics. Families participating in the CMTO experiment are quite economically disadvantaged (Panel A of Table 1). The mean (and median) household income of CMTO participants of around $19,000 falls at the 15th percentile of the national income distribution of families (based on data from the 2017 Current Population Survey) and less than one quarter of the median household income in 2017 of over $86,700 in King County. Only 6% of the CMTO household heads have a four-year college degree, and 14% were homeless or living in a group shelter at baseline. The vast majority (77%) of the household heads are female and 11% were married at baseline. Just over half the CMTO participants (50%) are Black (non-Hispanic), 24% are White (non-Hispanic), about 10% are Hispanic, and 2% are Asian. A little more than a third (35%) of the household heads are immigrants and about a fifth of the participants required a translator for the baseline survey and in-take services. 56% of participants were employed at baseline, and only 26% were working full-time (35 or more hours a week).[17]

Panel B of Table 1 provides information on CMTO participants' attitudes toward moves to higher-opportunity neighborhoods.[18] At baseline, CMTO participants expressed interest in moving to higher opportunity neighborhoods, but were worried about the feasibility of making such moves. More than 70% of households indicated they were comfortable moving to a racially different

[17]Although CMTO participants had low incomes relative to the median family, they were significantly better off than participants in the Moving to Opportunity experiment, which focused on residents of very high-poverty public housing projects (Sanbonmatsu, Ludwig, Katz, Gennetian, Duncan, et al., 2011; Orr, Feins, Jacob, Beecroft, Sanbonmatsu, et al., 2003). Only 28% of MTO household heads were employed at baseline as compared to 57% of CMTO household heads. The MTO sample also had a much smaller White non-Hispanic share of 3%, compared with 24% in CMTO. CMTO participants' baseline neighborhoods were also not nearly as distressed as those of MTO families. Only 2% of CMTO families were living in extremely high-poverty tracts (40% or higher poverty rate) at baseline, as compared to 100% of MTO families.

[18]See Appendix Table 10 for the exact questions used to assess these attitudes and the way in which responses were coded

neighborhood. Over 70% of families indicated that they were willing to move to at least one of three areas we named (Northwest Seattle, Northeast Seattle, and South of Ship Canal for SHA; North King County, East King County, and East Hill Kent for KCHA) that have many high-opportunity neighborhoods. But only 27% of the CMTO families felt they would find it easy to pay moving expenses to move to a different neighborhood. The primary motivation expressed by CMTO participants for moving to a new neighborhood was better schools (44%), safer neighborhood (20%), and better or bigger home (17%). Few CMTO participants list employment-related motivations for moving to a new neighborhood.[19] Panel C of Table 1 shows that CMTO families were living at baseline in relatively disadvantaged neighborhoods within King County on several dimensions. The mean poverty rate of the Census tracts in which CMTO families lived was 16% in 2016, as compared to 11% for King County. The mean predicted income rank in adulthood of children growing up in a low-income (25th percentile) family was 45.4 (about $37,000) in the baseline neighborhoods of CMTO families, which falls at approximately the 30th percentile of tracts across King County.

Balance Tests. The final column of Table 1 reports p-values for tests of the difference in the mean of each variable between the treatment and control groups.[20] The baseline characteristics are generally balanced between the treatment and control groups, as would be expected given random assignment. There is a slightly higher share of individuals with less than a high school degree in the control group and some imbalance in perceptions of neighborhoods and willingness to move to different types of areas. However, an F-test for balance across all the baseline variables shown in Table 1 yields a statistically insignificant p-value of 0.39. We conclude that the pattern of observed differences between the treatment and control groups is consistent with the degree of sampling variation that one would expect given random assignment of treatment status, but verify that the main results are robust to the inclusion of controls for characteristics that are not balanced.

The qualitative sample (the subset of households for whom we have post-move neighborhood satisfaction data) remains representative of the full CMTO quantitative sample (Appendix Table 3). There is no evidence of selective attrition from the qualitative sample: rates of response to the followup survey do not vary with treatment status and families who responded to the survey are balanced on observable baseline characteristics (Appendix Table 4).

[19] These motivations contrast with the MTO families, where concerns about gangs and violence was the primary motivation to move for most families, while better schools was the primary motivation for a much smaller group.

[20] Since randomization was stratified by PHA (Seattle vs. King County), we compute these p-values by regressing the outcome on indicators for treatment status and PHA and report the p-value on the treatment indicator. In practice, since randomization rates were essentially identical in the two PHA's, the resulting difference is very similar to the raw difference in means between the treatment and control group.

V Experimental Results

This section presents the main experimental results. We divide our analysis into five parts. First, we analyze how the CMTO treatment affected the rate of moves to high-opportunity areas, the primary outcome specified in our pre-analysis plan. Second, we predict the effects of the treatment on rates of upward income mobility using historical data from the Opportunity Atlas. Third, we examine heterogeneity in treatment effects across subgroups. Fourth, we analyze impacts on other dimensions of neighborhood and unit quality to assess whether families moving to opportunity made sacrifices on other margins. Fifth, we report results on neighborhood satisfaction based on post-move surveys. In the final subsection, we discuss how the experimental findings shed light on the relative importance of preferences vs. barriers in neighborhood choice using a stylized model.

V.A Impacts on Neighborhood Choice

We estimate the treatment effect of CMTO on an outcome y_i (e.g., an indicator for moving to a high-opportunity area) using an OLS regression specification of the form:

$$y_i = \alpha + \beta Treat_i + \delta KCHA_i + \gamma X_i + \epsilon_i \tag{1}$$

where Treat is an indicator variable for being randomly assigned to the treatment group, KCHA is an indicator for receiving a voucher from the King County housing authority (as opposed to the Seattle Housing Authority), and X is a vector of baseline covariates.

In our baseline specifications, we include the KCHA indicator (since randomization occurred within each housing authority) but no additional covariates X. In supplemental specifications, we evaluate the sensitivity of our estimates to the inclusion of the baseline covariates listed in Table 1. Including these additional covariates has little impact on the estimates, as expected given that the covariates are balanced across the treatment and control groups. We limit our sample to families who were issued vouchers before January 1, 2019 to allow sufficient time for lease-up by the time that the data for this paper were pulled (June 24, 2019).

Figure 4a shows the effect of the CMTO program on the fraction of families who rent units in high-opportunity areas using their housing vouchers. To facilitate visualization, we plot the control group mean (pooling all control group families across the two housing authorities) and the control group mean plus the estimated treatment effect β from equation (1). The CMTO intervention increased the share of families moving to high-upward-mobility (opportunity) areas

by 40.0 percentage points (s.e. = 5.2, p< 0.001) from 14.3% in the control group to 54.3% in the treatment group. The 14.3% rate of moves to high-opportunity areas in the control group is similar to historical rates (Figure 4), suggesting that the high rate of opportunity moves in the treatment group did not crowd out moves to opportunity areas that control group families would have made.[21]

In Figure 4b, we analyze whether the CMTO program affected overall lease-up rates, a secondary outcome in our pre-analysis plan. This figure replicates Figure 4a, changing the outcome to an indicator for leasing up anywhere (not just in a high-opportunity area). The lease-up rates are very similar and statistically indistinguishable across the treatment group (87.8%) and control group (84.2%). The fact that lease-up rates were quite high even in the control group shows that CMTO's impacts are not simply driven by providing services that enable families to use their vouchers (e.g., landlord referrals) and steering them to certain areas as a condition for receiving these services. Rather, CMTO changed *where* families chose to live by reducing barriers to leasing a unit in high-opportunity areas in particular.

Conditional on leasing up, 61.9% of families leased units in high-opportunity areas in the treatment group, compared with 17.0% in the control group (Figure 4c). Hence, if all families were to receive CMTO services and treatment effects remained stable, we would expect 61.9% (rather than the current 17%) of voucher recipients to live in high-opportunity areas in steady-state.

Figure 5 maps the neighborhoods to which treatment and control families moved (among those who leased a unit using their voucher). While control group families are clustered in lower-opportunity neighborhoods in South and West Seattle, treatment group families are widely dispersed across high-opportunity neighborhoods.[22] The 77 treatment group families in our sample who moved to an opportunity area spread out across 35 distinct Census tracts. The fact that the CMTO treatment induces families to move to a diffuse set of high-opportunity areas reduces the risk that the predicted gains from moving to a higher-opportunity neighborhood will be diminished by changes in neighborhood composition. To see this, suppose the CMTO program were scaled up to include all families with children who currently receive Housing Choice Vouchers in Seattle and King County. If families move to Census tracts at the same rates as in our treatment group, the CMTO program would increase the number of voucher holders as a fraction of the total population

[21] In particular, if there are a small number of units available in high-opportunity neighborhoods, the increased success of CMTO treatment group families in leasing those units could come at the expense of other voucher holders who would have gotten the units. This does not appear to occur in practice, presumably because the marginal family competing for housing in a high-opportunity neighborhood is typically not a voucher holder.

[22] At the point of voucher application, both treatment and control families are clustered in South and West Seattle (Appendix Figure 2).

by about 7.5 percentage points in the median high-opportunity tract to which CMTO families move.

V.B Predicted Impacts on Upward Mobility

How do the changes in neighborhood choices induced by CMTO affect children's future outcomes? Answering this question directly will require following children over time. However, we can predict the impacts of the moves induced by the CMTO program on children's future outcomes using the historical measures of upward mobility from the Opportunity Atlas (under our maintained assumption that rates of upward mobility will not change over time).

As specified in our pre-analysis plan, we measure upward mobility as the predicted adult household income rank for children with parents at the 25th percentile, drawn directly from the publicly available Opportunity Atlas data. The treatment effect on this measure of upward mobility is an increase of 2.1 percentile ranks (s.e. = 0.5, $p < 0.001$), from 44.4 (roughly an income of \$35,800 at age 34) in the control group to 46.5 (\$38,200) in the treatment group (Figure 4d).[23] Families in the treatment group also moved to neighborhoods with significantly higher predicted individual earnings (excluding spousal income), lower predicted teen birth rates, and lower predicted incarceration rates (Appendix Figure 3).

We can translate the treatment effect estimate of 2.1 percentiles on household income ranks into an estimated causal impact on income for a given child whose family is induced to move to an opportunity area by CMTO by making two adjustments. First, not all of the observational variation in upward mobility across areas is driven by the causal effects of place; some of it reflects selection that would not be captured by a child who moves. Chetty, Friedman, Hendren, Jones, and Porter (2018) estimate that 62% of the variation in upward mobility is due to causal effects, i.e. moving at birth to an area with 1 percentile higher predicted outcomes would increase a given child's rank in adulthood by 0.62 percentiles. Second, the treatment effect in Figure 4d understates the gains a given child would obtain by moving from a low to high-opportunity area because only 40% of families were induced to move to high-opportunity neighborhoods by the CMTO treatment.

Adjusting for these two factors, we estimate that the causal effect of the moves induced by the CMTO treatment for a child who moves at birth is $2.1 \times \frac{0.62}{0.4} \approx 3.3$ percentiles. This corresponds to an increase in annual household income of approximately \$3,700 (10.4%) when children are in

[23] For families who did not lease up using their vouchers, we use upward mobility in their origin Census tract as the outcome. Using the final, publicly available Opportunity Atlas data yields a similar estimate of 2.1 percentile ranks (s.e. = 0.5).

their mid-thirties. Projecting over the life cycle using a 0.5% annual income growth rate, results in an (undiscounted) total lifetime earnings increase of $210,000 (10.4%), or $85,000 in present value at birth with a 2% discount rate.[24]

As another benchmark, note that the gap in household income ranks between children growing up in 25th and 75th percentile families in Seattle is 13.6 percentiles. Hence, moving to a high-opportunity area reduces the intergenerational persistence of income by about 24.2%.

If the children who move to high-opportunity areas as a result of the CMTO treatment go on to earn more as predicted, the incremental income tax revenue from the higher earnings would more than offset the service cost of the program. We estimate that the treatment effect of the program on the present value of income tax revenue for children who move at birth is $4,000 (discounted at 2%), which is larger than the average program service cost of $2,600.[25]

In Figure 6, we analyze the distribution of treatment effects on upward mobility by plotting the probability density function of upward mobility for families in the treatment group vs. the control group. We plot these distributions separately for KCHA (Panel A) and SHA (Panel B) because the threshold used to designate high-opportunity areas (shown by the dashed line) differed in the two jurisdictions. Consistent with the results in Figure 4d, the distributions for the treatment group are shifted significantly to the right relative to those for the control group. The distributions show that families in the treatment group did not simply cluster in neighborhoods just above the upward mobility threshold used to define high-opportunity areas. Notably, some treatment families moved to the highest-upward-mobility neighborhoods in the county – areas where no one would have moved absent the services (as shown by the near-zero density in the control group in the upper right tail).[26]

Finally, we compare the treatment effects of CMTO – in which families could choose where to move – to those of MTO, which required families in the experimental group to move to lower-poverty neighborhoods to use their vouchers. Conditional on leasing up, CMTO produced roughly the same increase in predicted upward mobility as MTO (Appendix Figure 4a). But the CMTO

[24] See Appendix Table 5 for step-by-step details on these calculations. The corresponding estimates for individual earnings (excluding spousal income) are a 2.4 percentile gain, translating to approximately $2,094 (8.0%) per year in a lifetime earnings gain of $123,000.

[25] However, we caution that this cost calculation does not incorporate the costs of higher voucher payments generated by families in the treatment group moving to more expensive neighborhoods and the fact that voucher payments are indexed to local rents in SHA and KCHA (see Section 7 below). While these higher voucher payment costs are an additional expense borne by the government, they may vary across jurisdictions and could potentially be reduced by limiting the extent to which payment standards are increased in more expensive areas.

[26] In light of this result, an interesting question for future work is whether one might be able to further amplify the impacts of the CMTO intervention on upward mobility by setting the threshold used to define "high-opportunity" areas at a higher level, thereby encouraging more families to move to the highest-opportunity neighborhoods.

treatment group had a much higher voucher utilization rate than the MTO experiment group, in which only 48% of families of children aged under thirteen used their voucher (Appendix Figure 4b). As a result, the reduced-form ("intent-to-treat") effect of the CMTO program on upward mobility is substantially larger than the MTO experimental voucher (Appendix Figure 4c). These comparisons demonstrate that provision of mobility services can produce a high rate of moves to opportunity even without a paternalistic restriction on voucher use, ultimately resulting in higher rates of lease-up and larger impacts on upward mobility.

V.C Subgroup Heterogeneity

One concern with programs that seek to reduce barriers is that their effectivness may vary significantly across subgroups that face different types of barriers and constraints (e.g., racial/ethnic minorities or families with particularly low incomes). In Figure 7, we evaluate whether this is a concern by analyzing the heterogeneity in the CMTO treatment effect on the rate of moves to high-opportunity areas across subgroups.

Panel A of Figure 7 replicates Figure 4a separately for non-Hispanic Black head-of-households, non-Hispanic whites, and all other racial and ethnic groups. The CMTO treatment generated large increases in moves to higher opportunity areas of at least 30 percentage points across all of these groups. The significant gains among black families show that the CMTO treatment has substantial effects even in the presence of any racial discrimination that may exist in the housing market (Kain and Quigley, 1975). Conversely, the large treatment effects among white families show that the low rate of opportunity moves among voucher holders is not due solely to racial discrimination.

Panel B of Figure 7 splits the sample into families with household incomes below vs. above $19,000 per year (the median in the CMTO experimental sample). We find substantial treatment effects in both of these groups, demonstrating that the program yields benefits even for the most disadvantaged households.

In Table 2, we estimate analogous treatment effects for several other subgroups of the population by cutting the data on various baseline characteristics. In every one of the 37 subgroups considered in the table, we find a highly statistically significant treatment effect on the rate of opportunity moves of at least 30 percentage points. These groups include immigrants vs. U.S. natives, those with or without English as their primary language, and families with more or less optimistic views at baseline of moving to an opportunity area. There are no significant changes in overall lease-up rates in any of the subgroups (Appendix Table 6), consistent with the patterns in Figure 4b for the

full sample.

In sum, the CMTO intervention generates highly robust increases in moves to opportunity across subgroups of the population.

V.D Tradeoffs on Other Dimensions of Unit Quality

Do the families who are induced to move to higher-opportunity areas by the CMTO program make sacrifices on other dimensions of neighborhood or housing quality? To answer this question, we estimate treatment effects on a variety of unit- and neighborhood-level characteristics.

Figure 8a shows that the distance moved (and thereby distance back to one's prior neighborhood) is almost identical for treatment and control families who leased up. Figure 8b shows that the treatment also did not induce families to move to smaller housing units; if anything, families in the treatment group lease slightly larger units than those in the control group (though the difference in not statistically significant). Housing units rented by treatment group families are also quite similar to or better than those of the control group in terms of age, household appliances, and access to air conditioning (Appendix Table 7, Panel B).

Treatment group families move to neighborhoods whose characteristics are generally associated with higher neighborhood quality – lower poverty rates, more college graduates, more two-parent families, and higher scores on standard Kirwan indices of opportunity (Appendix Table 7, Panel A). This is because treatment group families who moved to high-opportunity areas ended up in neighborhoods that are quite representative of high-opportunity areas: there is no evidence of negative selection on observables or average rates of upward mobility among the set of tracts designated as high-opportunity (Appendix Table 8). High-opportunity areas tend to have lower poverty rates, more two-parent families, etc. (Chetty, Friedman, Hendren, Jones, and Porter, 2018), explaining why the treatment produces gains on these dimensions.

In short, the moves to opportunity induced by the CMTO treatment did not require families to make sacrifices in terms of observable neighorhood amenities or housing quality. One reason this might be the case is that Seattle and King County offer higher payments for more expensive neighborhoods, allowing families to access more expensive units in high-opportunity areas. Indeed, Panel C of Figure 8 shows that treatment group families move to units with monthly rents that are $186 higher on average than families in the control group. Given the structure of payment standards, this marginal cost is entirely borne by the housing authority rather than the families themselves: the treatment actually *reduced* out-of-pocket total rent payments by $37 per month on

average (Appendix Table 7). Understanding the tradeoffs that would be induced by CMTO-type programs in a setting without tiered payment structures is an interesting direction for further work.

V.E Neighborhood Satisfaction

In the final part of our experimental analysis, we ask whether families who moved to high-opportunity areas are more satisfied with their new neighborhoods. We surveyed 70 randomly chosen families who had leased up units using their vouchers about their satisfaction with their new neighborhoods. On average, these surveys were conducted 5.7 months after families had moved. As discussed in Section IV.B, families who responded to these surveys are representative of the full sample on observable characteristics and there is no evidence of selective attrition by treatment status. We therefore believe that inferences drawn from this smaller subgroup of respondents are likely to yield unbiased estimates of treatment effects in our broader experimental sample.

Families in the treatment group express much greater satisfaction with their new neighborhoods than control group families. At the end of the interview, families were asked, "Which of the following statements best describes how satisfied you are with your current neighborhood?," with five potential answers ranging from "very satisfied" to "very dissatisfied."Figure 9a shows that the treatment increased the share of families who report being "very satisfied" with their new neighborhoods by 33.6 percentage points (s.e. = 11.6, $p < 0.01$), from 28.6% in the control group to 62.2% in the treatment group (see Appendix Figure 6 for the full distribution of responses). Families were also asked, "Which of the following statements best describes how you feel about staying in your current neighborhood?," with five potential answers ranging from "very sure I want to stay" to "very sure I want to move to a different neighborhood." The treatment group families are 29.5 percentage points (s.e. = 10.7, $p < 0.05$) more likely to indicate they are "very sure" about wanting to stay in their new neighborhood (Figure 9b), suggesting that they will be more likely to stay in their new neighborhoods than typical housing voucher recipients.[27]

The sharp increases in neighborhood satisfaction allay the concern that the CMTO treatment may have steered or nudged families into new neighborhoods that end up being a poor fit after they arrive. Instead, these findings suggest that there are significant barriers to mobility that prevent

[27]One may be concerned that these responses are driven by social desirability bias, where families in the treatment group feel obliged to say positive things about the program and the neighborhood to the interviewers. To mitigate such biases, interview staff stressed that they were independent from the PHAs and the CMTO implementation team and worked to develop a rapport with families over two hours before asking these questions. Nevertheless, we plan to track persistence in high-opportunity areas to test whether treatment group members are in fact more likely to stay in their new neighborhoods.

low-income families with vouchers from moving to higher-opportunity areas that they actually prefer.

V.F Implications for Models of Neighborhood Choice

In this section, we formalize what we can learn from the experimental results about the role of preferences vs. barriers in standard models of neighborhood choice.

We begin by considering a frictionless model of the housing market in which all households live in the neighborhoods that maximize their utility. In this setting, our treatment effect estimates yield tight bounds on families' preferences for low vs. high-opportunity areas. We illustrate the intuition for these bounds in Figure 10 and present algebraic derivations using a canonical model of neighborhood choice with heterogeneous preferences in Appendix D. On the x-axis of Figure 10, we plot a family's net willingness to pay (WTP) for a *non-opportunity* neighborhood. Formally, the WTP is the indirect utility of moving to a non-opportunity neighborhood minus the indirect utility of moving to an opportunity neighborhood, taking into account rental costs as well as the baseline subsidies provided by the HCV program. Larger values on the x-axis indicate correspond to stronger preferences for non-opportunity neighborhoods (e.g., because of other amenities or proximity to family).

What is the distribution of WTP to move to a non-opportunity area in the population of CMTO participants? Given that 17% of the control group that leased up moved to an opportunity neighborhood (Figure 4c), a frictionless model inferring preferences from choices would imply that only 17% of families leasing up with vouchers prefer living in opportunity neighborhoods. This value is depicted by the open circle on the figure, where the y axis shows the fraction of families with WTP below a given level x (i.e., the CDF of the WTP distribution).

To further characterize the distribution of WTP, note that in a purely frictionless model, the services provided by CMTO could be purchased in the market at marginal cost, and hence would be valued at most at \$2,600 – the marginal cost of the CMTO program (see Appendix D). Hence, the fact that 62% of families who lease up in the treatment group move to high-opportunity areas would imply that 62% of households prefer living in opportunity neighborhoods when provided the equivalent of a \$2,600 subsidy to move to such areas. Put differently, 62% of families have a WTP for low-opportunity areas below \$2,600 – i.e., most families do not have a strong distaste for high-opportunity areas. This value is depicted by the solid circle in Figure 10.

Connecting these two points, as shown by the solid portion of CDF plotted in Figure 10, a

frictionless model would imply that 45% of families who apply for housing vouchers have a WTP for low-opportunity areas between $0 and $2,600. That is, the only way to rationalize our findings in a model where families live in their preferred neighborhoods is that a large group of families happen to be close to indifferent between high- and low-opportunity areas and thus are swayed by the relatively low-cost CMTO intervention.

This explanation, however, runs counter to two other experimental results documented above. First, we find nearly uniform treatment effects across various subgroups of the population (Table 2). It is unlikely that all of these subgroups would happen to have a distribution of WTP that places a large mass of families close to indifference across neighborhoods. Second, families who are induced to move to opportunity areas experience very large increases in neighborhood satisfaction (Figure 9a), contradicting the view that these families are close to indifference across neighborhoods.

Our experimental findings thus challenge traditional economic models of residential sorting and spatial equilibrium in which households are indifferent between locations given costs and amenities (e.g., Rosen, 1979; Roback, 1982). A more plausible explanation for these findings is that some families actually have a high WTP to move to opportunity but are prevented from doing so by barriers they cannot easily address themselves through market services. More broadly, our findings suggest that models in which preferences are the primary driver of neighborhood choice may not provide an accurate account of what drives residential segregation, especially among low-income families, consistent with evidence from other settings such as the Gatreaux Project in Chicago (Charles, 2003; Desmond and Shollenberger, 2015; DeLuca and Rosenbaum 2003; DeLuca, Wood, and Rosenblatt, 2019).

One reduced-form way to model barriers to neighborhood choice is as monetary search costs that families pay to find housing, as is common in the modern urban economics literature (e.g., Wheaton, 1990, Bayer, Ferreira, and McMillan, 2007, Kennan and Walker, 2011; Galiani, Murphy, and Pantano, 2015). The sharp increases in neighborhood satisfaction from moving to opportunity suggest that the search costs needed to rationalize our full set of experimental results must be quite large, persistent, neighborhood-specific, and independent of distance moved.[28] It is critical to unpack what these search costs are and develop models that specify their structure explicitly in order to understand how to reduce these costs and help families find housing in their preferred

[28]One prominent example of such a cost is racial discrimination by landlords, which has been incorporated into models of housing search since at least Kain and Quigley (1975). While racial discrimination may be an important barrier, it is worth noting that we find equally large treatment effects of the CMTO intervention for white families, suggesting that it is not the sole barrier at play. In addition, our finding that the treatment did not affect distance moved (Figure 8a) challenges standard parameterizations of search costs, which simply scale with distance moved.

neighborhoods. To this end, the rest of the paper focuses on characterizing the barriers families face and the mechanisms through which CMTO reduced those barriers.

