The Microgeography of Movement in Pittsburgh: Examining Neighborhood Population Movement Under Development in East Liberty

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Abstract

The East Liberty neighborhood of Pittsburgh has undergone considerable changes over the course of the last 30 years through public investment, nonprofit development corporations, and private developers. While these investments specifically targeted revitalizing East Liberty's business district and stimulating housing development, they have also changed the demographic composition within the neighborhood. (Tierney, 2019) New development has spurred concern and controversy regarding the influx of new high-income residents in a historically low-income, working class area. (Jones, 2019) The team, in coordination with Allegheny County Department of Human Services, looked at how this development has affected housing voucher households within East Liberty. Our analysis shows that voucher households who relocated from East Liberty to other Pittsburgh neighborhoods, especially since 2007, were on the whole moving to lower opportunity neighborhoods. At this time, the team cannot conclude that nearby developments are driving voucher residents to leave East Liberty. These findings suggest that other mechanisms may be at work and our findings can potentially be reconciled with subsequent research.

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I. Background

East Liberty, a predominantly African American and historically diverse, low-income, working class neighborhood (University of Richmond, n.d.) has undergone considerable changes over the course of the neighborhood's history. Once a thriving commercial district and neighborhood, East Liberty was celebrated as a success until the City of Pittsburgh's "Urban Renewal" project in the 1950s and 1960s. (East Liberty Development Inc., n.d.) During this time, hundreds of

acres were razed, displacing hundreds of small businesses and thousands of mostly low-income, African American residents. (Tierney, 2019) Those who stayed experienced significant economic decline and "white flight" which peaked in the 1980s. (Tierney, 2019)[1] The ensuing development following decades of public and private investment has resulted in the return of major retailers (Targeted News Services, 2010), new residential construction (East Liberty Development Inc., 2018), enhanced transportation systems (Fitzgerald & Halliday, 2012), and controversy regarding gentrification. (Jones, 2019)[2] The question is whether these concerns are grounded in reality, meaning: has the development in East Liberty had a negative impact on more vulnerable households by encouraging them to move out of East Liberty? And, if so, are these households moving to worse neighborhoods?

II. Data and Methodology

This project is unique in being able to track individual moves of voucher households over a time period of nearly two decades. Our client, the Allegheny County Department of Human Services (DHS), provided de-identified records of moves between 2003 – 2019 for individuals in housing voucher programs in Pittsburgh. There are two of these programs operating in East Liberty, one run by the City of Pittsburgh Housing Authority (HACP) and one run by the Allegheny County Housing Authority (ACHA). We did not distinguish between HACP and ACHA participants in our analysis because, according to DHS, these programs are nearly identical. The data obtained from DHS contained a total of 149,932 rows and 48.424 unique heads of household. (The data also contained information about dependents, but our analysis was limited to heads of household because movement is reasonably assumed to be identical for parents and children.) The racial and gender composition of the data can be described as follows: 96% of voucher households are African American, 3% are White, and < 1% are Asian, American Indian, or some other race; 85% of the voucher population is female. The raw data was cleaned in a process outlined in our appendix. We primarily used R statistical software, ArcGIS Pro mapping software, and Excel for the analysis.

We manually compiled a data set of notable construction projects undertaken in East Liberty throughout the study period.[3] This data set ultimately included demolitions and closings of naturally occurring affordable housing and developments with estimated costs over $1 million. To compile the data set, we used information from our advisory board members at the Urban Redevelopment Authority and at the East Liberty Development Inc., among other sources. The team supplemented manually gathered data with data on apartment complex construction projects provided by Anne Wright of Carnegie Mellon University's CREATE Lab. This apartment data included market rate, affordable-only, and mixed-income complexes, and the date each was constructed.

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[1] See Appendix (History of East Liberty) for a more detailed look at the period of disinvestment prior to the study period.

[2] See Appendix (Additional Visualizations) for a complete timeline of development projects within our project timeframe, which includes the year of the project, cost (if publicly available), and developer information.

[3] See Appendix (Development data descriptions and related documents) for more thorough explanation of how development data was acquired.

Our analysis was conducted in two primary phases: 1) analyzing voucher population movement in and out of East Liberty as well as comparable neighborhoods and 2) analyzing the causal relationship between voucher population movement out of East Liberty and development in East Liberty. For the first phase, we constructed a community disadvantage index and computed disadvantage "scores" for each census tract in Pittsburgh for each year of the study period. Movements between neighborhoods could then be compared on a year-by-year basis. In the second phase, we used OLS regression, logistic regression, and event study models to estimate the causal impact of major development projects on nearby households' decisions to stay or relocate outside of East Liberty.

III. Analyzing Movement Out of East Liberty

With individual-level data on voucher households, we were able to ask precise questions about mobility among voucher households, notably, when voucher households leave East Liberty, where do they go? We then analyzed how these destinations compare to East Liberty. Our finding is that the majority of households leaving East Liberty consistently relocated to a handful of neighborhoods just outside of East Liberty. Moves that are consistent in a geographic sense are not, however, necessarily consistent in the level of opportunity they are reasonably expected to bestow on the mover. In this section, we analyze voucher population movement out of East Liberty in terms of both geography and opportunity.

Destinations Outside of East Liberty