VI Qualitative Evidence on Mechanisms

In this section, we explore the mechanisms underlying the treatment effects documented above by presenting qualitative evidence from interviews with 110 families. These 110 families were randomly sampled from the study population, stratified by PHA, treatment status, and voucher status (leased-up or still searching). We oversampled families in the treatment group to maximize our power to learn about treatment mechanisms. As discussed in Section IV.B, families who participated in these interviews are representative of the full study population on observable characteristics and there is no evidence of selective attrition by treatment status.

We interviewed participants using an in-depth narrative approach, building on prior qualitative research of mobility programs (Darrah and DeLuca, 2014; DeLuca, Clampet-Lundquist, and Edin, 2016). We asked families about their lives broadly, such as their residential history, family dynamics, and children's schooling, and also focused on eliciting information about the barriers that families faced in moving to high-opportunity areas and the components of CMTO that were most useful in addressing those barriers. We describe our methods in more detail in Appendix C. The quotes and summaries presented below are representative of the modal experience reported by treatment group families who leased up in opportunity areas with the program.[29]

We structure our analysis in three parts. We begin with a descriptive characterization of the families in the sample that sheds light on the challenges they face in searching for housing. We then describe five key mechanisms that emerge in treatment group families' descriptions of how CMTO helped them overcome these challenges. Finally, we show how the *combination* of these mechanisms and the ability to customize the treatment to each family's particular needs was central to the program's success, drawing on both the interviews and quantitative evidence from our case management system on service utilization.

[29]To protect families' identities, all names used below are pseudonyms chosen by respondents. The findings reported in this version of the paper are based on 110 families who were interviewed between December 12th, 2018 and July 22nd, 2019. Interviews are ongoing, so the findings reported in this version of the paper may differ slightly from the final version when the study is fully completed.

VI.A Who are the Families Applying for Housing Vouchers?

Our conversations with families revealed several deeper dimensions of economic disadvantage and barriers to housing search beyond the measures in the baseline survey data summarized in Table 1. A substantial share of the families (32%) have children with significant physical, mental or emotional needs. 39% have a major health problem in the family. 31% had experienced domestic violence.[30] Many parents in the qualitative study describe their own childhoods as having been traumatic and attribute current struggles with depression, anxiety, phobias, and anger to histories of family "chaos," as one mother described it.

Caregiving responsibilities and own health issues make maintaining consistent employment difficult for a large share of the household heads. Perhaps as a result of these factors, the families have histories of housing insecurity and instability. One-fifth of them were doubled-up with family members at the time of their initial (pre-move) interviews. The majority were doubled-up in the past and many had experienced homelessness.

When we asked families to tell us about their residential histories, their accounts often included repeated denials when applying for rental housing, largely arising from credit problems. For example, one of the participants we met, Sandra, the mother of a thirteen-year old boy with significant health problems, had not received her voucher yet at the point of our conversation. Sandra told us she felt despondent about ever find housing in Seattle because of her poor credit history. She was frustrated and said, "I wish they'd do a *criminal* background check instead of a *credit* [check]—I have no crimes."

Although they were desperate to secure housing, many families began the CMTO program anxious about their prospects for finding it in the tight Seattle area housing market. The CMTO parents were generally interested in moves to high-opportunity areas and believed such moves would benefit both their children and themselves. However, they were pessimistic about the prospect of landlords in such areas being willing to rent to them.

Overall, the interviews paint a picture of families that have extremely limited time and resources to devote to housing search. These findings are consistent with significant "scarcity" in mental bandwidth in the terminology of Mullainathan and Shafir (2013), amplifying the scope for small frictions and barriers to affect families' behavior.

[30] These rates are likely lower-bound estimates, since they were voluntarily shared with interviewers. Had we asked directly about domestic violence or struggles with mental health, these numbers would likely be higher.

VI.B Five Mechanisms Underlying the CMTO Treatment Effects

Overall, treatment group families who moved to high-opportunity areas reported very positive experiences with the CMTO program. 69% reported largely positive experiences, 29% reported mixed or moderately positive experiences, and only 2% (one case) was largely negative in their description of the CMTO process.

We identified the specific mechanisms through which CMTO helped families move to high-opportunity areas by first reading entire interview transcripts and observing which mechanisms emerged as most salient from families' accounts of their experiences with CMTO. We then coded all transcripts for these mechanisms and then recorded the frequency with which families mentioned various themes. Families discussed five broad mechanisms: (1) emotional support from the program staff that increased families' confidence about their ability to find housing; (2) increased excitement about moving to high-opportunity neighborhoods; (3) a streamlined search process that reduced demands on families' time and cognitive bandwidth; (4) brokering between the program staff and landlords; and (5) strategically targeted short-term financial assistance.[31] The rest of this section illustrates these five mechanisms by presenting examples from specific interviews.

Mechanism 1: Emotional Support

To learn about families' experiences with CMTO, we asked an open-ended question in our interviews – "tell me about CMTO" – before probing about any of the program specific details. Many families' responded by describing how *emotionally* supported they felt by the program staff, how *confident* the program had made them feel, and how *relieved* they were when they began to realize what kind of support they were going to receive. 69% of families who leased up in opportunity areas reported that they felt support from CMTO staff.

Families frequently used words like "blessing" "relief" and "miracle," to describe the CMTO program. One mother even referred to a CMTO search assistance staff member as an "angel." Katie, a 23-year-old mother living in North Seattle, told us that CMTO helped her "get a voice," and feel more confident dealing with property managers and negotiating her needs. She said, "I kind of got to start speaking up and not being so scared... you can't lose your Section 8 for speaking out." Dee, a mother of five, explained that without CMTO she would not have had "the courage to even apply for this house" she was living in when we met her, given her credit history.

[31] Some of the mechanisms were anticipated in previous work identifying program components that lead to successful lease-ups in opportunity areas for the families in the Baltimore Housing Mobility Program (DeLuca and Rosenblatt, 2017).

Jackie, a former therapist with a nine-year-old son, told us in powerful terms how she felt when she realized what the CMTO program would provide:

> "a light bulb went on... it was this whole flood of relief... it was just the supportive nature of having lots of conversations with [the search assistance team] about, that they could call the landlords, that they - just about all the different programs. And, you know, helping pay the deposit was immense. That saved me, because I don't know how I would have done that. Yeah, just, you know, personally, mentally, emotionally, and financially, in every way, they were supportive... they just sort of swooped in."

Many families noted that the non-profit staff members' communication and support were critical to keeping them motivated throughout the search process. Mona, a mother of two who moved to the Bellevue area, said "[the search assistance staff member] was on top of everything on me. If it wasn't for her, I honestly think I would have lost my Section 8 because nobody was willing to give us an opportunity." Tina, who moved to North Seattle with her sons, excitedly told us, "wow this program, like they're with you at all times, they help you they're there to guide you."

These accounts differed from what we heard from control group members, like Arya, who wished she had more support when looking for housing. Arya described having a difficult time during a recent visit to an apartment leasing office, "could I get somebody to meet me there that might just sit there with me to, you know, provide that – I don't know, like, to explain the paperwork to me more or to be a second ear also. Because yeah, sometimes, I just – I have communication issues like understanding the person and I feel rushed because I can't get – I don't have the time to just get it out. So, I wanted somebody to come with me and [the PHA] emailed me back that they don't provide that service."

Mechanism 2: Increased Motivation to Move to Opportunity

In addition to the support they felt from the CMTO staff, many families also reported that they became more motivated by the possibility of moving to a high-opportunity area. They recalled learning about the benefits for their children's long-term success during the initial study intake process and throughout their meetings with search assistance staff. Many reported feeling "excited" by the prospect of living somewhere that, as Hiba, a mother of three, told us, "there is research they've shown... that are more opportunities, there are more graduations from school... That is what we are looking for." Melinda, a mother with a two-year old son, was clear that she was "tired of living around chaos," and became quite emotional when she heard that the program was about more than just providing housing assistance. She explained, "She [CMTO staff] made me cry when she kind of explained to me what the program does, like it's not just we pay your rent ... it's for

to make sure that not only you are in a good area but your kid can grow up in a good area and be successful it's like it made me so happy to think that my son is going to be in a area that can just help him be a good part of society." Overall, 88% of the treatment group families who moved to high-opportunity areas referenced their knowledge of research showing that moves to these areas would benefit their children.

Several families reported that the non-profit staff pitched the CMTO program more as a question of what families want for themselves, and what their vision for the future is, rather than a set of rules or requirements. This framing made some families feel like they were treated with care and respect, and that they were part of the process—neither forced into it nor isolated from it, in contrast to some of their experiences with other social service agencies. At their family navigator meeting, families were provided with a considerable amount of information and maps detailing all of the resources and amenities available in high-opportunity neighborhoods. Then the conversation between parents and the search assistance staff became an interactive and customized discussion of how those resources could fit into their bigger plan for themselves and their children. Dee told us, "[the family navigator] broke down the neighborhoods in ways that I never would have looked at." Given how unpredictable housing situations had been for many CMTO families, this was the first time some of them had the bandwidth and guidance to think these things through (see DeLuca, Wood, and Rosenblatt (2019) on reactive moves). Ashley, who was homeless before she and her daughter moved with CMTO, explained:

> "It was good because it gave you a breakdown of what you needed to do, questions you need to ask, things you need to think about like school district, grocery stores, public transportation... after that, I'm like, "Well, these are things that are really important to me." And you didn't think about – you don't think about how something so simple is so important... So, now, when I came into this [move], I knew what I wanted. I wanted something close for all these things and something for my daughter."

Mechanism 3: Streamlining the Search Process

Parents who participated in CMTO were juggling a number of things alongside their housing searches—including child care, multiple jobs, the fallout from domestic violence, and anxiety about becoming homeless. The many moving parts of the search process—from online searches to the landlord calls, apartment visits, security deposit paperwork, background checks, applications, inspections, and voucher payment paperwork—were often overwhelming for parents. It also took precious time away from their children. As Lisa, who moved with her children to the Lake City area of Seattle, said, "it was like me staring at my phone [to do online housing searches] like while

he's playing around and the less I have... to do that takes away from like me focusing on him or the other things that I need to do is the better."

The CMTO housing locators were able to reduce this stress and streamline the search process by giving families clear guidance on what to do. 69% of families who moved to opportunity areas mention receiving some kind of housing search assistance. Some families referred to a "plan" that they worked on with the CMTO search assistance staff. Others mentioned doing their "homework" to search for places, practice their landlord phone call script, and write down their attempts to find housing in their "search log."

The program also reduced the tax of fruitless and demoralizing housing searches by directly providing listings of rental units that were owned by landlords and property management companies with whom the CMTO staff had built relationships. The CMTO staff build trust with property owners and managers and increase the information these housing providers have about families, thus reducing the influence of "Section 8" stereotypes. Melinda explained how the list of referrals she received from her housing locator made it easier to find the place she moved into:

> "She gave me a list of apartments that CMTO worked with and I just based my search off of that list, so, cuz I was nervous about my credit and I just didn't wanna go through a whole bunch of denials if, you know, they're familiar with this program, then it'll be easier for me to get in... I don't think I would've tried out here honestly without them giving me like the areas that they feel like are more opportunities."

Mechanism 4: Landlord Brokering

The CMTO non-profit staff played a key role in facilitating relationships between prospective tenants and landlords, both in preparing the tenants before they met landlords and in participating in conversations with landlords themselves. 76% of the families interviewed reported that CMTO search assistance helped negotiate with landlords during some part of the process.

One key element of housing search preparation was the creation of a "rental resume," a document that families could use to present themselves to landlords. The essays helped families explain the circumstances surrounding barriers to housing, like poor credit histories, evictions or unemployment. Some families felt empowered by creating their rental resumes to help move beyond past barriers and achieve their hoped-for future through opportunity moves. The resumes also allowed the housing search assistance staff to better describe families in their conversations with prospective landlords.

Nicole, who moved with her 5-year-old son, described in detail how the rental resume seemed to make a big difference to the leasing company she ended up working with, despite her spotty credit

history:

> "Some landlords, you know, your credit could get denied like here like mine did and they could like you based on that [rental resume] and then, [ask] you [for] a higher deposit and that's what happened here. . . .because I had that credit resume explaining the four derogatory marks on my credit, how they got there, how long they've been there, what I'm doing to dispute them, how I'm getting them off if I'm on a payment plan like. . . And because of that, staff was just like, "Well, I mean, you seem smart, you seem like you're prepared, these things on your credit don't seem like a big deal..." And sure enough, she was like, "Just give her a chance, just higher deposit." So, that, it helped.

Many families also mentioned how valuable it was to have the housing search assistance staff directly speak with landlords on the CMTO participants' behalf. The staff lend families additional credibility during difficult conversations or when landlords seem on the edge of not accepting families. Lakeisha, a house cleaner who moved with her 9-year-old daughter, noted that having the CMTO housing search assistance team represent her when talking with landlords "felt like it's a reference." Dee's housing locator helped her move into a unit with a landlord who had never rented to a voucher holder before. She recounted the sales pitch the search assistance staff used to explain how the program worked and ended up benefitting both the landlord and the family:

> "She did the inspection, she did a lot of talking to the landlord and getting them to understand the program helping him figure out how to get started with the program or Section 8 and all, that was her. She worked with us and worked with the landlord. . . and did very good with helping a first time ever landlord, this is his first time even hearing about Section 8. . . .an opportunity for him to help us in a sideline kind of way, he doesn't really have to do anything except for say yes and we're glad that we can help with this people move into this neighborhood to better resources and stuff for their kids, that was his contribution to my kids' future."

Mechanism 5: Short-Term Financial Assistance.

Finally, many families remarked that the financial assistance they received from CMTO mattered for removing upfront roadblocks. 91% of the families we interviewed mentioned receiving financial assistance as part of the CMTO program. As Booth, a mother of two, said pointedly, "Well, if I had money for a security deposit, I'd [already]be paying rent somewhere." Lou explained how CMTO financial assistance made it easier for him and his wife by covering a number of upfront expenses, "CMTO, they help with the deposit, and you know, moving costs, if you have to bring stuff out of storage and things like that, and Section 8 pays for your first and last month rent. . . . You can move in without any hassle, so it really makes, makes it a lot easier to just focus on finding a place."

Importantly, the interviews suggest that it is not just providing lump-sum short-term financial assistance that makes the program effective. Rather, it is deploying funds *strategically* at the points at which its easiest to lose hope and lose landlords. Such timely financial assistance included paying rental application fees, paying "holding" fees so families don't lose their units while applications are being processed, clearing up old utility bills or paying for new ones, and providing more generous security deposits for families with a past eviction or poor credit record. For example, Stive, a father of two, explained:

> "She [the CMTO search assistance staff member] paid security deposit, I gave her the access to my personal page in the [website] of the home, of this apartment complex. And yes, it was really helpful it was quick, because I was so afraid [of losing the place] when I find it out that I have to make a decision about [taking the apartment], and in the same time I have to pay security deposits and a couple fees [when] I don't have resources."

VI.C Customization of Services to Families' Needs

The housing search assistance staff facilitated lease-ups in opportunity areas by combining several of the five approaches discussed above, depending upon each family's specific needs. For example, the emotional and psychological support keeps families connected to the program and optimistic about the end result of the process, which is necessary to motivate their individual housing search efforts, and to get them to the point where the CMTO staff can do the work of connecting with landlords in opportunity areas and completing the lease-up process. The customization of CMTO services – with nonprofit staff being able to flexibly respond to each family's specific situation and needs – appears to be crucial to its success. For instance, Jennifer, a mother of four, noted that the CMTO staff "understood the situation that I was in" and helped her accordingly.

Although many families mentioned several of the five mechanisms described above in their interviews, the intensity with which they used each component of the CMTO program varied greatly. This is borne out by data on service utilization from our case management system, which tracked the duration and nature of each of the contacts between CMTO staff and families. We report statistics on rates of service utilization in Appendix Table 9a. CMTO treatment group families who moved to a high-opportunity area received 7.67 hours of staff time on average, but there was substantial heterogeneity in the utilization of these services, with an interquartile range of about 4 hours to 10 hours. Similarly mean financial assistance for treatment group families leasing up in opportunity areas was $1954 dollars, with an interquartile range of $952 to $2,931. 52% of these families found the unit they moved into through a direct referral to a landlord found by the

non-profit staff, but 48% identified the units they moved into on their own. Different families also used different subsets of these services: for instance, the correlation between the number of hours of staff time used and the amount of financial assistance used is 0.19 (Appendix Table 9b).

When we talked to families in the control group, we virtually never heard them discuss receiving this kind of customized assistance, although several mentioned that they wished they had it. Christina, the mother of a six-year-old daughter, described how much she struggled to find housing herself:

> "I went through [local housing provider agency] to see if they could help me find an apartment. Nobody really helps you find an apartment. They just tell you that they like can help you get into it or they tell you that they can help you find one but they don't end up doing that cuz they have a lot of people that they're working with... I found this place [on my own]. I have sent emails back and forth begging to get in here... my application was sitting downstairs approved for like two days while I'm still in cars and outside with my daughter trying to figure it out. I could've been in here at an empty apartment at least with warmth. So, I ended up getting accepted for here. [Local non-profit housing provider] ended up paying for the move in fees and stuff like that which was a blessing but I feel like maybe if they could be more personal with their clients that they're accepting and taking on that I feel like that would help with the homeless situation a lot."

In sum, the CMTO program appears to have had large impacts through a combination of mechanisms that vary across families. In a sense, the fact that the intervention *cannot* be codified into a standardized set of protocols applied to all families is its strength. The general lesson may be that having a highly motivated case worker support each family in overcoming the barriers they face can help them make much more effective use of housing assistance programs (and perhaps other public programs more generally).

VII Alternative Policies to Increase Moves to Opportunity

In this section, we compare the impacts of the CMTO program to other, more standardized policies that aim to help families move to higher opportunity areas: financial incentives and information provision. We estimate the effects of financial incentives by analyzing the impacts of reforms implemented in Seattle and King County that increased voucher payment standards in certain high-rent and high-opportunity neighborhoods. We examine the effects of information provision in relation to the treatment effects of CMTO by comparing our experimental results to estimates from other studies that evaluated the effects of information provision using randomized trials.

VII.A Effects of Financial Incentives

One prominent approach to help families move to higher-opportunity neighborhoods is to offer higher voucher payments in higher-rent or higher-opportunity neighborhoods within a metro area. This is perhaps the most natural approach to reduce monetary search costs in standard economic models of neighborhood choice. It is also a policy, termed Small Area Fair Market Rents, that has gained popularity among housing authorities in recent years.

We estimate the effects of such financial incentives on families' neighborhood choices by analyzing two payment standard reforms. The first, implemented by KCHA in March 2016, increased payment standards in selected neighborhoods that had higher rents and scored higher in Kirwan indices of opportunity. The second, implemented by SHA in April 2018, effectively increased payment standards in exactly the same areas that we designated as "high opportunity" in CMTO. We analyze the impacts of these reforms using difference-in-difference designs, as in Collinson and Ganong (2018).

KCHA Increase in Payment Standards in High-Rent Areas. King County moved from a two-tier to a five-tier payment standard system in March 2016. The reform increased voucher payments in areas with higher rents. Appendix Figure 7 shows the resulting changes in payment standards across King County, which ranged from reductions of $220 per month in a few neighborhoods up to increases of $595 in the most expensive areas.

We use the PHAs' historical administrative data to analyze how families' neighborhood location choices changed around the reform in KCHA relative to families in SHA. SHA did not enact any changes in its policies at the same time and hence serves as a natural counterfactual.

Figure 11a plots the fraction of families who move to high-opportunity areas (as defined based on our CMTO designation in Section III) by the month in which families were issued their vouchers. To reduce noise, we group months into pairs of two in this and subsequent figures. The fraction of families who leased up in high-opportunity areas fluctuates around 20% both before and after the reform, which is marked by the dashed vertical line. In particular, there is no evidence of an increase in the rate of moves to high-opportunity neighborhoods in KCHA (the "treatment" group for the purposes of this quasi-experiment) relative to SHA (the "control group").

Under the identification assumption that trends in KCHA and SHA would have remained similar absent the reform, we can estimate the causal effect of the KCHA payment standard reform on the rate of moves to high-opportunity areas using a standard difference-in-difference regression

specification. We compare the rate of moves to high-opportunity areas in KCHA and SHA in the eight months before vs. after the policy change by running OLS regressions of the form:

$$y_i = \alpha + \beta_1 KCHA_i + \beta_2 Post_i + \beta_3 KCHA_i \times Post_i + \varepsilon_i,$$

where y_i is an indicator for moving to a high-opportunity neighborhood, $KCHA_i$ is an indicator for receiving a voucher from KCHA (rather than SHA), and $Post_i$ is an indicator for indicator for being issued a voucher in or after March 2016. We estimate that the causal effect of the reform on the rate of moves to high-opportunity areas is a statistically insignificant $\beta_3 = -3.6\%$ (s.e. $= 5.8$), as shown in Column 1 of Table 4. Controlling for family size and other covariates does not affect this estimate significantly (Column 2).[32] Hence, the KCHA reform increased the rate of opportunity moves by at most 7.7% at the top of the 95% confidence interval – substantially smaller than the CMTO treatment effect of 40%, shown by the dashed line in Figure 11a as a reference. Indeed, only 17% of KCHA families with children moved to high-opportunity areas in the eight months after the payment standard increase, far below the 63% rate achieved through the CMTO program in King County.[33]

Our analysis of the KCHA reform shows that raising payment standards in more expensive neighborhoods – as is typically done in SAFMR policies – does not necessarily induce families to move to higher-opportunity areas.[34] One interpretation of this result is that financial incentives have smaller impacts on neighborhood choice than the customized services offered through CMTO. An alternative interpretation is that incentivizing families to move to more expensive neighborhoods does not induce moves to opportunity because rents are not very highly correlated with upward mobility in King County (Figure 1b). To distinguish between these explanations, we now turn to

[32] Analogous DD specifications using median rents as the dependent variable suggest that the SAFMR reform induced families to move to more expensive areas (Columns 3 and 4 of Table 4), consistent with Collinson and Ganong (2018), although the estimates are somewhat imprecise and hence not statistically significant.

[33] Using a continuous measure of economic opportunity – the average predicted income rank of children raised in 25th percentile families in the neighborhoods to which families moved – rather than the binary CMTO designation of opportunity neighborhoods yields very similar conclusions (Appendix Figure 5).

[34] In contrast with this finding, Collinson and Ganong (2018) find that SAFMRs induced moves to higher-quality neighborhoods in Dallas, where quality is defined as an index of tract-level poverty rate, test scores, unemployment rate, the share of children with single mothers, and the violent crime rate. By contrast, we find that SAFMRs in King County had no impact on either an index of neighborhood quality similar to that used by Collinson and Ganong or the Opportunity Atlas measures of upward mobility. One explanation for the different results is that the correlation between rents and upward mobility is 0.56 in Dallas, significantly higher than the 0.18 correlation in King County. The tighter link between rents and opportunity in Dallas might increase the impacts of SAFMRs on opportunity moves there. That said, Collinson and Ganong also kindly re-examined their findings using the Opportunity Atlas measure of upward mobility and found an impact on the mean predicted rank of children with parents at the 25th percentile of 0.86 percentiles. Although this is a significant gain, it is still one third as large as the impact of CMTO, supporting the view that financial incentives have much smaller effects than customized mobility services.

a second quasi-experiment.

SHA Increase in Payment Standards in High-Opportunity Areas. In March 2018, SHA introduced a Family Access Supplement (FAS) that effectively increased payment standards in areas that were designated as "high opportunity" in the CMTO study. If a family moved to an opportunity area and the unit rent exceeded the voucher payment standard by an amount that would cause the household to pay more than 40% of their income, the FAS paid for the unit's rent minus 40% of the family's income (subject to a maximum, which was $400 for 2 bedroom units). For families who moved to an opportunity area, this additional rental support amounted to $144 per month on average.

The FAS was initiated at the same time as a pilot phase of the CMTO intervention prior to the CMTO experiment. It continued throughout the pilot and the experiment, effectively providing families in the control group higher payments to move to high-opportunity areas than they would have received had they gotten their vouchers before March 2018. The FAS was restricted to families with at least one child under 18. We therefore estimate the impact of the FAS by comparing families with children to families without children in SHA.[35]

Figure 11b plots the fraction of families moving to high-opportunity areas before and after the introduction of the FAS (shown by the dashed line) for households with vs. without children. During the CMTO pilot phase (shown in the shaded region), all families with children received CMTO services. The fraction of families moving to high-opportunity areas trended similarly prior to the CMTO pilot and the FAS payment standard reform. During the pilot, the rate of moves to opportunity for those with children spiked up to 80%, while the rate of such moves for the those without children (who were untreated) remained steady. After the pilot, the rate of opportunity moves (based on data for the CMTO control group) fell precipitously for families with children.

Under the identification assumption that the rate of opportunity moves for families with vs. without children would have remained similar after March 2018 in the absence of the FAS, we can infer that the SHA reform caused a small increase in the rate of moves to high-opportunity areas. Using a standard difference-in-differences specification comparing the rate of high-opportunity moves among families with vs. without children in SHA in the six months before March 2018 vs. the six months after May 2018 (after the CMTO pilot ended, using only families in the CMTO control), we estimate that the FAS increased the rate of opportunity moves by 13.8 pp (s.e. =

[35] We do not use KCHA as a counterfactual here because KCHA itself was implementing its CMTO pilot at the same time that SHA introduced the FAS.

5.11), as shown in Column 5 of Table 4. This is roughly one-third the size of the CMTO treatment effect.

The FAS has a recurring monthly cost of $144 on average for families who move to high-opportunity areas, which amounts to $12,100 over 7 years (the average period for which families use their vouchers). This is substantially larger than the cost of CMTO mobility services, which are about $4,700 per family that moved to a high-opportunity area. We therefore conclude that financial incentives have significantly smaller impacts per dollar of expenditure than customized mobility services even when targeted directly to high-opportunity areas.

VII.B Effects of Information Provision

Another alternative to customized housing search assistance is to provide information in a more standardized manner. Bergman, Chan, and Kapor (2019) randomized the provision of information to families about the quality of schools associated with rental units on GoSection8.com, a housing search platform widely used by voucher holders. They find small positive impacts of this low-cost intervention on the fraction of families who move to areas with better schools. Families who receive the information treatment move to areas that are 0.1 standard deviations (SD) better in the distribution of school quality (as measured by test scores) across school districts within a county. CMTO, by contrast, shifted families in the treatment group to neighborhoods that were 0.5 SD higher in the distribution of neighborhood quality (measured by rates of upward mobility) – a much larger impact (Appendix Table 7).

Schwartz, Mihaly, and Gala (2017) report results from a randomized trial in Chicago in which families receiving housing vouchers were given $500 of financial assistance and light-touch mobility counseling services to move to a high-opportunity area (defined based on a composite index of poverty rates, job access, and other characteristics). The counseling services offered in the Chicago trial were largely informational and "client-led" as opposed to the more intensive counselor-led services offered in CMTO. They find that these treatments had no impact on the rate of high-opportunity moves: less than 12% of families moved to high-opportunity neighborhoods even with these incentives and supports.

Supplementary evidence from our own data further supports the view that standardized information provision is unlikely to be adequate to induce moves to opportunity. The CMTO treatment increased the fraction of families living in high-opportunity Census tracts substantially (63 pp) even among families who lived in high-opportunity areas at baseline (Table 2). Since these families pre-

sumably were familiar with these neighborhoods to begin with, this finding weighs against the view that a lack of information is the central reason families do not move to opportunity. Furthermore, 72% of families report "good" or "very good" about moving to an opportunity neighborhood in the baseline survey, before the CMTO intervention began, again suggesting that they do not lack information about such areas.

Together, the results in this section suggest that the mechanisms through which the CMTO intervention works are not simply provision of financial support or information about high-opportunity areas. These findings are consistent with the qualitative evidence discussed above, and suggest that customized support in the search process and help in engaging landlords are likely to be pivotal elements in the program's success.

VIII Conclusion

Low-income families tend to live in neighborhoods that offer limited prospects for upward income mobility, amplifying the persistence of poverty across generations. This paper has shown that this pattern of segregation is not driven by deep-rooted preferences among tenants or landlords. Rather, low-income families live in such areas primarily because of barriers that prevent them from moving to higher-opportunity neighborhoods – barriers that can be addressed through short-term assistance in the housing search process. These findings challenge canonical economic models of neighborhood choice in which residential sorting patterns are determined primarily by families' preferences and call for greater modeling of the underlying structure of search costs.

More broadly, our findings suggest that the growing economic segregation of American cities (Reardon and Bischoff, 2011) is not an inevitable consequence of preferences, but rather a trend that can be addressed through modest changes in public policies. In particular, redesigning rental assistance programs to provide customized search assistance in addition to existing financial support could reduce segregation and thereby increase upward mobility significantly. Such programs could have little net cost to taxpayers, as the costs of the services would be more than offset by the increased tax revenue paid by children who earn more when they grow up.

Going forward, it would be useful to replicate the CMTO program implemented in Seattle and King County in other cities to understand whether the program can be scaled nationally with the same level of effectiveness. We also plan to run additional randomized trials to optimize the cost-effectiveness of the program and better understand underlying mechanisms. In parallel, recognizing that not all families can move to opportunity, we also hope to identify place-based investments that

can improve outcomes for residents of lower-opportunity areas.

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Appendix

A Algorithm for Constructing Opportunity Maps

We defined opportunity areas through a collaborative effort between the researchers and the staff of the Seattle and King County housing authorities. The primary input into the process is a preliminary version of the measures provided in the Opportunity Atlas. Using data provided in Chetty, Hendren, Kline, and Saez (2013), we measured the average child-income rank at age 30-35 for children who grew up in the 1980-1985 birth cohorts (measured in 2015). We focus on children who did not move across census tracts before age 23 during our sample window, and we assign these children to the childhood census tracts in which they grew up. For each tract in Seattle and King County, we then regress the child's income rank on their parents-income rank, and construct the predicted value at the 25^{th} percentile. We denote this value by y_t for each tract t.

We then construct a forecast model that incorporates several additional pieces of information to reduce sampling error in those estimates. To begin, we regress y_t on a vector of tract characteristics, X_t,

$$y_t = \beta X_t + \epsilon$$

where X_t consists of poverty rates in 2010, average family income at age 22 for children in the 1986-93 cohorts who grew up in families with incomes at the 25^{th} percentile (i.e. upward mobility measured at an earlier age for slightly later non-overlapping cohorts), average college "quality" (as measured by the average earnings of the children who went to the same college) for children in the 1986-91 cohorts who grew up in families with incomes at the 25^{th} percentile, mean 4th grade average math and reading test scores for children in low-income families (children who received free or reduced lunch) averaged from 2015 to 2016, and an indicator for whether or not the tract is within the city of Seattle. We standardize each of these covariates to have mean zero and standard deviation of 1 throughout Seattle/King County. This regression is weighted by the precision (inverse of variance) of the initial estimate, y_t.

We then form the predicted values $y_t^x = \hat{\beta} X_t$ for each tract and the residuals $\epsilon_t^x = y_t - y_t^x$. Next, we estimate the signal to noise ratio of the residuals using the estimated standard error of y_t. We use the ratio of estimated signal to total variance, $\hat{\kappa}_t$, in each tract to form the forecast:

$$\hat{y}_t = \hat{\beta} X_t + \hat{\kappa}_t \epsilon_t^x$$

We then define opportunity neighborhoods by beginning with the set of tracts whose forecast, $\hat{y}_t$, fall in the top 21% of tracks for SHA and top 40% of tracks for KCHA. Roughly, this corresponds to a third of tracts being classified as the initial set of opportunity neighborhoods.

Given this measure, we then considered three sets of potential modifications that account for: (a) changes in neighborhoods over time (b) geographic continuity, and (c) dropping tracts with large concentrations of voucher holders.

To evaluate neighborhood change, we conducted an extensive set of robustness analyses using additional data sources. Most notably, we obtained test-score information for children in each tract for recent cohorts. We evaluated trends in both average test scores and in particular test scores for children on free and reduced price lunch. Our evaluation revealed that although some neighborhoods are changing in terms of average test scores (or average poverty rates), the average test scores conditional on free and reduced price lunch status were not changing over time. This led us to conclude that although neighborhood compositions might be changing over time, we do not have evidence that the impact of the neighborhoods on the upward mobility of its low-income

children was changing over time. As a result, we proceeded with our forecasted upward mobility measure, $\hat{y}_t$, as the primary input into the opportunity-mapping procedure.

Next, we made several additions to allow for geographic continuity. Here, we evaluated each specific tract with the PHAs to discuss the broad set of mobility characteristics of the included tract along a range of dimensions and helped the PHAs make judgement calls on whether to include the tract - these calls weighed their perceived value of the continuity against the difference in upward mobility characteristics of the tract. Lastly, the PHAs excluded a few tracts that already had a large concentration of voucher holders, with the idea that the services were not needed to facilitate moves to such areas. The combination of these (relatively minor) adjustments led to the opportunity maps used in the intervention.

B CMTO Program Costs

This appendix describes our cost estimates and compares them to estimates in the literature of the costs of similar programs. We note that there are several important contextual factors that may impact how transferrable cost estimates are to other contexts. In particular, both the Housing Assistance Payments (HAP) and financial assistance (e.g., security deposits) are in part driven by high housing costs in the Seattle metropolitan area. In contrast to some other mobility programs, there were also no post-move services provided to families in CMTO.[36] Finally, CMTO services were implemented by a local non-profit who provided services at a regional level across both housing authorities.

B.1 Programmatic Costs

In Panel A of Table 3, we estimate the average cost of CMTO services per voucher issued at $2,573. This cost figure sums three components, detailed in Panel B, including financial assistance, the cost of program staff, and PHA costs associated with administering CMTO. When characterizing the services offered to the CMTO treatment group, we find the per-issuance cost to be the most intuitive measure of the cost of the program as it reflects the actual outlay of funds for each family and is not driven by outcomes that may be affected by the experiment itself (e.g., lease-up rates). However, when estimating total expenditures for a projected number of lease-ups (and when comparing to other interventions that report only this metric), practitioners may find it useful to consider the per leased-up voucher cost that divides average cost per issuance by the lease-up rate. For CMTO, the lease-up rate was 88%, resulting in a per-lease cost of CMTO of $2,926.

When comparing against the benefits of an opportunity move (for example, the increase in lifetime earnings), we calculate the average cost per opportunity move by inflating cost-per-lease-up by the fraction of leased-ups that moved to an opportunity neighborhood to account for the expenditures incurred for families that do not move to an opportunity area.[37] In CMTO, 62% of treatment-group families that leased up moved to an opportunity area, resulting in a CMTO cost per opportunity move of $4,712. Finally, to put these costs into context, we calculate the average lifetime HAP expenditure for an average control-group family ($1,376/month) over seven years (the average voucher duration for families with kids at KCHA and SHA). The CMTO program cost of $2,573 is 2.2% of this seven-year HAP cost, emphasizing that the up-front cost of CMTO per family

[36] Our current cost estimates also do not include landlord damage mitigation fund costs because, to date, no such claims have been received. As such expenses are incurred over time, the effective per voucher cost of CMTO could rise.

[37] Note that this approach does not use average costs conditional on moving to an opportunity neighborhood because some costs are paid for all families issued vouchers and using services.

is modest relative to long-run Housing Choice Voucher costs per family.

In Panel B, we report the components of the average per issuance cost. Here, we provide further details on each category. For program staffing costs and PHA administration costs, we calculated the annual (fixed) cost to administer the program and divided by the number of vouchers we estimate to be a feasible annual load for that staffing level (264). We calculated this estimate based on the PHAs' estimation that the program staff were operating at steady-state peak capacity from September to November 2018. Their workload during these months reflected an average of 22 issuances per month in the months prior, leading to an annual load of 264 issuances per year.

Financial Assistance Costs per Issuance. Using the case-management database described in Section 4, we estimate average financial assistance costs per issuance across all treatment-group households issued vouchers, including families that did not move to an opportunity neighborhood or lease up at all. The results reported here use the same sample as the rest of the paper, vouchers issued in 2018, to ensure that families have had sufficient time to lease up and utilize financial assistance resources. We estimate an average take-up of financial services of $1,070 with a standard deviation of $1,241 and a maximum of $4,040. This category includes financial outlays on behalf of CMTO families including security deposits (average $844/issued voucher), pro-rated rent ($70/voucher), renter's insurance ($43/voucher), screening fees ($45/voucher), administrative fees ($39/voucher), holding fees ($22/voucher), and a miscellaneous category ($7/voucher). When calculating total programmatic costs, we subtract from this $385 as the average security deposit per issuance for the control group. As some financial assistance components are contingent on leasing up in an opportunity area, costs for the average family leasing up in an opportunity area are significantly higher (approximately $1,878).

One complication in calculating the marginal cost of the CMTO program is that KCHA (and to a lesser extent SHA) provide security-deposit assistance with all issued vouchers. By assigning the cost of treatment-group security deposits to the CMTO budget, we are overstating the marginal cost of the treatment group relative to the control group by essentially double counting security deposit expenses since the PHAs pay security deposits for some of the control group. To account for control-group security deposit usage, we estimate the fraction of the control group that uses security deposit assistance by PHA (77% for KCHA and 13% for SHA) along with the average security deposit expense by bedroom size and PHA. Per issued control-group voucher, the PHAs spend an average of $385 on security-deposit assistance, representing costs that would have been paid anyway but for CMTO.

Program Services Costs per Issuance. We estimate program services costs per issuance to be $1,500. These costs include salary and benefits for four full-time staffers, half of one full-time manager, and one full-time administrative assistant, as well as costs expensed by the program contractors consisting of mileage and training costs ($2,000/month), materials and supplies ($1,000/month), overhead such as utilities ($2,500/month), interpreter costs ($600/month), and other miscellaneous costs ($1,000/month) including cell phones, postage, and insurance. The total annual cost of this category is $396,092, which we divide by 264 families to arrive at a per-family cost of $1,500. Some of staffer time was spent on research-specific asks, such as entering data into the MIS system. We have been conservative and included this time in our cost estimates, considering that a similar program without a research component would probably still have an administrative burden and possibly face other costs the staff didn't happen to incur such as paid family leave, etc..

PHA Administration Costs per Issuance. We estimate the marginal costs for PHA administration of the CMTO program per issuance to be $392. This category consists of salary and benefits for two PHA project managers spending 50% of their time managing CMTO service implementation divided by 264 annual issuances. An alternative arrangement would be for contractors to replace

much of PHA staff time with additional management expenditures, but that is not reflective of how CMTO actually worked. Also, although many other PHA staff worked on CMTO (including an estimated 5% of a senior manager's time), we follow standard capital budgeting practices by not including their time as a CMTO cost because it is likely these PHA labor costs would have been incurred by the PHAs anyway even without the CMTO project. If instead additional staff had been hired to handle the PHA work left undone because staff were spending time on PHA, then we would want to include such costs. We have excluded start-up costs (PHA staff development time, piloting, grant writing time, etc.) from PHA administration costs to better approximate the marginal cost of administering a similar program per voucher recipient.

B.2 Housing Assistance Payment Costs

In Panel C of Table 3, we estimate incremental HAP costs, i.e., the difference between average treatment-group HAP expenditures ($1,610/month) and average control-group HAP expenditures ($1,376/month), resulting in a monthly difference of $234 additional HAP spent on the treatment group than the control group ($2,804/year). Given that Seattle is an unusually expensive housing market, we also report the incremental HAP cost relative to baseline (average control) HAP in percentage terms (17%), a metric that is perhaps more useful to lower-cost areas.

B.3 Comparison with Cost Estimates from Other Programs

Appendix Table 1 compares our cost estimates with recent studies that estimated programatic costs for other mobility programs. Overall, our takeaway is that CMTO is not more expensive than comparable mobility programs. Still, we are actively seeking ways to design a more cost-effective version of CMTO in Phase 2.

Feins, McInnis, and Popkin (1997) estimate the average cost of the counseling provided to the original MTO experimental group per opportunity move to be $3,077. Assuming their estimates are in 1997 dollars, we use the CPI to adjust for inflation, implying an MTO cost of $4,814 in 2018 dollars. Cunningham and Popkin (2002) evaluate the Housing Opportunity Program (HOP), a mobility program funded by the Chicago Public Housing Authority. While Cunningham and Popkin (2002) do not provide cost estimates, Schwartz, Mihaly, and Gala (2017) report a nominal cost per opportunity move for HOP of $3,528 ($4,925 in 2018 dollars, assuming the original estimates are in 2002 dollars).

Cunningham, Scott, Narducci, Hall, Stanczyk, et al. (2010) do not detail the cost model of a specific program and instead survey the components of mobility assistance programs across 11 PHAs, drawing from interviews with mobility program staff. They find that cost estimates vary dramatically (ranging from $70-$6,000 per issuance, not adjusted for inflation) across PHAs due to programmatic differences in mobility programs and differences in how PHAs calculate costs. In particular, for those with mobility programs operated by outside contractors, total program costs included staffing and overhead (supplies, security deposit payments, rental space, etc.). For mobility programs run in-house, PHAs had difficulty separating staff time and overhead costs that went directly to the mobility programs.

Rinzler, Tegeler, Cunningham, and Pollack (2015) use cost data from the Baltimore Housing Mobility Program (BHMP) to model costs per opportunity move for a hypothetical housing mobility pay-for-success program of $3,235 in 2015 dollars ($3,427 adjusted for inflation). Program costs as defined in their model consist of mobility program services, including counseling, housing search assistance, and landlord engagement. BHMP resulted from a court order desegregating Baltimore public housing and has several programmatic differences from CMTO, such as not offering

financial assistance but offering post-move support and requiring families to move to an opportunity neighborhood. Administrative costs for administering the HCV program are not included in cost estimates. Costs estimates are calculated as BHMP's total expenditure divided by their total number of lease-ups. One complication in comparing this estimate to CMTO's cost per lease-up is that differences in cost per lease could be driven by differences in lease-up rates.

Schwartz, Mihaly, and Gala (2017) evaluate a mobility program by the Chicago Regional Housing Choice Initiative intended to provide light-touch and cost-effective counseling (and no financial assistance) using a randomized controlled trial. In 2017 dollars, they estimate a counseling cost per opportunity move of $2,869 ($2,939 in 2018 dollars). Finally, Sard, Rice, Bell, and Mazzara (2018) propose a reimagined HCV program that would include mobility services and a home-visiting program. The mobility services would include housing search assistance, credit repair, opportunity area education, and landlord-tenant mediation. They estimate a cost of $4,500 per issuance for such a program.

C Qualitative Study: Methods

This appendix provides some further information on the methods used in the qualitative component of the study, described in Section VI.

Sample Definition. To create the sample for the qualitative interviews, we stratified by PHA (SHA, KCHA), treatment status (treatment, control), and by lease up status (leased up, still searching). While the first two categories are straight forward, the last category had to be constructed by considering participants' voucher and lease up status as of March 2019. If the participant had not yet received a voucher or received a voucher but was still searching for housing, we categorized them as "still searching." We then randomly selected participants from each stratum. Appendix Table 2 shows the number and percentage of participants we selected from each category.

The sampling framework heavily weighted treatment group participants and participants who were still searching for housing to ensure that we would be able to collect data about the housing search process in real time. In all, we sampled 153 treatment households (65% of the treatment group) and 45 control households (22% of the control group).

Recruitment. The qualitative research team was led by Stefanie DeLuca and comprised of four graduate students and seven undergraduate students from Johns Hopkins University. Nearly all of the students had previous qualitative research experience, and several had experience working on housing mobility programs specifically. Six graduate students from the University of Washington were hired to help with data collection. We also employed a local research firm, MEF Associates, to assist with ongoing data collection. In all, 22 people conducted interviews since the project's beginning. The majority of interview respondents were recruited through phone calls, although some responded to recruitment letters we sent through mail and email. Once we made contact, most people (93%) agreed to an interview immediately, or agreed to schedule one at a more convenient time. The biggest barrier to recruitment was disconnected phone numbers and incorrect addresses, reflecting the financial and housing precarity of program participants. Ongoing recruitment will be aided with updated information each month from the PHAs as well as door-knocking visits.

Our sample included some families with limited English proficiency, reflecting the diversity of program participants. To address language barriers, families chose one of three translation options to complete an interview, whichever they felt most comfortable with: a neighbor, friend or family member; a third-party in-person language interpretation service; or a third-party phone interpretation service.

Most interviews were conducted in respondents' homes. If the respondent was not comfortable

meeting with us at home, interviews were conducted at other locations they chose, such as local libraries or McDonald's restaurants. The semi-structured interviews lasted anywhere between one and four hours with most interviews lasting approximately two hours. Respondents were asked about their personal life –residential history, children's schools, employment and education history, and health – as well as their experiences working with the PHAs and (if applicable) CMTO. All interviews were recorded and transcribed. The respondents were paid $50 for their time.

Narrative Interviewing. Our methods are derived in part from a long tradition in the social sciences, especially the work of urban sociologists who developed methods of observing social life and the ways individuals make meaning of their everyday routines (see Anderson, 1990; Becker, Geer, Hughes, and Strauss, 1961; Burawoy, 1979; Edin and Lein, 1997; Liebow, 1967). Specifically, we used narrative interviewing techniques (see DeLuca, Clampet-Lundquist, and Edin, 2016and Boyd and DeLuca, 2017 for more on this method), a semi-structured approach to interviewing that uses open-ended questions to allow a wide range of responses to emerge, with targeted follow-up questions to ensure all interviews covered the same material. These interviews create a more natural, in depth conversation, rather than a clinical series of questions and short answers.

Interviews are conducted without copies of the interview guide visible. Interviewers instead memorize a detailed interview protocol (with a shorthand notecard nearby for review of interview topics if needed), and the interviews are recorded. This allows the interviewers to focus on the respondent, making eye contact and not causing distraction by flipping through paper and writing notes. The approach communicates to the respondent that we are focused entirely on hearing their story and perspective, rather than on simply going through a list of specific questions by rote. Thus, more detailed stories and unexpected answers are more likely to emerge, especially those unanticipated by the researchers (in sharp contrast to forced choice response survey questions). We start our interviews with a broad question: "Tell me the story of your life." This gives the respondents the sense that we are interested in the whole story of who they are. Further, the opening directive signals to them that we want them to talk—a lot—and that this is not a survey. Rather than merely documenting the events of our research participants' lives, the interviewing approach provides a setting in which respondents reveal how they see things, what they feel is important, how they have made sense of their past and imagine their future. Respondents can then answer in their own words, without worrying about giving a "wrong" answer or saying too much. The protocol not only enriches the study findings by allowing for a broad range of answers, but it also reduces stress and the chances that respondents will feel coerced to say particular things.

In-depth interviewing can be especially effective for creating rapport and developing trust for stigmatized groups, such as low-income families receiving housing vouchers. By conducting interviews with empathy and non-leading, non-judgmental questions, respondents are often put at ease, and may feel less scrutinized. If respondents have some control over the way they can answer questions, and feel that the interviewer is truly interested in them and lets them speak at length, they may feel comfortable to open up more candidly (we experienced this often when interviewing the CMTO families).

Analysis. The research team used emerging themes from previous research, fieldnotes and interviews to create a codebook for the data set (including codes for analytically important themes in the paper, such as whether respondents mentioned feeling supported by CMTO staff, whether CMTO staff helped navigate with landlords on respondents' behalf, and whether respondents mentioned receiving financial assistance for their CMTO move). A team of coders then used this codebook to identify which reoccurring themes were present in individual interviews. This team consisted of 13 members, nine from Johns Hopkins University who did the initial coding and four from the University of Washington who also coded the same interviews to obtain inter-coder reliability. Two of the coders from Hopkins did not conduct any interviews in Seattle, providing an additional

independent source of reliability for some of the coding.

Ethnographic Observations. Although we focus primarily in this paper on data from the interviews, our fieldwork also contains other elements of observation that support our interpretation of the data. Every time we interviewed families, we spent hours in their homes, talking to other household members and friends as they came and went, playing with children, meeting neighbors, and watching neighborhood activities. During recruiting, we drove repeatedly up and down neighborhood streets, knocking on doors, and eating at local fast-food places during breaks. We gave people rides so that they could errands, dropped people off at the social service agencies so they could apply for utility assistance, and we took them to lunch or dinner, sometimes with other family members. In other words, the interviews are part of a larger set of fieldwork practices, and we took detailed notes on all of those as well.

Researchers digitally recorded initial impressions of the interviews immediately after the interviews occurred, and wrote fieldnotes for each interview. Fieldnotes describe everything that happened during an interview visit, including: the setting (usually the housing unit and neighborhood blocks surrounding the house);, what participants were like (e.g., attire, demeanor); interactions with other family members; any other information that was not recorded (warm-up and exiting conversations);and conversations that took place over the course of the interview itself. The post-interview fieldnotes alsoand a summary of summarize the interview, with a focus on central research questions. as well as capture information that is not recorded (e.g., attire, demeanor, interaction with fieldworkers and family members).

Analyses in the paper are also informed by the following ethnographic data: three in-person observations of families with search assistance staff at their initial one on one meetings; attendance at a CMTO staff meeting; three informational meetings with all of the CMTO family and housing search assistance team members (two by phone and one each in person); in-person meetings with CMTO study intake staff at both SHA and KCHA; informational meetings with staff from the KCHA voucher program; two years of weekly phone meetings with PHA and CMTO research partners, MDRC implementation researchers, and J-PAL staff (January 2017 and ongoing).

D Economic Model of Neighborhood Choice

In this appendix, we derive the bounds on willingness to pay discussed in Section V.F in a canonical model of neighborhood choice with heterogeneous preferences.

Consider a frictionless discrete choice framework in which family i chooses neighborhood type $j \in \{H, L\}$ corresponding to high-opportunity and low-opportunity neighborhoods, respectively, to maximize their indirect utility of living in neighborhood j. The indirect utility of living in neighborhood j for family i is

$$u_{ij} = \varepsilon_{ij} - P_j \tag{2}$$

where ε_{ij} is the idiosyncratic preference that household i has for neighborhood j and P_j is the cost of living in neighborhood j. We normalize the coefficient on costs to one so that preferences ε are interpretable in dollar terms.

Families choose the neighborhood type that maximizes their indirect utility and therefore move to an opportunity neighborhood whenever

$$u_{iH} > u_{iL} \tag{3}$$

$$\underbrace{\varepsilon_{iH} - \varepsilon_{iL}}_{\text{marginal benefit of } H} > \underbrace{P}_{\text{marginal cost of } H} \tag{4}$$

where $P = P_H - P_L$ denotes the marginal cost of moving to neighborhood H. Absent any additional resources, the share of families moving to an opportunity neighborhood s_H is

$$s_H = \Pr(j^* = H) = \Pr(\varepsilon_{iH} - \varepsilon_{iL} > P). \tag{5}$$

In this framework, the fact that 17% of families in the control group who lease up move to high-opportunity areas implies that $\hat{s}_H = 0.17$. That is, 83% of families have a disutility of living in the high-opportunity neighborhood that is greater than the cost of living in a high-opportunity neighborhood, i.e. have a net willingness-to-pay for low-opportunity areas that is positive: $WTP_i = \varepsilon_{iL} - \varepsilon_{iH} + P > 0$.

Now consider the CMTO treatment group. For this group, the indirect utility of moving to neighborhood j is

$$u_{ij}^T = \delta_i S_j - P_j + \varepsilon_{ij}, \tag{6}$$

where S_j is a variable representing the cost of the moving assistance services offered by the public housing authority for households moving to neighborhood j, including security-deposits and search assistance services. In the CMTO experiment, $S_L = 0$ and $S_H = \$2,600$. The coefficient δ_i governs the translation of the dollar value of these services to utility. In an environment with no frictions where these services can be purchased in the market, we would expect $\delta_i \leq 1$: families should value the services at most at their marginal cost, as they would have already purchased them otherwise.

Treatment-group families choose to move to a high-opportunity neighborhood when

$$u_{iH}^T > u_{iL}^T \tag{7}$$

$$\varepsilon_{iH} - \varepsilon_{iL} > P - \delta_i S_H \tag{8}$$

and hence the share of treatment-group families that lease up who move to an opportunity neighborhood is

$$s_H^T = \Pr(\varepsilon_{iH} - \varepsilon_{iL} > P - \delta_i S_H). \tag{9}$$

For the CMTO treatment group, $\hat{s}_H^T = 0.62$, meaning that 62% of families preferred high-opportunity neighborhoods after they were provided with the services targeted at high-opportunity areas. Given $\delta_i \leq 1$, we can infer these 62% of families have a net willingness to pay (WTP) for low-opportunity areas that is less than \$2,600, i.e., $WTP_i = \varepsilon_{iL} - \varepsilon_{iH} + P < \$2,600$.[38]

Putting together these two bounds, we infer that

$$\Pr(WTP_i \in [0, S_H]) = \Pr(\varepsilon_{iH} - \varepsilon_{iL} - P \in [-S_H, 0]) > s_H^T - s_H = 0.45, \tag{10}$$

if $\delta_i \leq 1$. That is, the frictionless model implies that 45% of families have net WTP for a low-opportunity area between \$0 and \$2,600, i.e., a large mass of families are close to indifferent between high- and low-opportunity neighborhoods as shown in Figure 10.

In an environment where families face frictions in housing search or other constraints (e.g., a lack of liquidity to pay for services up front), the value of the CMTO services δ_i could be greater than one. In this setting, choices can no longer be directly translated into preferences (WTP). In particular, some families may have very high WTP for high-opportunity areas yet are

[38] Of course, not everyone in the treatment group received exactly \$2,600 in services. Appendix B discusses heterogeneity in services take-up and notes that the maximum cost of financial services taken up was \$4,040. A conservative upper bound for the cost of CMTO services (replacing \$1,070 with \$4,040 in Table 3) would therefore be \$5,543. However, we focus on the average cost of around \$2,600 as it better represents the overall expense required to support the treatment effects we see here.

prevented from moving to such areas (absent CMTO-type services) due to frictions in the housing search process. As discussed in the text, we believe that such a model is more likely to match our experimental results, and hence view unpacking and modeling the structure of these search frictions as a valuable direction for further work.

Table 1
Summary Statistics and Balance Tests for Households in Experimental Sample

	Pooled	Control			Treatment			P-Value of T-C Difference
	Mean (1)	Mean (2)	SD (3)	N (4)	Mean (5)	SD (6)	N (7)	(8)
A. Head of Household Demographics								
Age	34.2	34.2	9.1	133	34.2	7.8	141	0.974
Annual Household Income ($)	19639	19932	12282	133	19362	13393	141	0.669
% Speak English (w/o Translator)	80.7	79.7	40.4	133	81.6	38.9	141	0.726
% Born Outside the U.S.	36.6	37.9	48.7	132	35.5	48.0	141	0.698
% Black Non-Hispanic	50.2	50.8	50.2	128	49.6	50.2	139	0.933
% White Non-Hispanic	24.0	22.7	42.0	128	25.2	43.6	139	0.654
% Hispanic	9.0	10.2	30.3	128	7.9	27.1	139	0.526
% Asian Non-Hispanic	2.2	2.3	15.2	128	2.2	14.6	139	1.000
% Female Head of Household	77.5	71.0	45.6	131	83.8	37.0	136	0.011**
% Married Head of Household	11.2	13.0	33.7	131	9.6	29.5	136	0.429
% Less than High School Grad	19.2	24.6	43.2	130	14.2	35.0	141	0.034**
% High School Degree	32.1	34.6	47.8	130	29.8	45.9	141	0.361
% Attended Some College	42.4	33.1	47.2	130	51.1	50.2	141	0.003***
% BA or more	6.3	7.7	26.8	130	5.0	21.8	141	0.340
% Homeless	13.6	15.2	36.0	132	12.1	32.7	141	0.474
% Currently Working	56.4	63.6	48.3	132	49.6	50.2	141	0.019**
% Works Full-Time (Over 35 Hours/Week)	26.4	32.6	47.0	132	20.6	40.6	141	0.022**
% Commute > 30 min to Work	32.2	34.5	47.8	84	29.4	45.9	68	0.521
% with Car and Driver's License	66.2	62.1	48.7	132	70.0	46.0	140	0.172
Number of Children	2.2	2.3	1.4	133	2.1	1.4	141	0.462
Children's Average Age	6.5	6.4	4.0	130	6.6	4.2	138	0.618
B. Neighborhood-Related Questions								
% Starting in High-Opportunity Tract	9.8	8.6	28.1	105	11.0	31.4	109	0.552
% Satisfied with Current Neighborhood	54.2	50.0	50.2	128	58.1	49.5	136	0.189
% Would Leave Neighborhood if Got Voucher	50.4	55.5	49.9	128	45.6	50.0	136	0.116
% Feel They Could Find Place in New Neighborhood	50.4	55.9	49.9	118	45.2	50.0	126	0.096*
% Could Pay for a Move	27.5	31.1	46.5	132	24.1	42.9	141	0.215
% Good with Moving to Racially Diff Neighborhood	77.9	82.4	38.2	131	73.6	44.3	140	0.078*
% Good with Moving to Specific Neighborhood in Opportunity Area	72.5	75.0	43.5	132	70.2	45.9	141	0.341
% Considering Different School for Any Child	60.3	66.0	47.6	100	55.0	50.0	109	0.109
% Unsatisfied with Any Child's Current School	14.4	16.0	36.8	100	12.8	33.6	109	0.530
% Primary Motivation to Move is Schools	44.3	45.5	50.0	132	43.3	49.7	141	0.711
% Primary Motivation to Move is Safety	20.1	20.5	40.5	132	19.9	40.0	141	0.923
% Primary Motivation to Move is Bigger/Better Home	17.2	14.4	35.2	132	19.9	40.0	141	0.238
C. Characteristics of Origin Neighborhood (Census Tract)								
Predicted Mean Household Income Rank (p=25)	45.4	45.5	3.1	105	45.3	3.0	109	0.578
Incarceration Rate (p=25)	2.1	2.1	1.5	132	2.1	1.4	139	0.935
Teen Birth Rate (Women; p=25)	23.3	23.9	7.9	132	22.8	7.7	139	0.273
% in Poverty (2016 ACS)	16.1	16.2	10.4	132	15.9	8.9	139	0.850
% Black (ACS 2013-2017)	10.5	11.0	9.2	132	10.1	7.7	139	0.394
% Low-Inc. 3rd Graders Proficient in Math (2015)	42.0	42.4	11.4	130	41.6	11.8	136	0.576
% in Extreme Poverty (Rate > 40%) Tract (2016 ACS)	1.8	2.3	15.0	132	1.4	12.0	139	0.640

F-Test	F-Statistic	P-Value	N
	1.053	0.394	274

Notes: This table presents baseline summary statistics for households in the analysis sample (households issued vouchers in 2018). The first three variables of Panel C show Census tract measures of mean household income rank, incarceration rates and teen birth rates for children whose parents were at the 25th percentile of the national household income distribution (see Chetty, Friedman, Hendren, Jones, and Porter (2018) for details). In column (8) we show the p-value for a test of the difference between treatment and control group means, estimated by regressing each variable on indicators for treatment status and PHA. The number of observations is lower for some variables because of non-response. We regress treatment status on all baseline variables in the table, controlling for PHA, and compute the F-statistic from a test of the variables' joint significance. To preserve the full sample in that regression, we replace missing values in each variable with a constant and add an indicator variable for imputed. The resulting F-statistic and p-value are shown at the bottom of the table. All regressions use robust standard errors. *** *p<0.01, ** p<0.05, * p<0.1*

Table 2
Heterogeneity of Treatment Effects

	Share Moving to Opportunity Area (%), Unconditional on Lease-Up					
	Control Mean	Treatment Mean	Treatment Effect	SE	N	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
A. Pooled and by Housing Authority						
All Families	14.3	54.3	40.0	5.2	274	0.000
All Families (Controls)	14.3	51.3	37.0	6.0	274	0.000
Seattle Housing Authority	12.7	44.4	31.7	7.6	126	0.000
King County Housing Authority	15.7	62.8	47.1	7.0	148	0.000
B. By Head of Household Demographic Characteristics						
Black Non-Hispanic	12.3	46.2	33.9	7.3	134	0.000
White Non-Hispanic	10.3	65.9	55.6	10.2	64	0.000
Other Race/Ethnicity	23.5	60.5	37.0	10.8	69	0.001
Born Outside the U.S.	10.0	46.7	36.7	8.2	100	0.000
Born in the U.S.	17.1	59.0	41.9	6.7	173	0.000
English Isn't Primary Language	11.1	44.7	33.6	11.7	54	0.004
English Is Primary Language	15.2	56.6	41.4	5.8	219	0.000
20 years or more in Seattle/King County	13.2	56.1	42.9	7.7	117	0.000
Less than 20 years in Seattle/King County	15.2	53.1	37.9	7.0	156	0.000
Started in High Opportunity Tract	22.2	85.3	63.1	15.9	21	0.000
Didn't Start in High Opportunity Tract	12.5	49.9	37.4	6.0	193	0.000
Income < $19,000 (sample median)	15.9	51.8	36.0	7.8	128	0.000
Income > $19,000 (sample median)	13.2	57.9	44.7	7.3	135	0.000
No College	9.1	56.9	47.8	7.0	139	0.000
Some College or More	22.6	52.6	30.0	8.1	132	0.000
Currently Working	13.1	46.2	33.1	7.0	154	0.000
Currently Not Working	16.7	62.1	45.4	8.0	119	0.000
Uses Child Care	21.7	53.3	31.6	7.8	139	0.000
Doesn't Use Childcare	6.3	55.4	49.1	6.6	134	0.000
C. By Perceptions About Moving at Baseline						
Feels Good About Moving to an Opportunity Area	15.2	54.8	39.6	6.2	198	0.000
Doesn't Feel Good About Moving to an Opportunity Area	12.1	53.1	41.0	9.8	75	0.000
Satisfied With Current Neighborhood	9.4	54.7	45.3	6.6	143	0.000
Unsatisfied/Indifferent With Current Neighborhood	18.8	52.6	33.8	8.4	121	0.000
Sure Wants to Leave Current Neighborhood	16.9	56.4	39.5	7.8	133	0.000
Sure Wants to Stay in Current Neighborhood or Indifferent	10.5	51.1	40.5	7.1	131	0.000
Feels Good About Moving to Racially Different Neighborhood	12.0	58.0	46.0	5.8	211	0.000
Feels Bad/Indifferent About Moving to Racially Different Neighborhood	26.1	45.9	19.8	12.6	60	0.117
Sure Could Pay for Moving Expenses	14.6	65.4	50.7	9.3	75	0.000
Not Sure Could Pay for a Moving Expenses	14.3	51.3	37.0	6.1	198	0.000
Sure Could Find a New Place	15.2	49.2	34.0	8.0	123	0.000
Not Sure Could Find a New Place	15.4	54.4	39.0	7.9	121	0.000
D. By Children Characteristics						
Mean Children Age Above 6 years	16.4	48.0	31.6	7.4	142	0.000
Mean Children Age Below 6 years	11.1	60.9	49.8	7.3	126	0.000
More than 2 Children	14.0	46.7	32.7	9.1	85	0.000
2 Children or Less	14.4	59.0	44.6	6.3	189	0.000
Considering Different Schools	12.1	46.9	34.8	7.6	126	0.000
Not Considering Different Schools	14.7	59.1	44.4	9.4	83	0.000

Notes: This table reports treatment effects by subgroup. The data is restricted to the analysis sample (vouchers issued in 2018). In row 2 we control for baseline characteristics shwon in Table 1. See Appendix Table 10 for a detailed definition of the variables. All regressions include PHA fixed effects and use robust standard errors.

Table 3
Creating Moves to Opportunity Program Costs

	Average Cost
A. Total Costs	
Cost of CMTO services per family issued	$2,573
Cost of CMTO services per family leased	$2,926
Cost of CMTO services per opportunity move	$4,712
Cost of CMTO services per family issued / 7-year HAP costs per family	2.2%
B. Costs by Service Category	
Cost of CMTO financial assistance per issuance	$1,070
Cost of CMTO program services per issuance	$1,500
Cost of PHA CMTO administration per issuance	$392
Cost savings of PHA services paid by CMTO	($389)
C. Housing Assistance Payment (HAP) Costs	
Incremental HAP cost per lease per year	$2,804
Incremental HAP / average HAP costs per family	17.0%

Notes: This table reports average cost metrics for the CMTO treatment group. Panel A reports average total CMTO service costs in four ways: per voucher issued, per family leased up, per opportunity move completed, and per family issued as a percentage of 7-year HAP costs for one family. Cost of CMTO services per family issued as a percentage of 7-year Housing Assistance Payment costs per family is the cost of CMTO services per issuance divided by the KCHA and SHA average HAP cost for the control group over seven years (the average voucher duration for families with children). Panel B reports average cost by category. Program services include costs paid to the Navigator service providers, which includes costs for staff, management, administrative assistance, mileage, overhead, and materials. Financial services costs include security deposits, adminstrative fees, holding fees, pro-rated rent, renter's insurance, and screening fees. PHA administration costs per issuance consist of a project manager at each PHA spending 50% time managing CMTO service implementation. Cost of CMTO services per family issued a voucher in Panel A consist of all CMTO programmatic costs in panel B, less $389 of security deposit assistance that would have been provided by the PHAs as part of existing PHA policy, estimated using the control group average security deposit take-up. Panel C reports the incremental HAP expenditure for the treatment group relative to the control group per family that leased up.

Table 4
Financial Incentives: Impacts of Quasi-Experimental Estimates

Reform:	KCHA 5 Tier Voucher Payment Standard Reform				SHA Family Access Supplement			
Outcome:	% Moving to High Opportunity		Median 2 BR Rent ($)		% Moving to High Opportunity		Median 2 BR Rent ($)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DD Effect	-3.59	-4.70	55.92	70.52	13.79***	13.82***	-22.31	-11.84
	(5.75)	(6.21)	(49.23)	(52.05)	(5.11)	(5.26)	(74.14)	(76.50)
Controls:								
Number of Kids		X		X		X		X
Month Voucher Issued FE		X		X		X		X
Observations	533	528	325	323	534	534	414	414

Notes: This table estimates the effects of two reforms involving financial incentives for moves to designated neighborhoods using the difference in difference specifications described in Section 7a. Columns (1) through (4) estimate the effects of KCHA's 5 tier voucher payment standard reform introduced in March 2016 using data on households with children who were issued a voucher between July 2015 and November 2016. Columns (5) through (8) estimate the effects of SHA's Familiy Access Supplement introduced in February 2018 using data on households who were issued a voucher between August 2017 and October 2018, excluding those issued a voucher between February and April 2018, which is when the CMTO pilot took place (see Figure 11 and Section 7a for details). Columns (1), (3), (5) and (7) show the difference in difference estimates without additional controls. Columns (2), (4), (6) and (8) add a set of indicator variables for the number of children in the household and the month in which the voucher was issued. Columns (3), (4), (7) and (8) show the effect of each policy on median rent for two-bedroom units (2011-2015 American Community Survey) in the tract where households leased up. Tract median rents are only observed for families who lease up using a housing voucher. All regressions use robust standard errors. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 1
Costs of CMTO vs. Other Mobility Programs

Program	Cost Metric	Estimated Cost	Source
1. Creating Moves to Opportunity	Cost per family issued	$2,573	Table 3
2. Creating Moves to Opportunity	Cost per opportunity move	$4,712	Table 3
3. Moving to Opportunity	Cost per opportunity move	$4,814	Feins et al. (1997)
4. Housing Opportunity Program	Cost per opportunity move	$4,925	Schwartz et al. (2017)
5. Survey of PHA programs	Cost per family issued	$70-6,000	Cunningham et al. (2010)
6. Baltimore Housing Mobility Program	Cost per opportunity move	$3,427	Rinzler et al. (2015)
7. Chicago Regional Housing Choice Initiative	Cost per opportunity move	$2,939	Schwartz et al. (2017)
8. Hypothetical Mobility Program	Cost per family issued	$4,500	Sard et al. (2018)

Notes: This table reports cost metrics for CMTO and comparison mobility programs. Costs in rows 3 and 4 and rows 6 and 7 have been adjusted for inflation to 2018 dollars using the CPI. See Appendix B for details.

Appendix Table 2
Qualitative Study Sampling and Response Rate

A. Sampling Targets

	Treatment (1)	*Control* (2)	*Total* (3)
Still Searching	74 (100%)	23 (25%)	97
Leased up	79 (50%)	22 (20%)	101
Total	153	45	198

B. Response Rate

	Treatment (1)	*Control* (2)	*N* (3)	*N / Target Sample Size* (4)	*N / Number Contacted* (5)
Target	153	45	198		
Interviewed	91	23	114	58%	70%
Refusals	5	3	8	4%	5%
Contact, No Interview Yet	34	6	40	20%	
No Contact/Bad Contact Info	23	11	34	17%	
Actual Contacts	130	32	162	82%	

Notes: This table shows the sampling scheme and response rates for the qualitative study sample. Panel A shows the number and percentage of participants selected from each group formed by the combination of treatment status and lease-up status. Panel B shows the number of households at each stage, from households targeted to households actually contacted. Column (4) shows the number of household in each stage as a share of all households targeted, and column (5) shows the share of household interviews and refusals as a share of households actually contacted.

Appendix Table 3

Summary Statistics for Households in Qualitative Sample vs. Not in Qualitative Sample

	Full Sample		Qualitative Sample		Not in Qualitative Sample		P-Value of Difference
	Mean (1)	N (2)	Mean (3)	N (4)	Mean (5)	N (6)	(7)
A. Head of Household Demographics							
Age	34.39	324	34.58	110	34.29	214	0.783
Annual Household Income ($)	19772	324	19736	110	19790	214	0.973
% Speak English (w/o Translator)	80.86	324	86.36	110	78.04	214	0.054*
% Born Outside the U.S.	37.46	323	31.82	110	40.38	213	0.118
% Black Non-Hispanic	50.16	317	52.29	109	49.04	208	0.613
% White Non-Hispanic	24.92	317	22.02	109	26.44	208	0.386
% Hispanic	8.52	317	7.34	109	9.13	208	0.574
% Asian Non-Hispanic	2.52	317	2.75	109	2.40	208	0.897
% Female Head of Household	75.00	316	72.64	106	76.19	210	0.484
% Married Head of Household	11.71	316	9.43	106	12.86	210	0.309
% Less than High School Grad	19.94	321	19.09	110	20.38	211	0.707
% High School Degree	31.78	321	30.91	110	32.23	211	0.877
% Attended Some College	42.37	321	44.55	110	41.23	211	0.582
% BA or more	5.92	321	5.45	110	6.16	211	0.816
% Homeless	13.62	323	14.55	110	13.15	213	0.744
% Currently Working	55.42	323	53.64	110	56.34	213	0.675
% Works Full-Time (Over 35 Hours/Week)	27.24	323	27.27	110	27.23	213	0.937
% Commute > 30 min to Work	35.03	177	40.68	59	32.20	118	0.277
% with Car and Driver's License	65.22	322	64.55	110	65.57	212	0.862
Number of Children	2.19	324	2.12	110	2.23	214	0.490
Children's Average Age	6.60	317	6.82	108	6.48	209	0.475
B. Neighborhood-Related Questions							
% Starting in High-Opportunity Tract	11.51	252	14.12	85	10.180	167	0.374
% Satisfied with Current Neighborhood	54.07	307	50.00	102	56.098	205	0.317
% Would Leave Neighborhood if Got Voucher	52.12	307	52.94	102	51.707	205	0.893
% Feel They Could Find Place in New Neighborhood	53.10	290	60.00	100	49.474	190	0.089*
% Could Pay for a Move	27.55	323	30.91	110	25.822	213	0.371
% Good with Moving to Racially Diff Neighborhood	76.64	321	71.56	109	79.245	212	0.142
% Good with Moving to Specific Neighborhood in Opportunity Area	72.14	323	65.45	110	75.587	213	0.072*
% Considering Different School for Any Child	60.00	250	64.71	85	57.576	165	0.275
% Unsatisfied with Any Child's Current School	14.40	250	20.00	85	11.515	165	0.092*
% Primary Motivation Schools	42.41	323	34.55	110	46.479	213	0.038**
% Primary Motivation Safety	21.05	323	20.00	110	21.596	213	0.709
% Primary Motivation Bigger/Better Home	16.41	323	19.09	110	15.023	213	0.360
C. Characteristics of Origin Neighborhood (Census Tract)							
Forecasted Mean Household Income Rank (p=25)	45.49	252	45.55	85	45.46	167	0.803
Incarceration Rate (p=25)	2.14	319	2.17	107	2.13	212	0.807
Teen Birth Rate (Women; p=25)	23.24	319	23.00	107	23.36	212	0.668
% in Poverty (2016 ACS)	16.67	319	17.73	107	16.13	212	0.187
% Black (ACS 2013-2017)	11.11	319	12.42	107	10.45	212	0.117
% Low-Inc. 3rd Graders Proficient in Math (2015)	41.71	313	40.35	106	42.41	207	0.154
% in Extreme Poverty Tract (2016 ACS)	1.88	319	0.93	107	2.36	212	0.275

F-Tests	F-Statistic	P-Value	N
Unconditional on Lease-up	1.096	0.328	324
Conditional on Lease-up	1.147	0.267	262

Notes: This table compares the households in the qualitative sample to the households in the experimental sample. The qualitative sample is composed of all households that have been interviewed for the qualitative study. The set of households not in the qualitative sample is defined as all households in the experimental sample who are not included in the qualitative sample. We estimate a regression of a qualitative sample indicator on all variables in shown in the table, plus a PHA indicator, and compute the resulting F-Statistic for the joint significance of these variables. We do so in two ways: first, we restrict the sample to all interviewed households, and second by restricting the sample to households that have leased-up and therefore can answer the neighborhood satisfaction and willingness to stay in neighborhood survey questions. See Table 1 and Appendix Table 10 for a detailed definition of the variables. All regressions use robust standard errors. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 4

Summary Statistics for Treatment vs Control Households in the **Qualitative** Sample

	Control		Treatment		P-Value of T-C Difference
	Mean (1)	N (2)	Mean (3)	N (4)	(8)
A. Head of Household Demographics					
Age	32.24	21	35.13	89	0.101
Annual Household Income ($)	17571.43	21	20247.19	89	0.380
% Speak English (w/o Translator)	80.95	21	87.64	89	0.384
% Born Outside the U.S.	33.33	21	31.46	89	0.878
% Black Non-Hispanic	70.00	20	48.31	89	0.098*
% White Non-Hispanic	15.00	20	23.60	89	0.340
% Hispanic	5.00	20	7.87	89	0.506
% Asian Non-Hispanic	0.00	20	3.37	89	0.090*
% Female Head of Household	80.95	21	70.59	85	0.518
% Married Head of Household	9.52	21	9.41	85	0.729
% Less than High School Grad	33.33	21	15.73	89	0.162
% High School Degree	33.33	21	30.34	89	0.697
% Attended Some College	28.57	21	48.31	89	0.082*
% BA or more	4.76	21	5.62	89	0.951
% Homeless	23.81	21	12.36	89	0.291
% Currently Working	61.90	21	51.69	89	0.317
% Works Full-Time (Over 35 Hours/Week)	28.57	21	26.97	89	0.734
% Commute > 30 min to Work	23.08	13	45.65	46	0.276
% with Car and Driver's License	47.62	21	68.54	89	0.133
Number of Children	1.95	21	2.16	89	0.434
Children's Average Age	5.76	21	7.08	87	0.078*
B. Neighborhood-Related Questions					
% Starting in High-Opportunity Tract	11.11	18	14.93	67	0.662
% Satisfied with Current Neighborhood	40.00	20	52.44	82	0.410
% Would Leave Neighborhood if Got Voucher	55.00	20	52.44	82	0.926
% Feel They Could Find Place in New Neighborhood	63.16	19	59.26	81	0.809
% Could Pay for a Move	38.10	21	29.21	89	0.612
% Good with Moving to Racially Diff Neighborhood	90.48	21	67.05	88	0.002***
% Good with Moving to Specific Neighborhood in Opportunity Area	57.14	21	67.42	89	0.504
% Considering Different School for Any Child	80.00	15	61.43	70	0.136
% Unsatisfied with Any Child's Current School	20.00	15	20.00	70	0.930
% Primary Motivation Schools	33.33	21	34.83	89	0.952
% Primary Motivation Safety	19.05	21	20.22	89	0.830
% Primary Motivation Bigger/Better Home	14.29	21	20.22	89	0.558
C. Characteristics of Origin Neighborhood (Census Tract)					
Forecasted Mean Household Income Rank (p=25)	45.82	18	45.48	67	0.630
Incarceration Rate (p=25)	2.06	21	2.20	86	0.583
Teen Birth Rate (Women; p=25)	23.43	21	22.89	86	0.879
% in Poverty (2016 ACS)	16.96	21	17.92	86	0.613
% Black (ACS 2013-2017)	13.53	21	12.15	86	0.664
% Low-Inc. 3rd Graders Proficient in Math (2015)	40.17	21	40.39	85	0.965
% in Extreme Poverty Tract (2016 ACS)	4.76	21	0.00	86	0.313

F-Tests	F-Statistic	P-Value	N
Unconditional on Lease-up	0.762	0.815	110
Conditional on Lease-up	0.677	0.854	70

Notes: This table replicates the summary statistics in Table 1, but restricts the sample to families who participated in the qualitative survey defined in Appendix Table 3. All regressions use robust standard errors. See Table 1 for further details. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 5
Calculation of Lifetime Earnings Effect of CMTO

(1) Average Upward Mobility (in ranks) in control group destinations	44.41
(2) [Translated to 2015 USD]	35,816.78
(3) Treatment effect (TOT) on Upward Mobility (in ranks)	5.26
(4) Estimated causal effect of move from birth [= 62% of (3)]	3.26
(5) Expected Upward Mobility (in ranks) for treated [= (1) + (4)]	47.67
(6) [Translated to 2015 USD]	39,538.81
(7) Causal effect of CMTO on yearly income at age 34 (2015 USD) [= (6) - (2)]	3,722.02
(8) Avg family income at age 34 (2015 USD, from ACS)	64,160.33
(9) Undiscounted income over the lifecycle from ACS, 0.5% income growth (2015 USD)	3,614,277.80
(10) Impact as % of avg family income in ACS [= (7) / (8)]	5.80
(11) Causal treatment effect on undiscounted lifetime income (USD) [= (10) * (9)]	210,000.00
(12) Discounted income over the lifecycle from ACS, 0.5% income growth (2015vUSD)	1,468,756.30
(13) Causal treatment effect on discounted lifetime income (USD) [= (10) * (12)]	85,000.00

Notes: This table outlines the steps we use to translate our estimated treatment effects into lifetime earnings effects for the children whose families moved to opportunity neighborhoods as a result of CMTO. We estimate the impact on incomes for a child that moved to an opportunity neighborhood at birth. Row (1) presents the average Upward Mobility (i.e. the family income rank at age 34 of children, based on their childhood neighborhood, for families at the 25th percentile of the parental income distribution) corresponding to the control group destinations. Row (2) then reports the translation of this level into 2015 USD. Row (3) presents the treatment effect of CMTO on Upward Mobility for those who moved to an opportunity neighborhood (TOT). Row (4) multiplies this effect by 62%, which uses the estimate from Chetty et al. (2018) that children who move at birth to a neighborhood with 1 rank higher upward mobility grow up to have an income rank that is 0.62 units higher. Row (5) presents the sum of this effect and the control group mean. Row 6 translates this into 2015 USD. Row (7) computes the difference in expected income levels between the treated and untreated groups. Row (8) reports the mean family income (individual income plus spousal income for married couples, to correspond to our measure of family income in the Opportunity Atlas) from the 2015 ACS at age 34. Row (9) presents the undiscounted sum of mean family income in the 2015 ACS summing across all ages but assuming 0.5% wage growth from birth. Row (10) computes the percentage impact on incomes by dividing (7) over (8). Row (11) computes the impact on lifetime undiscounted income assuming the percent impact over the life cycle is constant. Rows (12) and (13) compute the impact on discounted income. Row (12) presents mean income discounted over the life cycle at 2%, assuming 0.5% income growth from birth. Row (13) computes the impact on discounted income, again assuming the percent impact over the life cycle is constant.

Appendix Table 6
Heterogeneity of Treatment Effects on Lease-up Rates

	Lease-up Rates (%)					
	Control Mean	Treatment Mean	Treatment Effect	SE	N	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
A. Pooled and by Housing Authority						
All Families	84.2	87.8	3.6	4.2	274	0.396
All Families (Controls)	84.2	87.6	3.4	4.6	274	0.462
Seattle Housing Authority	81.0	84.1	3.2	6.8	126	0.641
King County Housing Authority	87.1	91.0	3.9	5.2	148	0.454
B. By Head of Household Demographic Characteristics						
Black Non-Hispanic	84.6	88.1	3.5	5.9	134	0.556
White Non-Hispanic	86.2	87.7	1.5	8.3	64	0.856
Hispanic	92.3	80.5	-11.8	14.4	24	0.411
Other Race/Ethnicity	81.0	90.3	9.3	11.0	45	0.397
Born Outside the U.S.	88.0	86.4	-1.6	6.8	100	0.812
Born in the U.S.	81.7	88.7	7.0	5.4	173	0.195
English Isn't Primary Language	88.9	85.2	-3.7	9.5	54	0.695
English Is Primary Language	82.9	88.3	5.4	4.7	219	0.251
20 years or more in Seattle/King County	83.0	89.0	5.9	6.5	117	0.359
Less than 20 years in Seattle/King County	84.8	86.9	2.1	5.6	156	0.704
Started in High Opportunity Tract	100.0	92.2	-7.8	8.0	21	0.327
Didn't Start in High Opportunity Tract	85.4	88.9	3.5	4.8	193	0.471
Income < $19,000 (sample median)	81.0	85.8	4.9	6.6	128	0.458
Income > $19,000 (sample median)	86.8	90.9	4.1	5.5	135	0.448
No College	81.8	90.4	8.6	5.9	139	0.143
Some College or More	86.8	85.2	-1.6	6.1	132	0.791
Currently Working	83.3	88.2	4.8	5.6	154	0.387
Currently Not Working	85.4	87.4	2.0	6.5	119	0.757
Uses Child Care	84.1	86.3	2.2	6.0	139	0.708
Doesn't Use Childcare	84.1	88.8	4.7	6.0	134	0.432
C. By Perceptions About Moving at Baseline						
Feels Good About Moving to an Opportunity Area	85.9	91.7	5.8	4.5	198	0.197
Doesn't Feel Good About Moving to an Opportunity Area	78.8	79.2	0.4	9.7	75	0.964
Satisfied With Current Neighborhood	78.1	86.2	8.1	6.5	143	0.211
Unsatisfied/Indifferent With Current Neighborhood	90.6	89.4	-1.2	5.5	121	0.822
Sure Wants to Leave Current Neighborhood	84.5	85.5	1.0	6.3	133	0.879
Sure Wants to Stay in Current Neighborhood or Indifferent	84.2	89.0	4.8	6.1	131	0.427
Feels Good About Moving to Racially Different Neighborhood	87.0	88.3	1.2	4.5	211	0.789
Feels Bad/Indifferent About Moving to Racially Different Neighborhood	73.9	86.4	12.5	11.0	60	0.258
Sure Could Pay for Moving Expenses	82.9	91.5	8.6	7.7	75	0.267
Not Sure Could Pay for a Moving Expenses	84.6	86.8	2.2	5.0	198	0.666
Sure Could Find a New Place	83.3	91.3	7.9	6.0	123	0.183
Not Sure Could Find a New Place	84.6	83.7	-0.9	6.7	121	0.893
D. By Children Characteristics						
Mean Children Age Above 6 years	80.6	86.7	6.1	6.3	142	0.332
Mean Children Age Below 6 years	87.3	90.0	2.7	5.7	126	0.637
More than 2 Children	83.7	88.5	4.8	8.5	85	0.578
2 Children or Less	84.4	88.5	4.1	5.2	189	0.432
Considering Different Schools	84.8	81.7	-3.1	6.7	126	0.645
Not Considering Different Schools	79.4	91.7	12.3	8.0	83	0.125

Notes: This table replicates Table 2 using lease-up rates as the outcome. See Table 2 for details.

Appendix Table 7
Treatment Effects on Neighborhood and Housing Unit Characteristics

A. Neighborhood Characteristics	Control Mean	Treatment Mean	Treatment Effect	Standard Error of Treatment Effect	Treatment Effect in Standard Deviations	Standard Error of Treatment Effect in Standard Deviations
Mean Commute Time (Minutes)	29.92	28.24	-1.68***	0.41	-0.48	0.12
Distance to City Hall of Largest City in CZ (Miles)	12.39	10.92	-1.46**	0.72	-0.21	0.10
Distance Moved (Miles, Topcoded at 50 Miles)	10.62	10.58	-0.04	1.38	0.00	0.12
% Commute < 15 Mins (2016)	16.34	17.25	0.91	0.74	0.15	0.12
# Jobs For No HS Degree, 1 Mile Radius	162.64	182.26	19.62	37.46	0.07	0.13
Resident Demographics						
% White (2017)	50.27	56.76	6.49***	2.11	0.37	0.12
% Black (2017)	11.13	7.44	-3.69***	0.98	-0.44	0.12
% Hispanic (2017)	13.48	10.25	-3.23***	0.92	-0.40	0.11
% Foreign-Born (2016)	23.76	24.29	0.53	1.21	0.05	0.12
% Married (2010)	46.39	50.12	3.73***	1.24	0.34	0.11
% of Children with Single Parents (2013-2017)	33.62	28.76	-4.86***	1.70	-0.34	0.12
% >= College Education (2017)	36.07	47.39	11.32***	2.17	0.58	0.11
Population Density (2010, # People per Square Mile)	2,304.50	2,306.64	2.14	171.94	0.00	0.11
Tract Income and Other Characteristics						
Median HH Income (2017)	68,292.52	84,702.16	16409.64***	3,432.36	0.54	0.11
% Labor Force Participation (2010)	0.71	0.69	-0.02**	0.01	-0.27	0.12
% Poverty (2017)	14.55	12.30	-2.25**	1.00	-0.26	0.12
Median Home Value (2010)	334,009.16	413,917.50	79908.36***	15,009.31	0.60	0.11
Mail Response for Households	76.68	77.94	1.26**	0.55	0.28	0.12
Theil Index of Racial Segregation	0.12	0.12	-0.01	0.01	-0.11	0.12
Other Indices of Opportunity						
Kirwan Overall Child Opportunity Score	-0.12	0.13	0.25***	0.05	0.57	0.12
Kirwan Educational Subscore	-0.27	0.15	0.42***	0.08	0.63	0.11
Kirwan Health/Environment Subscore	0.01	0.11	0.10***	0.04	0.33	0.12
Kirwan Social/Economic Opportunity Subscore	-0.10	0.12	0.22***	0.07	0.40	0.12
HUD Transit Index	80.91	80.88	-0.03	1.08	0.00	0.12
Environmental Health Index	11.64	13.30	1.65	2.07	0.10	0.13
Children's Long-Term Outcomes						
KIR Race Pooled, Parents 25th %	46.27	47.85	1.58***	0.44	0.42	0.12
KFR Race Pooled, Parents 25th %	44.43	46.52	2.09***	0.50	0.47	0.11
KFR White, Parents 25th %	46.37	48.21	1.83***	0.62	0.34	0.12
% Low-Income Female Teen Births, Parents 25th %	21.61	16.38	-5.23***	0.96	-0.62	0.11
% Long-Run Low-Income Incarceration, Parents 25th %	2.14	1.62	-0.52***	0.15	-0.40	0.12
B. Unit Characteristics						
Square Feet	1,278.83	1,419.91	141.08	110.12	0.22	0.17
Year Built	1,985.91	1,981.68	-4.23	4.02	-0.18	0.17
Household Appliance Index	0.63	0.64	0.00	0.05	0.01	0.13
Baths	1.89	2.12	0.23**	0.12	0.33	0.17
Share With Air Conditioning	14.29	14.23	-0.05	2.79	0.00	0.09
Total Rent Paid to Owner	1,795.23	1,990.00	194.77***	72.70	0.34	0.13
Rent Paid by PHA	1,380.71	1,640.29	259.58***	75.57	0.43	0.12
Utilities Paid (estimate by PHAs)	137.12	169.50	32.38***	11.04	0.38	0.13
Total Out of Pocket Expenditures (Tenant)	517.02	479.47	-37.55	72.65	-0.10	0.20

Notes: This table reports estimates from seoarate regressions of neighborhood and housing unit characteristics on an indicator from treatment status. All regressions control for PHA and use robust standard errors. Panel A shows treatment effects on neighborhood characteristics unconditional on lease-up, and Panel B shows treatment effects on unit characteristics after conditioning the sample on lease-up because these characteristics are only available for those who leased up. The Household Appliance Index is the sum of six indicators for common appliances observed in the rental listings: microwaves; refrigerators; washers; dryers; dishwashers; and garbage disposal. For the distance moved variable, distances were computed using tract centroids, so households who move to the same tract as their origin tract are indicated as having moved 0 miles. Distance moved was topcoded at 50 miles, and households that did not lease up were coded as having moved 0 miles. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 8
Neighborhood Characteristics of High vs. Low Opportunity Areas

	Population Tract Averages, Weighted by Children in Families Below Median Income				
	All Tracts (1)	Non-High-Opportunity Tracts (2)	High-Opportunity Tracts (3)	High-Opportunity Tracts Moved Into By CMTO Participants (4)	Z-Score for (3)-(4) (5)
Mean Commute Time (Minutes)	29.01	29.62	26.86	27.18	0.08
Distance to City Hall of Largest City in CZ (Miles)	11.84	12.21	10.51	10.28	-0.03
% Commute < 15 Mins (2016)	17.47	17.14	18.65	17.59	-0.15
# Jobs For No HS Degree, 1 Mile Radius	189.62	199.07	156.21	168.22	0.03
Resident Demographics					
% White (2017)	53.81	51.16	63.17	62.24	-0.05
% Black (2017)	9.11	10.74	3.35	4.28	0.11
% Hispanic (2017)	12.78	14.36	7.20	7.16	0.00
% Foreign-Born (2016)	24.19	23.99	24.90	23.94	-0.08
% Married (2010)	50.24	48.29	57.14	54.80	-0.22
% of Children with Single Parents (2013-2017)	29.61	32.60	19.05	22.21	0.22
% >= College Education (2017)	39.33	34.21	57.46	58.24	0.04
Population Density (2010, # People per Square Mile)	2174.42	2255.41	1887.98	2005.32	0.08
Tract Income and Other Characteristics					
Median HH Income (2017)	75986.53	68269.98	103276.59	103351.29	0.00
% Labor Force Participation (2010)	69.80	69.82	69.76	69.79	0.01
% Poverty (2017)	13.00	14.32	8.35	9.57	0.14
Median Home Value (2010)	366668.91	334382.78	481908.56	486582.91	0.04
Mail Response for Households	77.29	76.57	79.84	78.81	-0.19
Theil Index of Racial Segregation	0.13	0.14	0.12	0.11	-0.20
Other Indices of Opportunity					
Kirwan Overall Child Opportunity Score	-0.04	-0.15	0.34	0.37	0.07
Kirwan Educational Subscore	-0.13	-0.31	0.51	0.56	0.07
Kirwan Health/Environment Subscore	0.05	0.02	0.16	0.19	0.13
Kirwan Social/Economic Opportunity Subscore	-0.05	-0.17	0.35	0.36	0.01
HUD Transit Index	79.56	79.72	78.99	80.03	0.09
Environmental Health Index	13.22	12.50	15.53	17.13	0.09
Children's Long-Term Outcomes					
KIR Race Pooled, Parents 25th %	46.73	45.70	50.37	49.82	-0.14
KFR Race Pooled, Parents 25th %	45.50	44.16	50.27	48.99	-0.27
% Low-Income Female Teen Births, Parents 25th %	19.67	22.06	11.25	10.73	-0.06
% Long-Run Low-Income Incarceration, Parents 25th %	1.92	2.11	1.28	1.27	-0.01

Notes: This table shows neighborhood characteristics for different groups of Census tracts. The first three columns show averages (weighted by the number of people within tracts with below median income) for all tracts, low-opportunity tracts, and high-opportunity tracts, respectively. The fourth column shows averages for high opportunity tracts to which CMTO participants moved, weighted by the number of CMTO participants that moved to each tract. The final column shows the Z-score of the difference between the weighted average for all high opportunity tracts and the weighted average of high opportunity tracts to which CMTO families moved.

Appendix Table 9
Intervention Dosage: Treated Households' Usage of CMTO Services

	Pooled		Moved to Low Opportunity Tract		Moved to High Opportunity Tract	
	N (1)	Mean (2)	N (3)	Mean (4)	N (5)	Mean (6)
A. Usage of Search Assistance Services						
Total hours in contact with non-profit or PHA staff	141	6.31	47	4.70	77	7.28
Hours in contact non-profit or PHA staff per month	141	1.61	47	1.10	77	2.09
Percent that received search assistance	141	97.87	47	95.74	77	98.70
Percent that received rental application coaching	141	89.36	47	82.98	77	92.21
Percent that did a neighborhood tour	141	22.70	47	17.02	77	27.27
Percent that visited locations	141	22.70	47	10.64	77	31.17
B. Linkage to Units and Landlords						
Percent linked to a unit through the MIS system	141	47.52	47	6.38	77	81.82
Percent linked to a unit of a landlord contacted by non-profit staff	141	29.79	47	2.13	77	51.95
C. Financial Assistance						
Percent that received any financial assistance (%)	141	65.96	47	27.66	77	96.10
Total amount of assistance among families that received financial assistance ($)	92	1640	13	317	74	1954
Percent that received screening fee assistance (%)	141	59.57	47	25.53	77	87.01
Amount of screening fee assistance among families that received screening fee assistance ($)	84	75	12	66	67	76
Percent that received deposit assistance (%)	141	55.32	47	4.26	77	94.81
Amount of deposit assistance among families that received deposit assistance ($)	76	1566	1	2200	73	1588

D. Correlations Between Usage of CMTO Services

	Time Meeting with CMTO Staff	Financial Assistance	Unit Found Through Housing Locator
Time Meeting with CMTO Staff	1		
Financial Assistance	0.19	1	
Unit Found Through Housing Search Assistance	0.09	-0.08	1

Notes: This table shows service usage statistics for families in the CMTO treatment group as recorded by the housing authorities and non-profit staff running the CMTO services. In Panel A, time meeting with CMTO staff was estimated based on the lengths of specific interactions, which includes in-person meetings and phone calls, and the share of households receiving specific services was derived from contact logs between the non-profit staff and the households. Links to units and landlords come from the platform set up to facilitate interactions between landlords, non-profit staff and households (called MIS). Financial assistance includes assitance to defray moving costs, such as screening fees, security deposits, and holding fees. We restrict the sample to the CMTO treatment group families that recieved vouchers before January 1 2019. In Columns (1) and (2), we pool all CMTO treatment families, in Columns (3) and (4) we restrict the sample to treatment group families who moved to low-opportunity tracts, and in Columns (5) and (6) we restrict the sample to treatment group families who moved to high-opportunity tracts. Panel D shows Pearson correlations between covariates of different CMTO service categories among families in the treatment group whose voucher was issued to January 1, 2019 and who moved to high-opportunity areas.

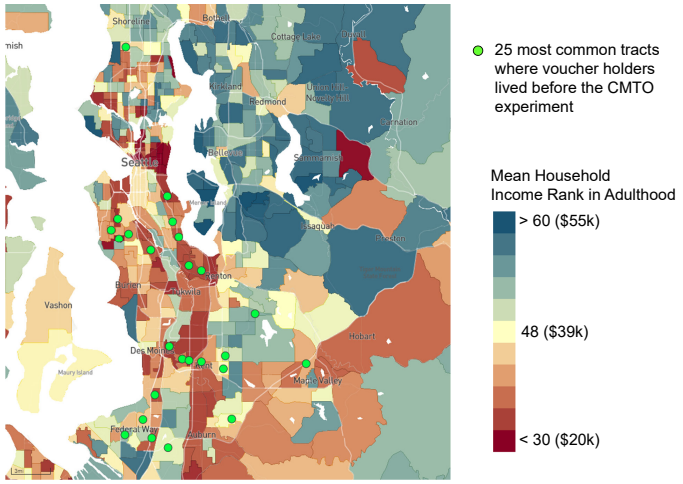
Appendix Table 10
Baseline Survey Questions and Coding of Variables

	Instrument Reference	Variable Coding Details
A. Baseline Variables		
% Speak English	Q7. Is an interpreter or translation service being used for survey administration?	
% Born Outside the U.S.	Q10. In what country were you born?	
% Less than High School Grad	Q22. What is the highest level of education that you have completed?	= Grade 9 or less OR Grade 10 or grade 11 OR Attended grade 12 but did not receive high school diploma or GED certificate
% High School Degree	Q22. What is the highest level of education that you have completed?	= GED certificate OR High school diploma
% Attended Some College	Q22. What is the highest level of education that you have completed?	= Some college or Associate's or two-year degree
% BA or more	Q22. What is the highest level of education that you have completed?	= Four-year college degree or higher
% Homeless	Q14. Where do you currently live?	= Homeless or in a group shelter
% Currently Working	Q15. Are you currently working for pay?	
% Commute > 30 min to Work	Q17. How long does it take you to get to your job?	= 31 to 45 minutes OR 46 minutes to one hour OR More than one hour
% with Car and Driver's License	Q19. Do you have a valid driver's license? AND Q20. Do you have access to a car that runs?	
% Satisfied with Current Neighborhood	Q32. Which of the following statements best describes how satisfied you are with your current neighborhood?	= Very satisfied OR Somewhat satisfied
% Would Leave Neighborhood if Got Voucher	Q33. Which of the following statements best describes how you feel about staying in your current neighborhood if you receive a voucher?	= Somewhat sure I want to move to a different neighborhood OR Very sure I want to move to a different neighborhood
% Feel They Could Find Place in New Neighborhood	Q47: How sure are you that you could find a home in a new neighborhood in [Seattle/King County]?	= Very sure OR Fairly sure
% Could Pay for a Move	Q50. How sure are you that you will be able to pay for any moving expenses?	= Very sure OR Fairly sure
% Good with moving to Racially Diff Neighborhood	Q43. How would you feel about moving to a neighborhood where almost all of the other residents are of a different race or ethnicity than your own?	= Very good OR Good
% Good with Moving to Specific Neighborhood in Opportunity Area	Q36. If a home or apartment were to be available, how would you feel about moving to ___? Would you feel… AND Q39. How would you feel about moving to ___? AND Q42. How would you feel about moving to neighborhoods ___?	= Very good OR Good [in at least one of the questions]
Number of Children	Remind me how many children do you have?	
Children's Average Age	Q53. What is the child's age?	
% Considering Different School for Any Child	Q58. Are you currently considering transferring him/her to a different school (or Pre-K/Pre-school program)?	= Yes [for at least one child]
% Unsatisfied with Any Child's Current School	Q57. How satisfied are you with his/her current school (or Pre-K/Pre-school program)?	= Somewhat unsatisfied OR Very unsatisfied [for at least one child]
20 years or more in Seattle/King County	Q13. How long have you lived in the Seattle or King County area in your lifetime?	
Uses Child Care	Q27. What types of child care do you use for your child or children? (Check all that apply)	
Feels Good About Moving to an Opportunity Area	see % Good with Moving to Specific Neighborhood in Opportunity Area	
Sure Wants to Leave Current Neighborhood	see % Would Leave Neighborhood if Got Voucher	
Sure Could Find a New Place	see % Feel They Could Find Place in New Neighborhood	
B. Public Housing Authority Data		
% Black / Hispanic / Latino / White	3k. Use code or codes at bottom of page that the family says best indicates each household member's race. Select as many codes as appropriate	
Income < $19,000	19h:The total dollar amounts listed in column 19f.	Note: 19f is income minus exclusions

Notes: This table presents definitions of the variables, which come from the baseline survey and from PHA administrative data (HUD form 50058).
The baseline questionnaire can be found here.

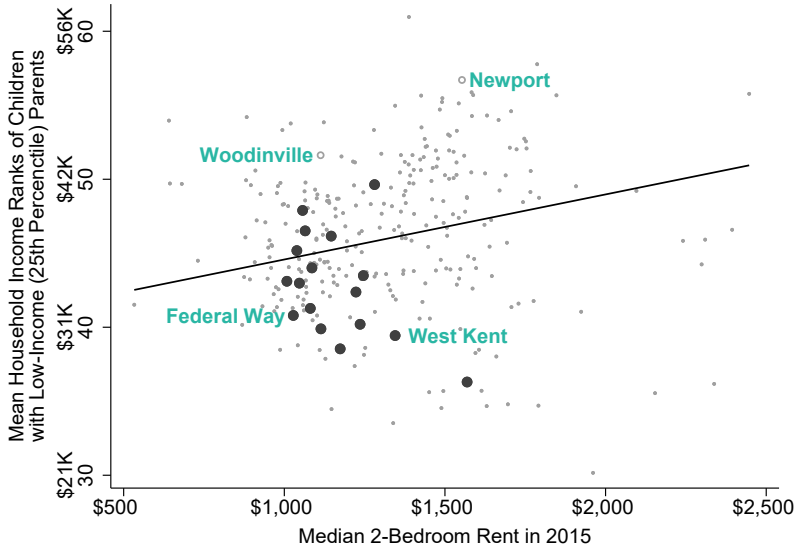
FIGURE 1: The Geography and Price of Opportunity in Seattle

A. Upward Mobility by Census Tract in Seattle and King County



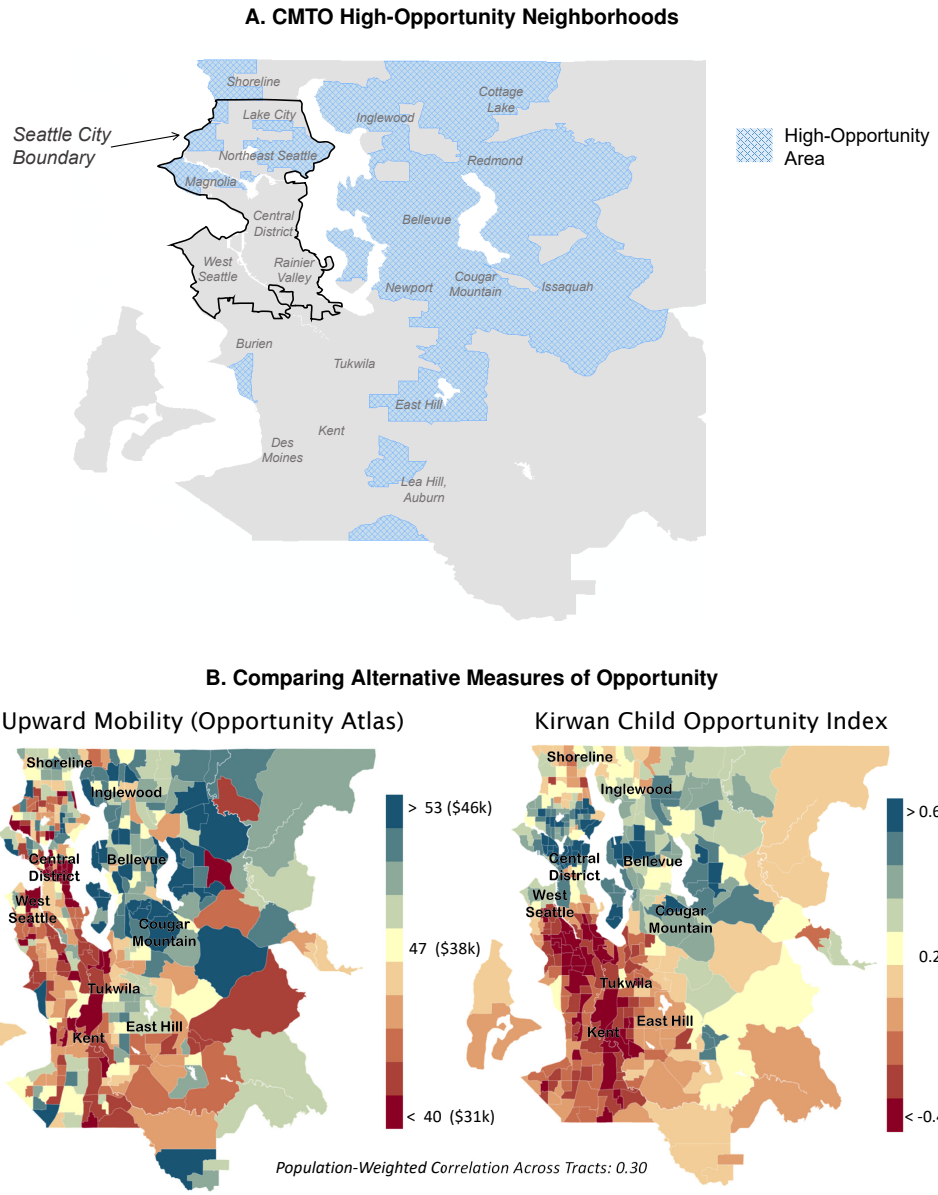
This map must be printed in color to be interpretable

B. Upward Mobility vs. Rents, by Tract



Notes: The map in Panel A maps the Opportunity Atlas estimates of mean household income ranks for children whose parents were at the 25th percentile of the national household income distribution (approximately $27,000) for the 1978-1983 birth cohort, which we refer to as upward mobility. This measure is estimated separately in each tract through the estimation procedure outlined in Chetty, Friedman, Hendren, Jones, and Porter (2018). Green dots represent the 25 tracts in which families with children using Housing Choice Vouchers represented the largest share of the tract population between 2015 and 2017, which is prior to the start of the CMTO experiment. Panel B presents a scatter plot comparing tract-level upward mobility vs. median rent for two-bedroom, renter-occupied units surveyed in the 2011-2015 American Community Survey. The inner numbers on the vertical axis show the Opportunity Atlas estimates of mean household income ranks depicted in Panel A, while the outer numbers on the vertical axis convert those ranks to 2015 dollars. The darker points represent the same 25 most common tracts in which voucher recipients lived prior to the CMTO experiment highlighted in Panel A (seven of the 25 most common tracts are not shown due to missing rental data). The black best-fit line is estimated using a regression of upward mobility on median rent for two-bedroom homes, weighted by the number of children growing up in households below the 50th percentile of the national income distribution in a tract. Federal Way and West Kent are two low-upward mobility tracts among the 25 most common tracts in which voucher recipients lived prior to the CMTO experiment. Woodinville and Newport, denoted by hollow points, are two high–upward mobility tracts with varying rents that that were not among the 25 most common tracts.

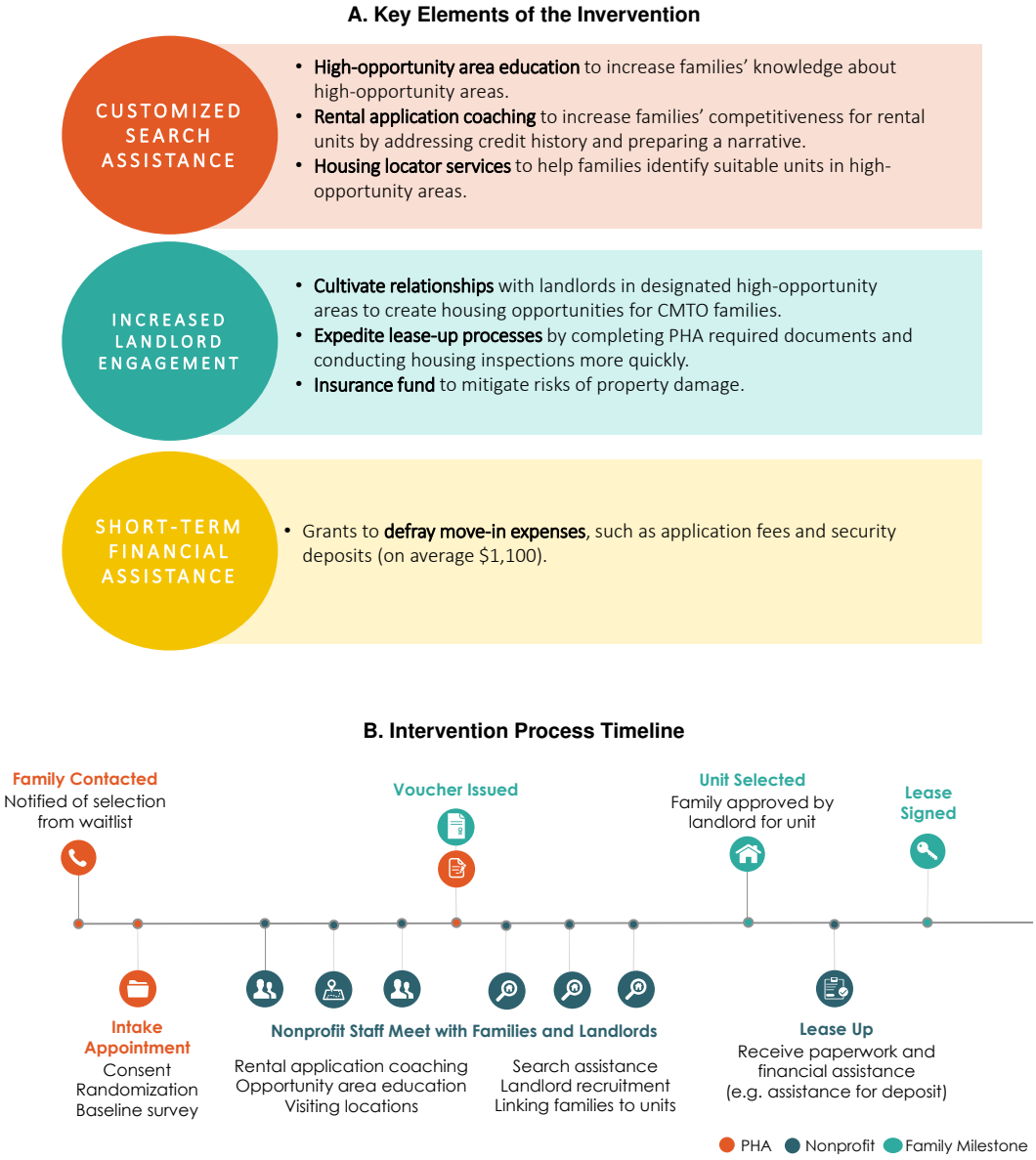
FIGURE 2: Definition of High-Opportunity Neighborhoods



These maps must be printed in color to be interpretable

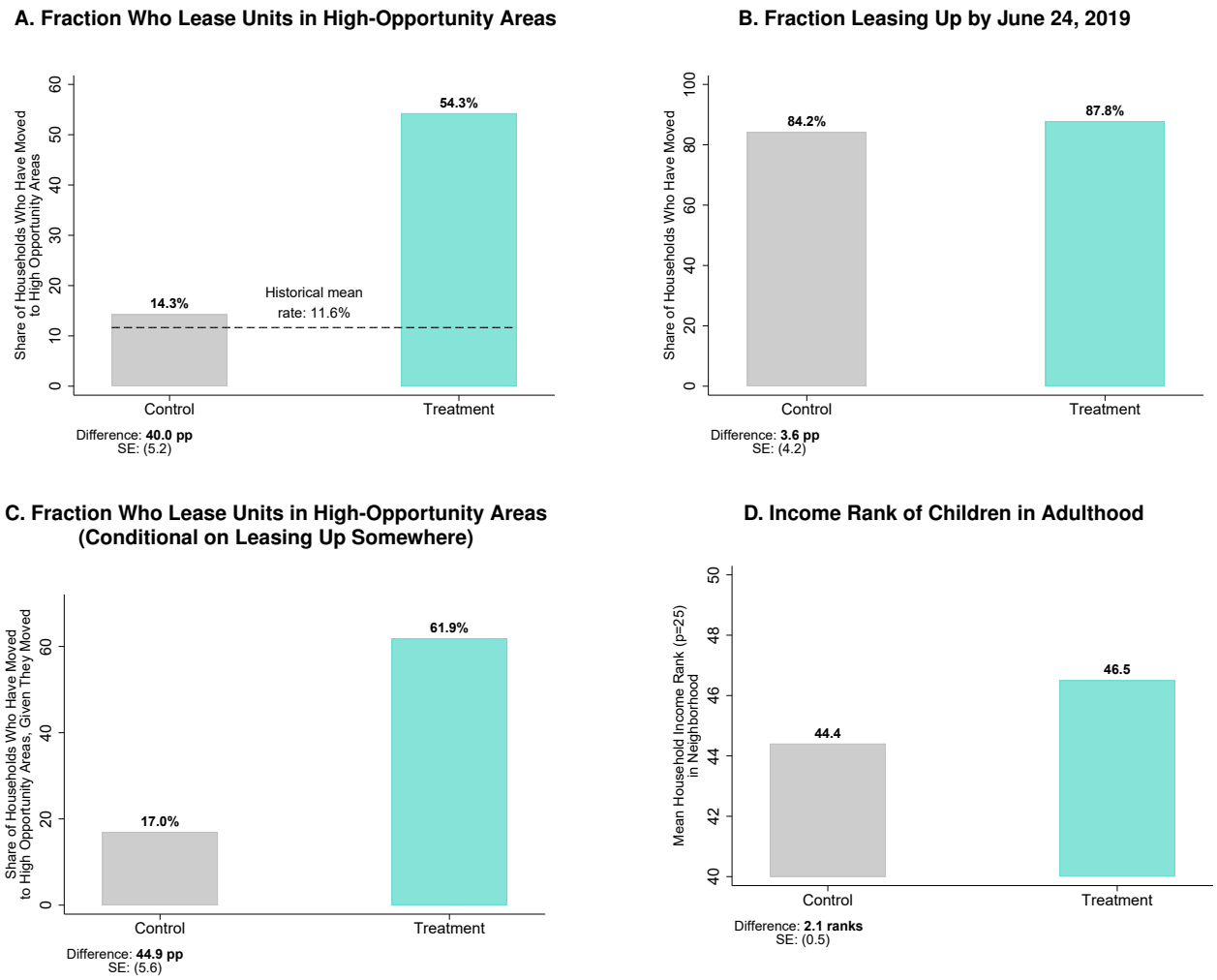
Notes: Panel A shows the tracts designated as high-opportunity areas in the CMTO experiment, which are shown in blue cross-hatch. Panel B compares upward mobility from the Opportunity Atlas to the Kirwan Child Opportunity Index. The Kirwan Child Opportunity Index is constructed by The Kirwan Institute for the Study of Race and Ethnicity and combines 19 components, measured between 2007 and 2013 from three subject domains (Educational Opportunity, Health and Environmental Opportunity, and Social and Economic Opportunity), into one index standardized according to the metropolitan area mean and standard deviation. The population-weighted correlation between the two measures across tracts is 0.30.

FIGURE 3: CMTO Program Structure



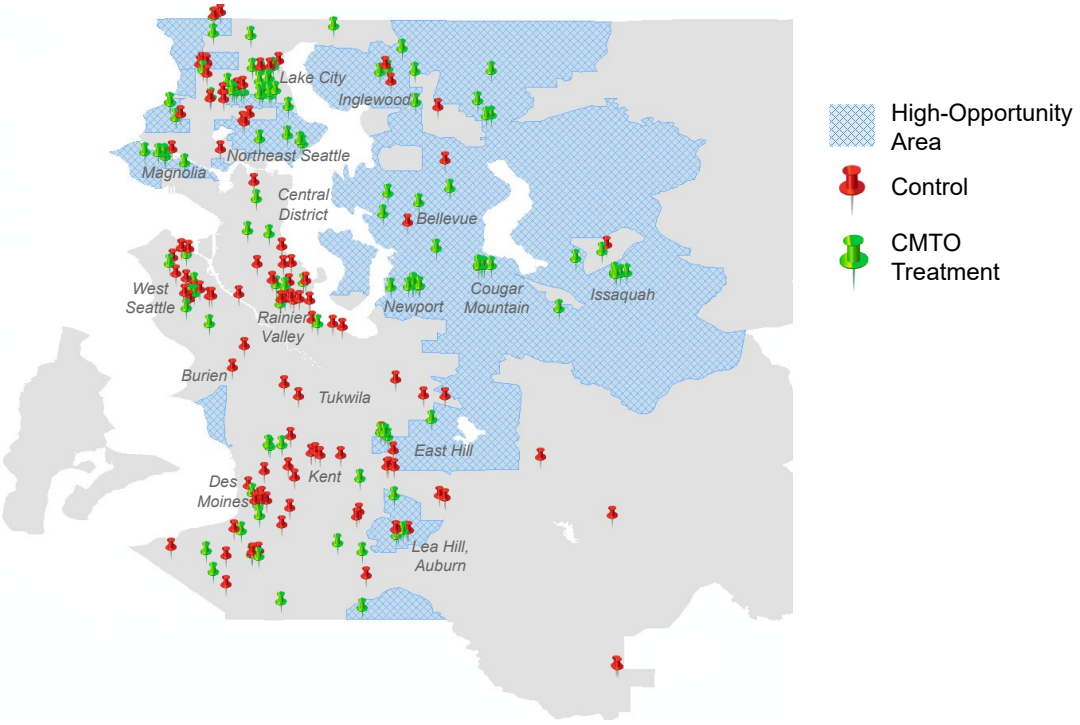
Notes: This figure describes the CMTO intervention. Panel A describes the components of the intervention: search assistance; increased landlord engagement; and short-term financial assistance. Panel B presents a stylized timeline of the treatment intervention from the perspective of a family in the treatment group.

FIGURE 4: CMTO Treatment Effects on Neighborhood Choice



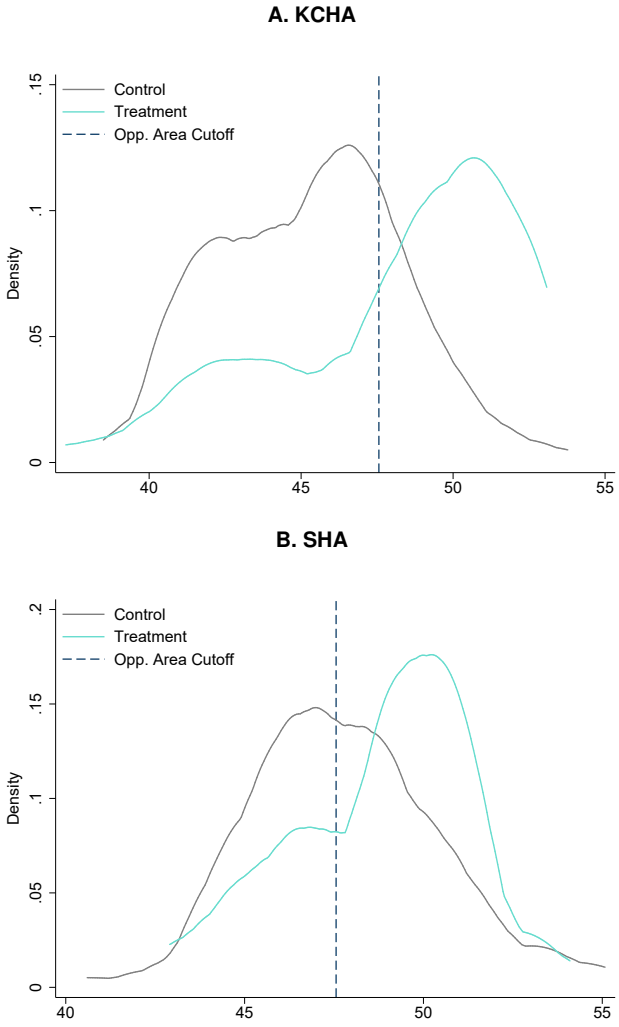
Notes: This figure presents CMTO treatment effects on neighborhood choice outcomes. Panel A presents the treatment effect on leasing homes in high opportunity areas. The dashed line represents the historical rate at which families who received vouchers from SHA and KCHA leased units in high opportunity areas between 2015 and 2017; Panel B presents the treatment effect on leasing up in any area; Panel C presents the treatment effect on leasing homes in high opportunity areas, conditional on leasing up; and Panel D presents the treatment effect on destination tract upward mobility, as measured in the Opportunity Atlas. The control means are calculated as the share of households moving to high opportunity areas within households in the control group. Treatment effects are estimated with a regression of moving to an opportunity neighborhood on PHA indicators and a treatment indicator for each demographic group. The treatment mean is calculated as the control mean plus the treatment effect, where the treatment effect is estimated from a regression of the dependent variable in the panel on assignment to the treatment group and a PHA indicator. All regressions use robust standard errors and all panels are restricted to households who were issued vouchers before January 1, 2019 and are based on lease-ups up to June 24, 2019.

FIGURE 5: Map of Destination Tracts for Voucher Recipients



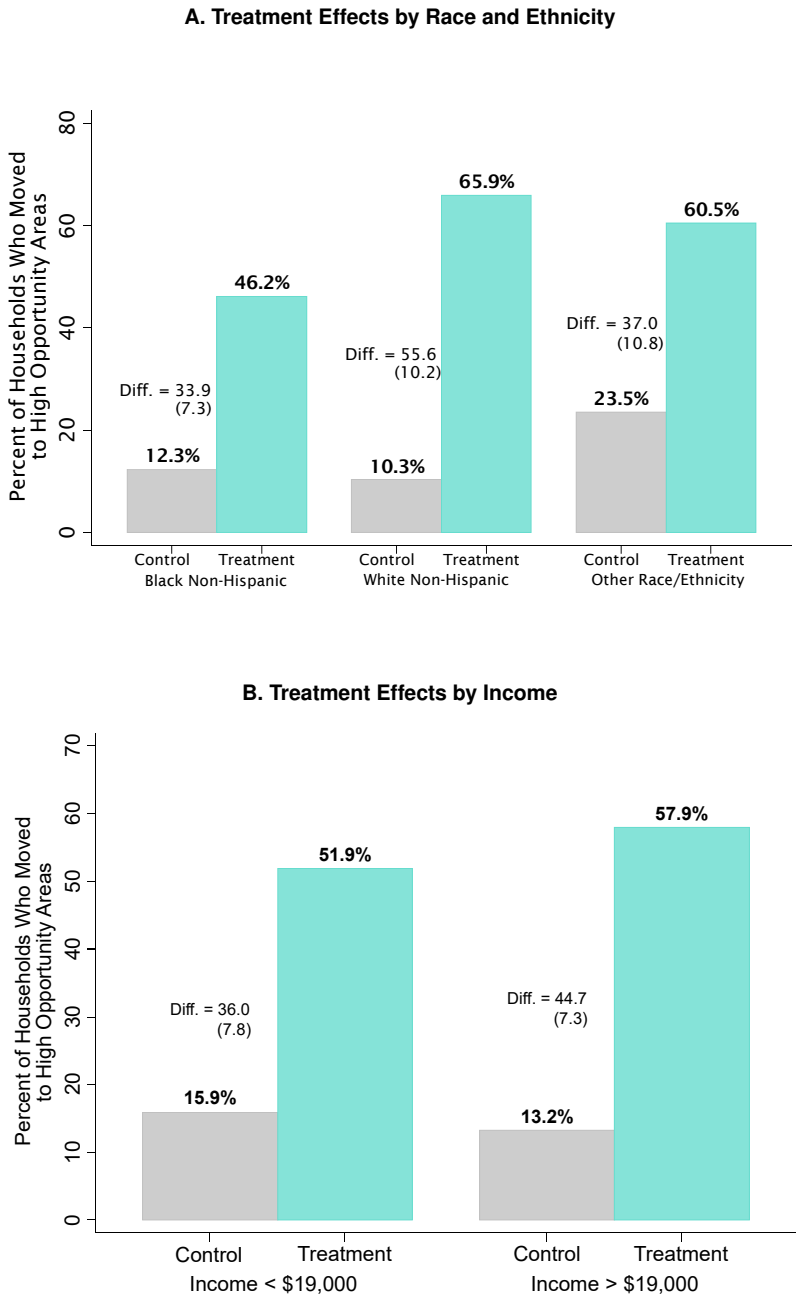
Notes: This figure presents a map of the destination tracts for families in the CMTO treatment and the control groups who moved using their vouchers. High-opportunity areas are highlighted in blue cross-hatch. Families who were issued vouchers in 2019 are excluded from the map. To protect confidentiality, the locations shown are approximated by introducing a small amount of random noise to the destination tract centroid.

FIGURE 6: Distribution of Tract-Level Upward Mobility for Treatment vs. Control Group



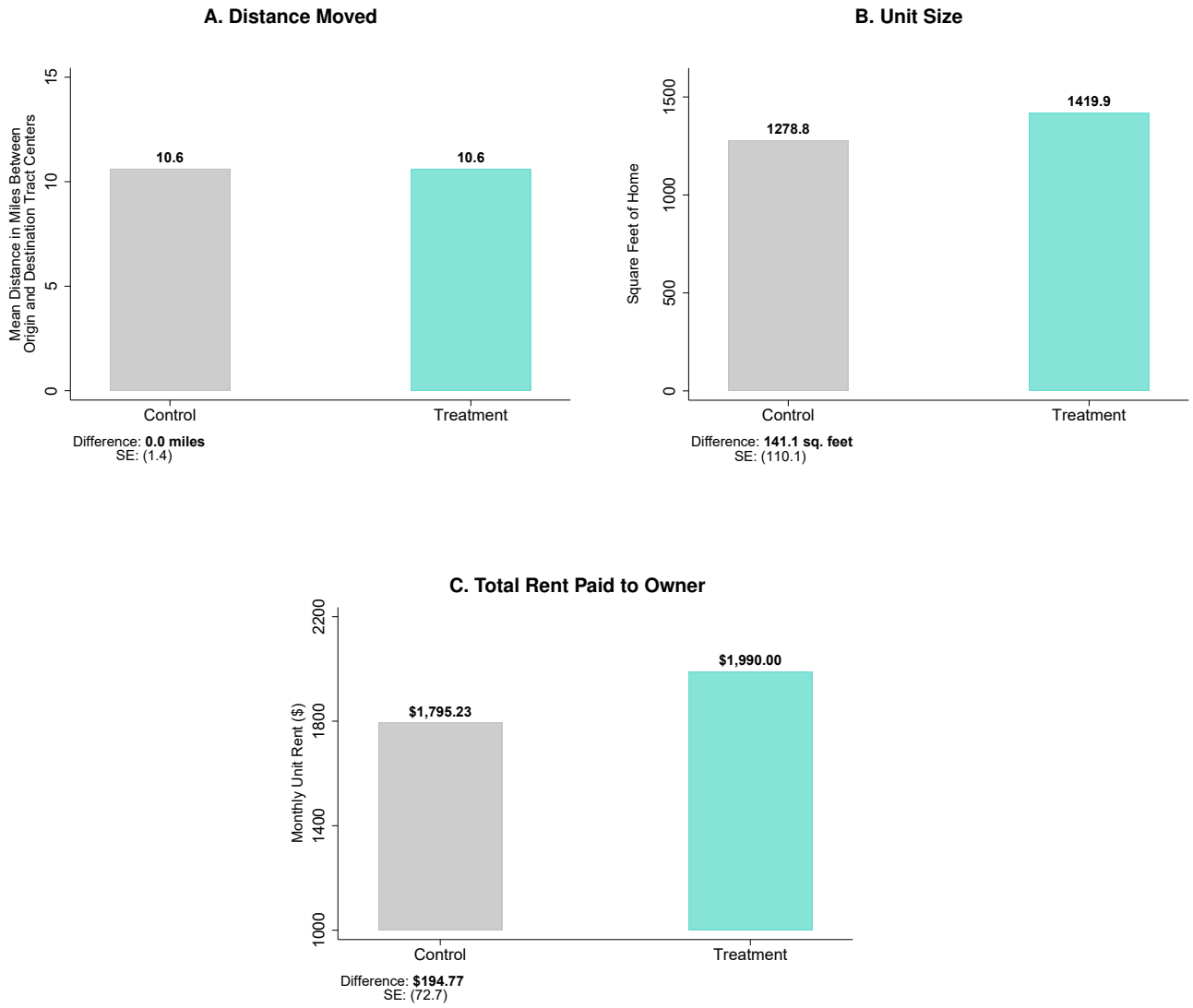
Notes: This figure presents kernel density plots for the tract-level unconditional forecasted household income rank for children growing up in the 25th percentile of the national income distribution, split by assignment to the CMTO treatment and control groups. Panel A presents the results for King County Housing Authority, while Panel B presents the results for Seattle Housing Authority. The blue line represents the treatment group, while the gray line represents the control group. The dotted line is mean forecasted household income rank weighted by the original IRS sample counts and centered within PHA. Both panels are restricted to households issued vouchers before January 1, 2019. Bandwidths are calculated to minimize integrated square error assuming the data is Gaussian and a Gaussian kernel is used.

FIGURE 7: Heterogeneity in Treatment Effects



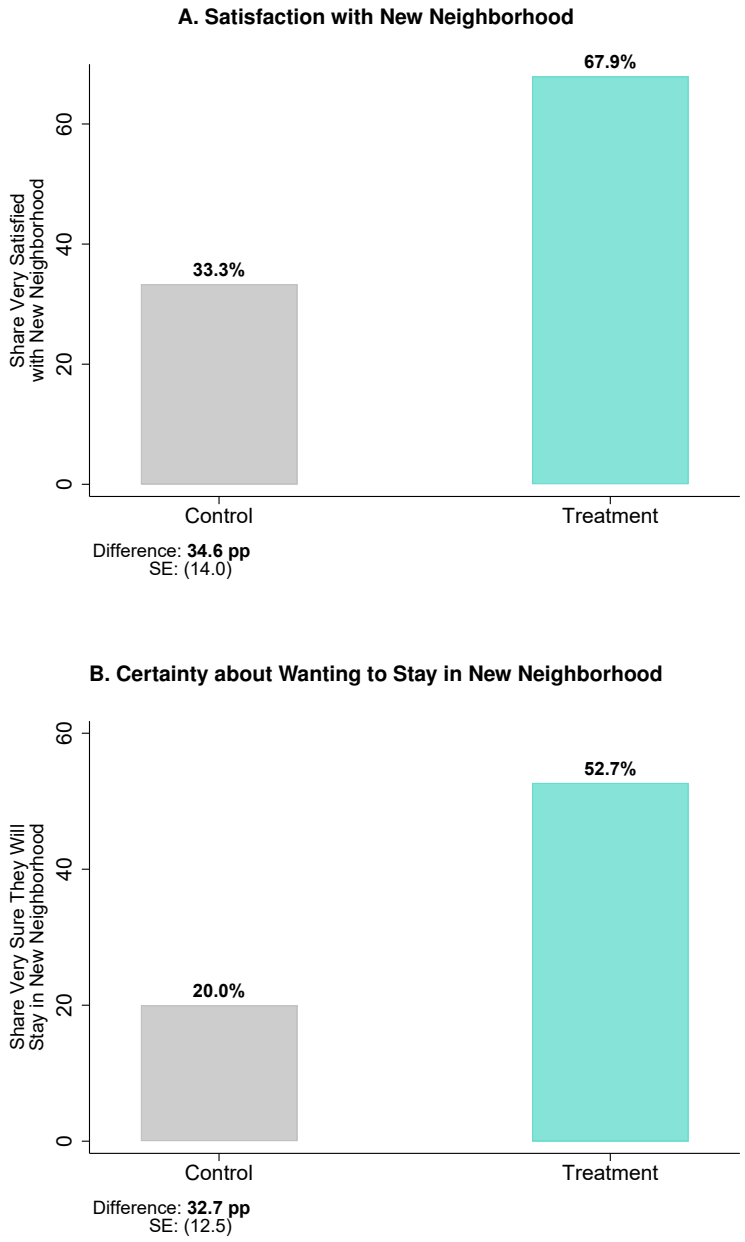
Notes: This figure presents estimates of treatment effects on the share of households moving to high opportunity areas by race/ethnicity and by income of the voucher holder. Panel A shows treatment effects by race and Panel B shows treatment effects by income. We restrict panel A to the 97% of participants who report their race and panel B to the 96% who report their income. The control means are calculated as the share of households moving to high opportunity areas within households in the control group. Treatment effects are estimated with a regression of moving to an opportunity neighborhood on PHA indicators and a treatment indicator for each demographic group. The treatment mean is calculated as the control mean plus the treatment effect, where the treatment effect is estimated from a regression of the dependent variable in the panel on assignment to the treatment group and a PHA indicator. These regressions are estimated separately for each subgroup. All regressions use robust standard errors, and all panels are restricted to households who were issued vouchers before January 1, 2019.

FIGURE 8: Treatment Effects on Neighborhood and Unit Quality



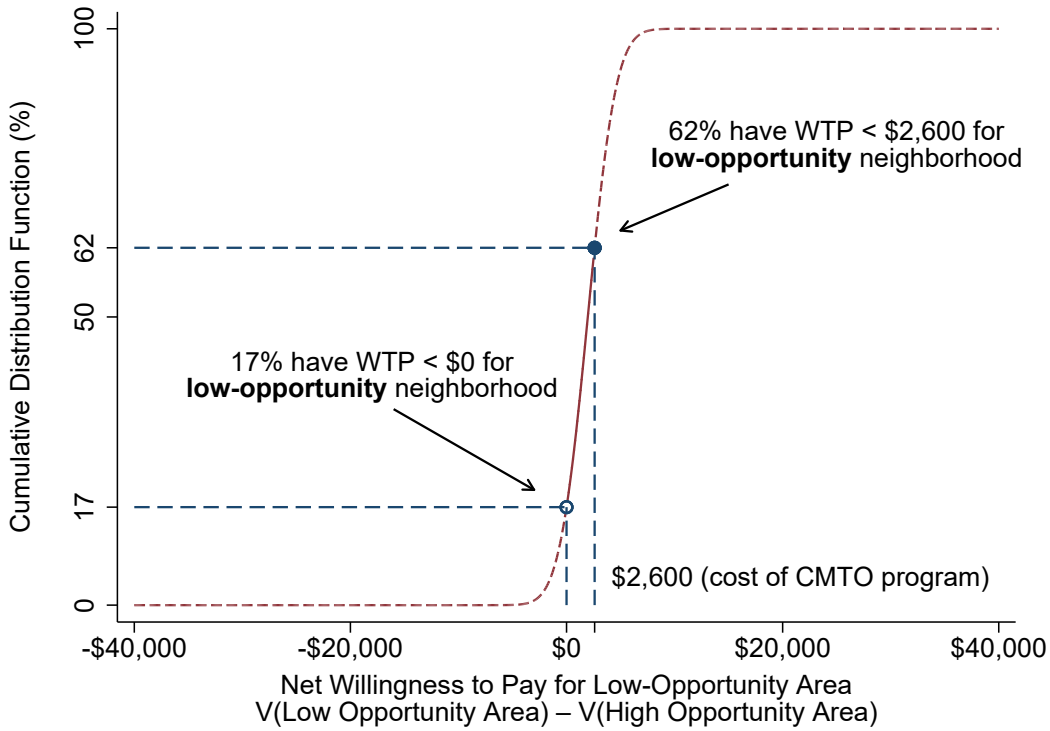
Notes: This figure presents CMTO treatment effects on the distance moved by participants, square footage of the unit families move to, and the total rent paid to the property owner for this unit. Panel A presents the average distance in miles between origin and destination tracts where we winsorize distance at 50 miles. Panel B presents the average square footage of the unit. Panel C presents the total rent paid to the property owner. The control means are calculated as the share of households moving to high opportunity areas within households in the control group. Treatment effects are estimated with a regression of moving to an opportunity neighborhood on PHA indicators and a treatment indicator for each demographic group. The treatment mean is calculated as the control mean plus the treatment effect, where the treatment effect is estimated from a regression of the dependent variable in the panel on assignment to the treatment group and a PHA indicator. The reported difference is the treatment effect, and the standard error on the difference is the robust standard error on the treatment coefficient in the regression.

FIGURE 9: Treatment Effects on Post-Move Neighborhood Satisfaction



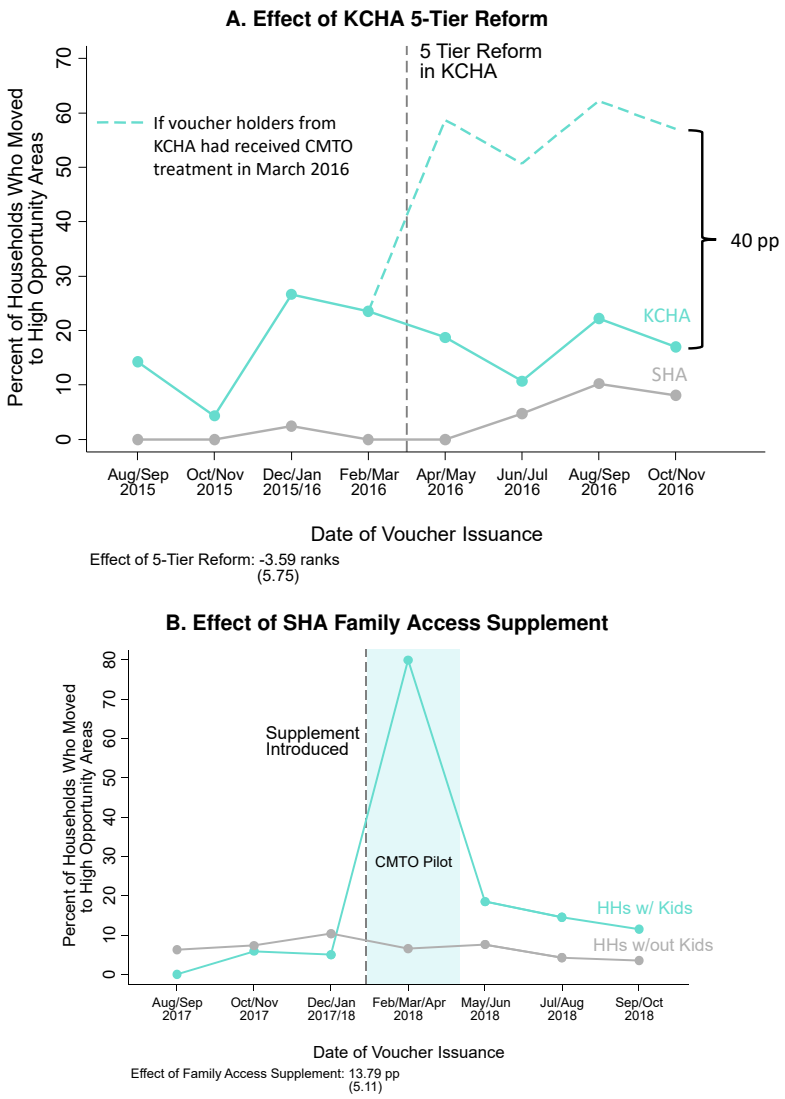
Notes: This figure shows treatment effects using data from a follow-up qualitative survey administrered to a random sample of CMTO participants. Panel A presents measures of neighborhood satisfaction in which participants were asked, "Which of the following statements best describes how satisfied you are with your current neighborhood? - 1. Very Satisfied - 2. Somewhat satisfied - 3. In the middle - 4. Somewhat dissatisfied - 5. Very dissatisfied - 6. (No Answer) ." Panel B presents measures of the certainty with which participants want to stay in their new neighborhood. Participants were asked, "Which of the following statements best describes how you feel about staying in your current neighborhood? - 1. Very sure I want to stay - 2. Somewhat sure I want to stay - 3. In the middle - 4. Somewhat sure I want to move to a different neighborhood - 5. Very sure I want to move to a different neighborhood - 6. (No Answer) ." The control means are calculated as the share of households moving to high opportunity areas within households in the control group. Treatment effects are estimated with a regression of moving to an opportunity neighborhood on PHA indicators and a treatment indicator for each demographic group. The treatment mean is calculated as the control mean plus the treatment effect, where the treatment effect is estimated from a regression of the dependent variable in the panel on assignment to the treatment group and a PHA indicator. The reported difference is the treatment effect, and the standard error on the difference is the robust standard error on the treatment coefficient in the regression. The sample is all surveyed households who leased-up, including households receiving vouchers after 1 January 2019. For the full distribution of responses, see Appendix Figure 6.

FIGURE 10: Distribution of Preferences for High-Opportunity Neighborhoods Implied by Frictionless Model



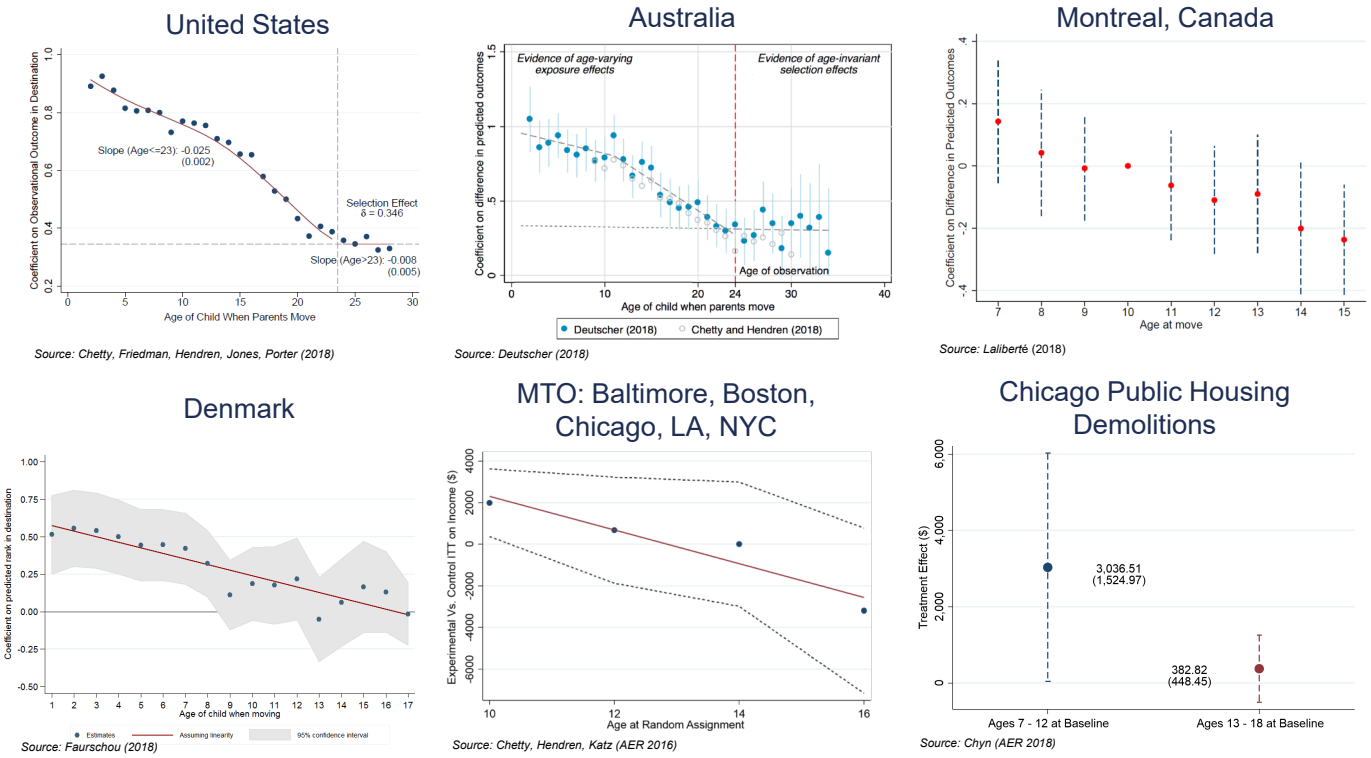
Notes: This figure present a hypothetical CDF of families' net willingness to pay to move to low-opportunity neighborhoods, under the assumptions of a frictionless model of neighborhood choice in which CMTO services are valued at marginal cost. The open circle represents the share of families leasing up with vouchers who have a negative net willingness to pay to live in low-opportunity neighborhoods, i.e., who prefer living in high-opportunity neighborhoods even when they are not offered any CMTO services. The closed circle represents the share of families leasing up with vouchers who have a net willingness to pay to live in low-opportunity neighborhoods that is below $2,600, i.e. who prefer living in high-opportunity neighborhoods when they are offered CMTO services. The red line shows a hypothetical distribution of preferences that would be consistent with the observed behaviour in a frictionless model of neighborhood choice.

FIGURE 11: Effects of Voucher Payment Standard Changes on Moving to Opportunity



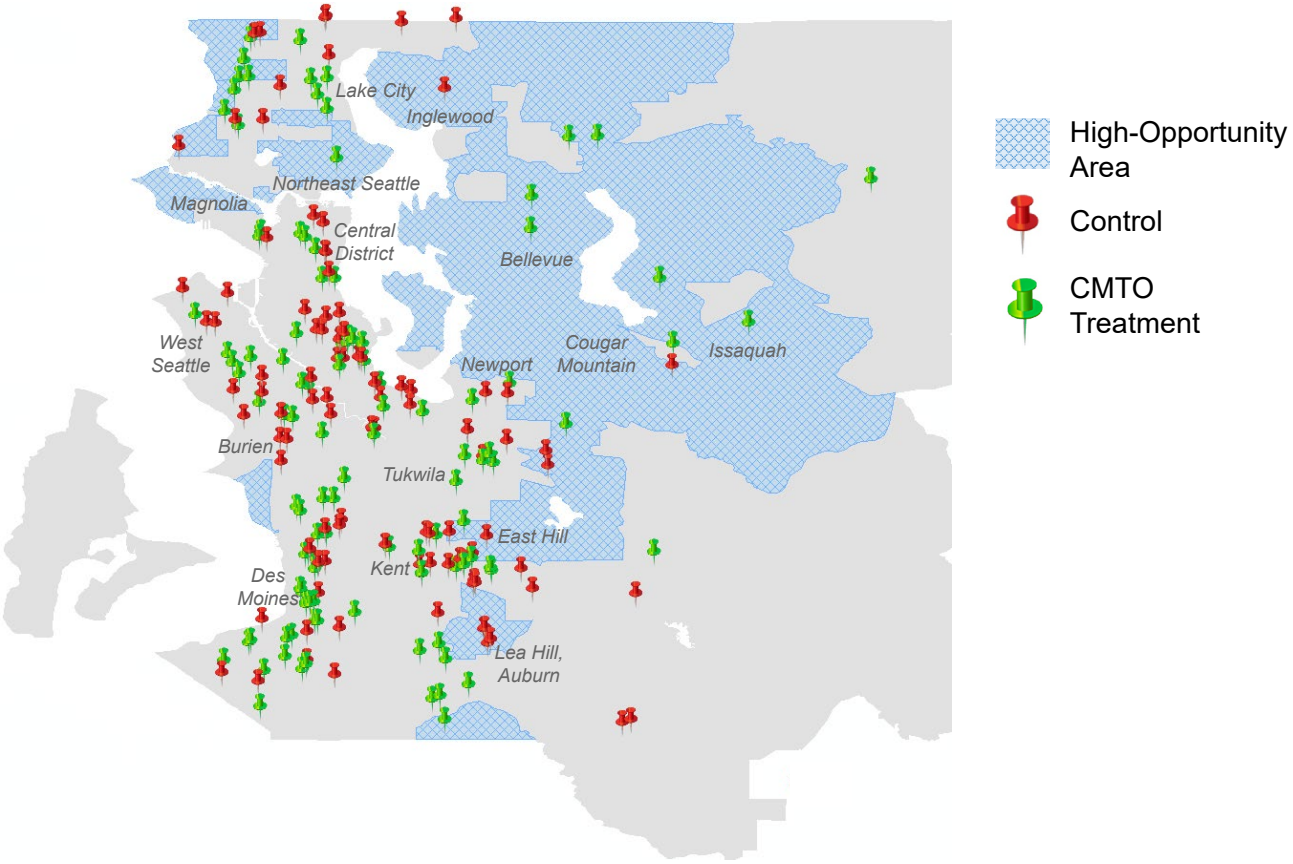
Notes: This figure plots the share of households who move to high opportunity areas before and after the introduction of two reforms. Panel A presents shows the share of households with children receiving vouchers who chose to move to opportunity areas. The estimates are split between households whose voucher was issued by the King County Housing Authority, in blue, and households whose voucher was issued by the Seattle Housing Authority, in gray. The estimates are grouped over two-month intervals from July 2015 to November 2016. The grey dotted line represents the introduction of a 5-Tier Voucher Payment Standard system in March 2016 by the King County Housing Authority. We show the effect of the reform on the share moving to high opportunity areas using a difference in difference estimate (defined in Section 7a). The blue dotted line was constructed by adding the experimental treatment effect of CMTO on moving to high opportunity areas shown in Figure 5a to the grey series after March 2016. Panel B shows the share of households receiving vouchers from the Seattle Housing Authority who chose to move to opportunity areas. The estimates are split between households with children, in blue, and households without children, in gray. The shaded blue period between February and April 2018 represents the time period of the CMTO pilot. The estimates outside the blue shaded region are grouped over two-month intervals from August 2017 to October 2018. The estimates in the blue shaded region are grouped over February to April 2018. The grey dotted line represents the introduction of Family Access Supplement (FAS) in February 2018. We show the effect of the reform on the share moving to high opportunity areas using a simple difference in difference estimate (defined in Section 7a).

APPENDIX FIGURE 1: Causal Effects of Moving to a Better Neighborhood: Evidence from Prior Research



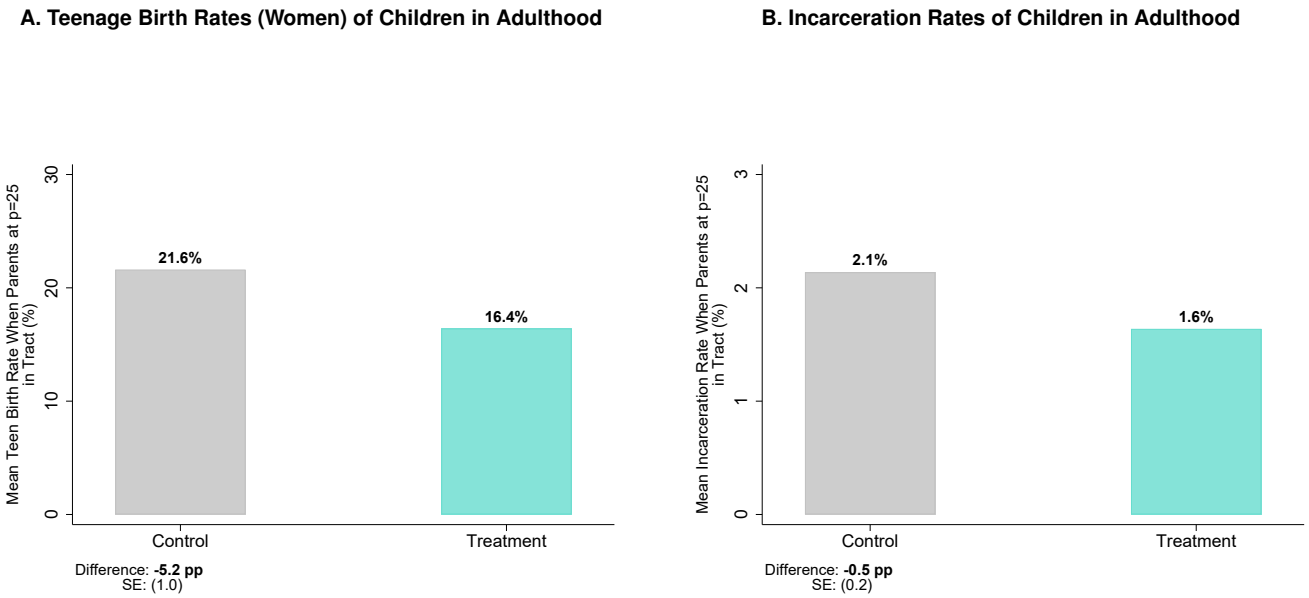
Notes: This figure reproduces estimates from a recent set of papers estimating the the causal effects of the neighborhood in which a child grows up on their subsequent adult outcomes. Each figure depicts the gain from moving to an area with better observed outcomes, by the age at which children make that move. Panel A presents estimates of exposure effects from the US from Chetty, Friedman, Hendren, Jones, and Porter, 2018. Panel B presents estimates of exposure effects from Australia from Deutscher, 2018. Panel C presents estimates of the coefficient on difference in predicted university enrollment outcomes from Montreal, Canada from Laliberté, 2018. Panel D presents estimates from Denmark from Faurschou, 2018. Panel E presents evidence from the Moving to Opportunity experiment studied in Chetty, Hendren, and Katz, 2016. Panel F presents evidence from variation in public housing demolitions, studied in Chyn, 2018.

APPENDIX FIGURE 2: Map of Origin Tracts for Voucher Recipients



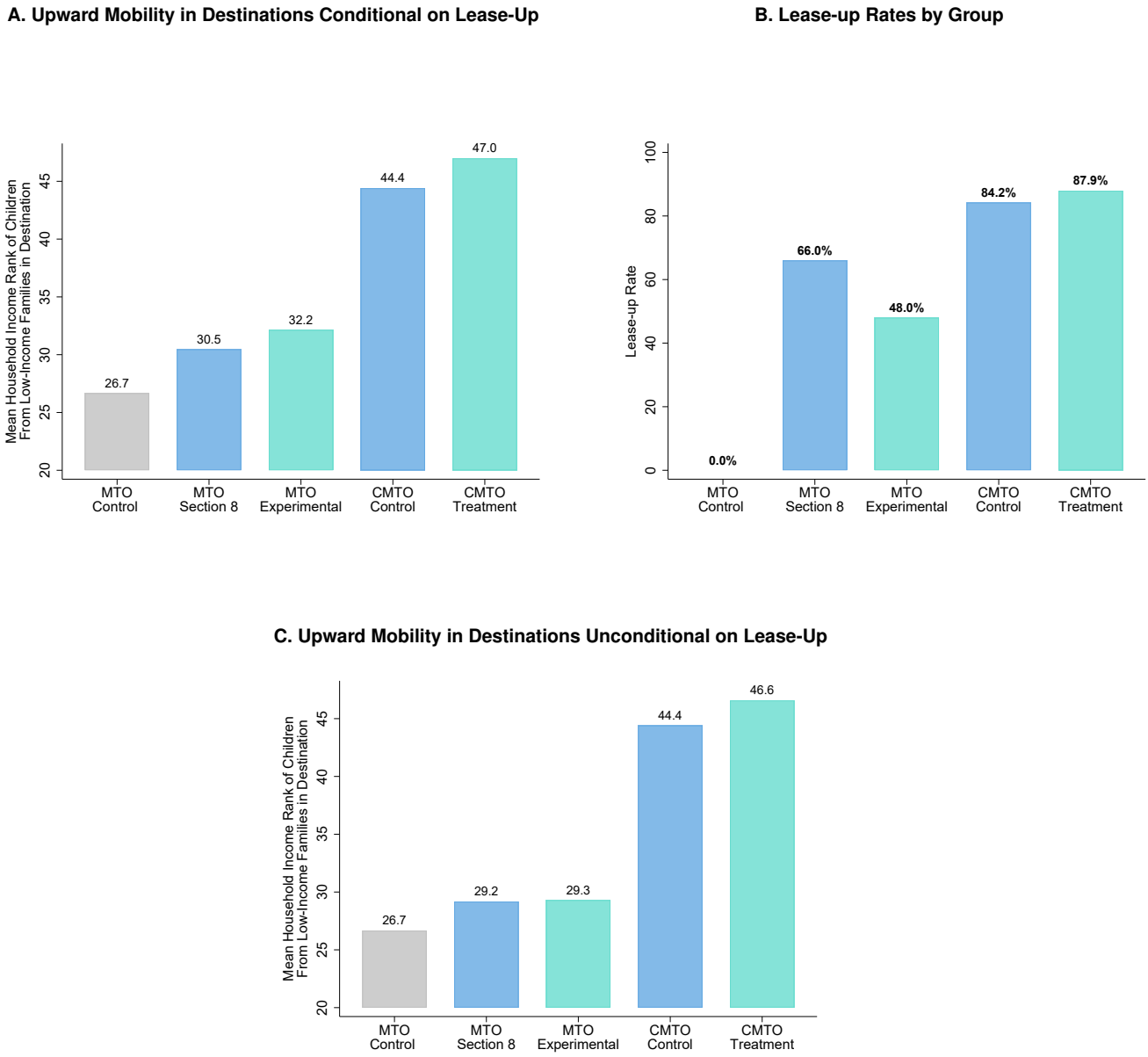
Notes: This figure presents a map of origin tracts of experimental participants in the control and treatment groups. High-opportunity areas are highlighted in blue cross-hatch. Those 201 voucher recipients whose origin location was outside the area of Seattle and King County or who were issued vouchers before January 1, 2019 are excluded from the map. To protect confidentiality, locations shown are approximate with a small amount of random noise infused, starting from tract centroids.

APPENDIX FIGURE 3: Predicted Treatment Effects on Other Long-Term Outcomes



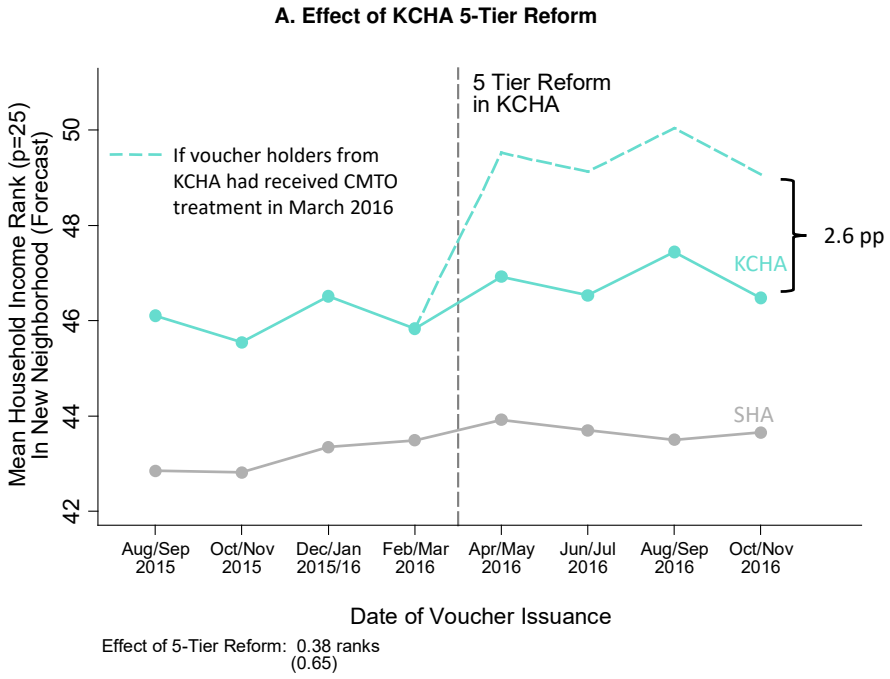
Notes: These figures each present the predicted effects of CMTO on other long-term outcomes measured by destination tract. Importantly, these are not outcomes of CMTO participants but rather outcomes of individuals who grew up in households with family income at the 25th percentile of the national income distribution in the destination neighborhoods to which CMTO participants moved. Panel A presents the effect on the tract-level teenage birth rates for children who grew up in the tract. Panel B presents the effect on incarceration rates (on April 1, 2010) for children who grew up in the tract. We construct these estimates by regressing each outcome on a treatment indicator variable as well as a PHA indicator variable. The control means are calculated as the share of households moving to high opportunity areas within households in the control group. Treatment effects are estimated with a regression of moving to an opportunity neighborhood on PHA indicators and a treatment indicator for each demographic group. The treatment mean is calculated as the control mean plus the treatment effect, where the treatment effect is estimated from a regression of the dependent variable in the panel on assignment to the treatment group and a PHA indicator. The reported difference at the bottom of each figure equals the coefficient for the treatment effect indicator. The standard error is the robust standard error on the treatment coefficient in the regression. All panels are restricted to households who were issued vouchers before January 1, 2019.

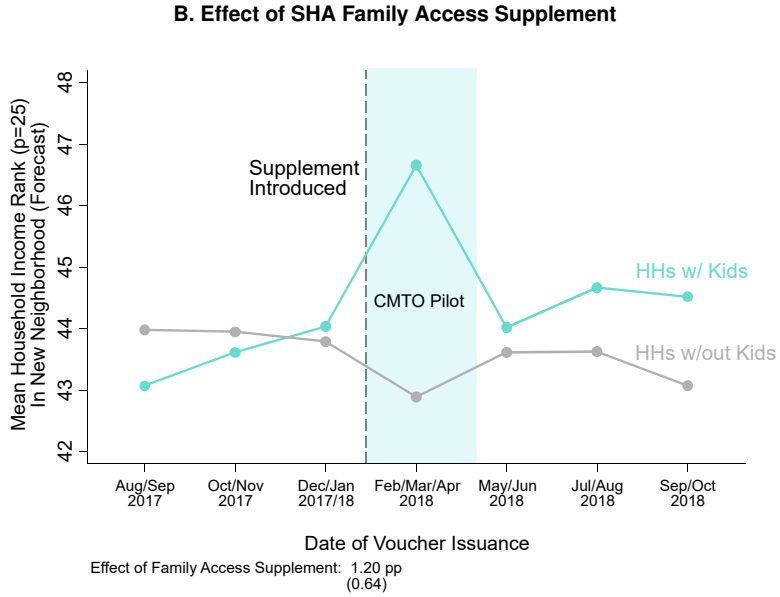
APPENDIX FIGURE 4: Comparison Between MTO and CMTO Treatment Effects



Notes: These figures present comparisons between MTO and CMTO. In each figure, we plot the means for the treatment and control groups in the MTO and CMTO experiments. Panels A and C compare mean household income rank of children from low-income families based on the Opportunity Atlas characteristics of the destinations in which participants choose to locate. Panel A presents the estimates conditional on lease-up, and Panel C presents the results unconditional on lease-up. MTO participants are, on average, closer to the 10th percentile of the national income distribution, in comparison to CMTO participants, who are generally closer to the 25th percentile of the national income distribution. For this reason, we plot upward mobility measures for children from families in the 10th percentile of parental income for MTO and for children from families in the 25th percentile for CMTO. Panel B presents the lease-up rates of the groups in each experiment (where the control group is 0% because they did receive vouchers).

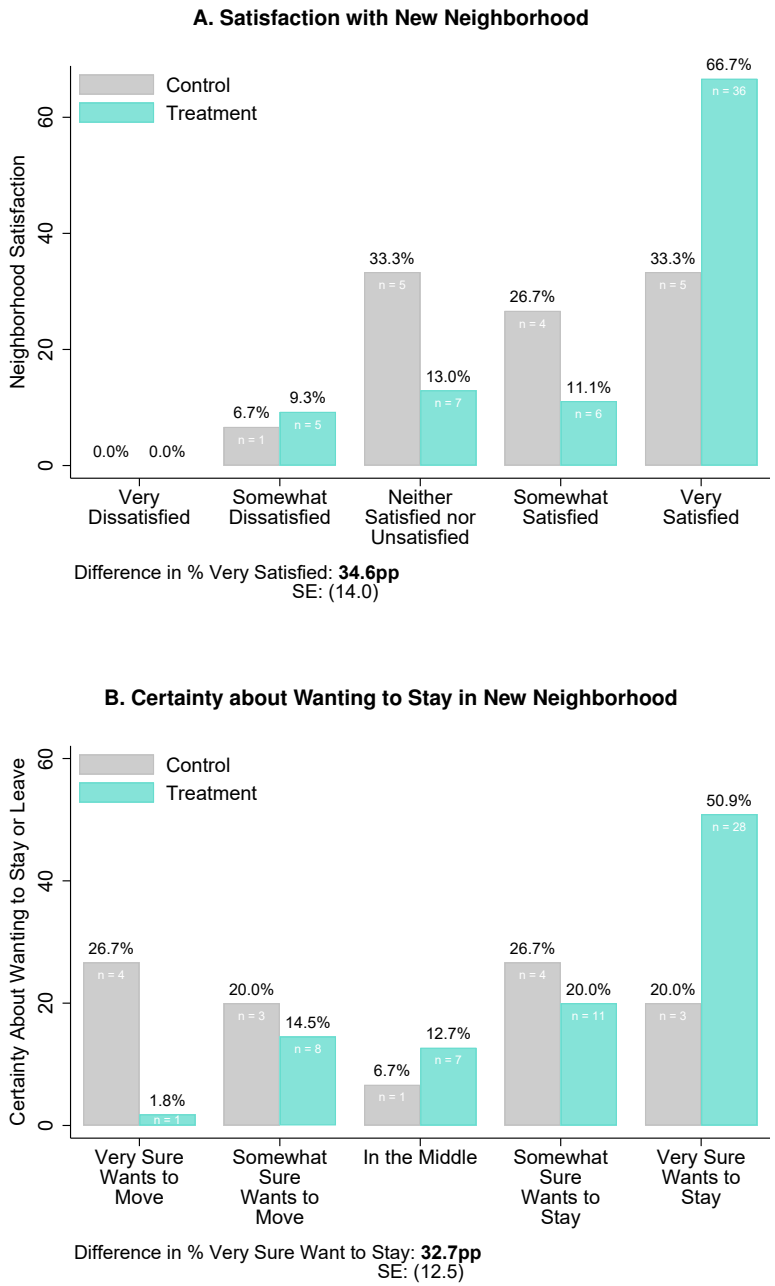
APPENDIX FIGURE 5: Effects of Voucher Payment Standard Changes on Moves to Neighborhoods with Higher Upward Mobility





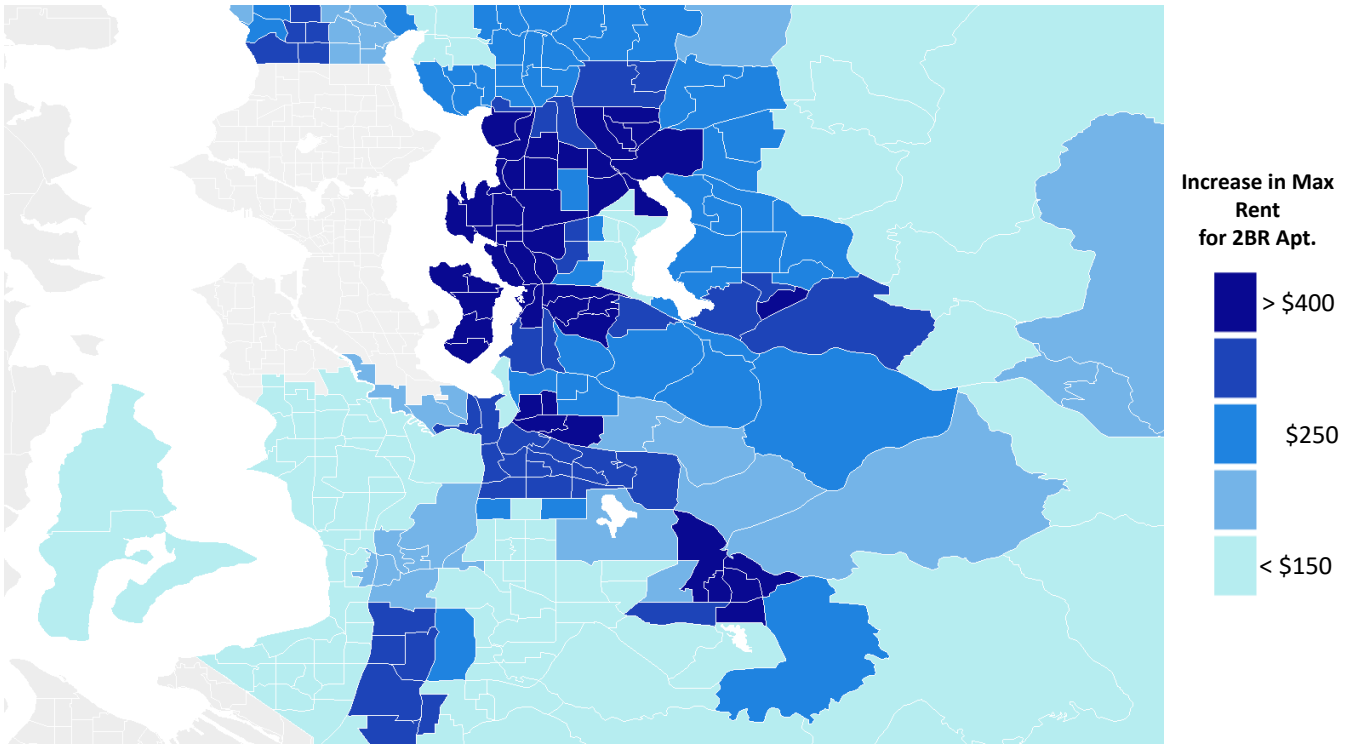
Notes: This figure replicates Figure 11 using the preliminary atlas measure of mean forecasted household income rank of children in adulthood as the outcome variable, as opposed to the fraction of families that moved to high opportunity areas.

APPENDIX FIGURE 6: Treatment Effects on Post-Move Neighborhood Satisfaction



Notes: This figure uses data from a follow-up qualitative survey administered to a random sample of CMTO participants. Panel A presents measures of neighborhood satisfaction in which participants are asked, "Which of the following statements best describes how satisfied you are with your current neighborhood? - 1. Very satisfied - 2. Somewhat satisfied - 3. In the middle - 4. Somewhat dissatisfied - 5. Very dissatisfied - 6. (No Answer) ". Panel B presents measures of how much individuals want to stay (versus leave) their new neighborhood. Participants are asked, "Which of the following statements best describes how you feel about staying in your current neighborhood? - 1. Very sure I want to stay - 2. Somewhat sure I want to stay - 3. In the middle - 4. Somewhat sure I want to move to a different neighborhood - 5. Very sure I want to move to a different neighborhood - 6. (No Answer) ".

APPENDIX FIGURE 7: Changes to King County Housing Authority Payment Standards in March 2016



Notes: This figure presents a map which visualizes KCHA's various increases in payment standards across King County, implemented in March 2016. The map plots the increase in maximum rent for a two-bedroom apartment paid for through vouchers from KCHA, comparing maximum rents in the pre-period (January 2015 to February 2016) to the post-period (March 2016 to December 2017). Darker blue areas saw larger increases in maximum rent allowances from KCHA for two-bedroom apartments, while lighter blue areas witnessed smaller increases.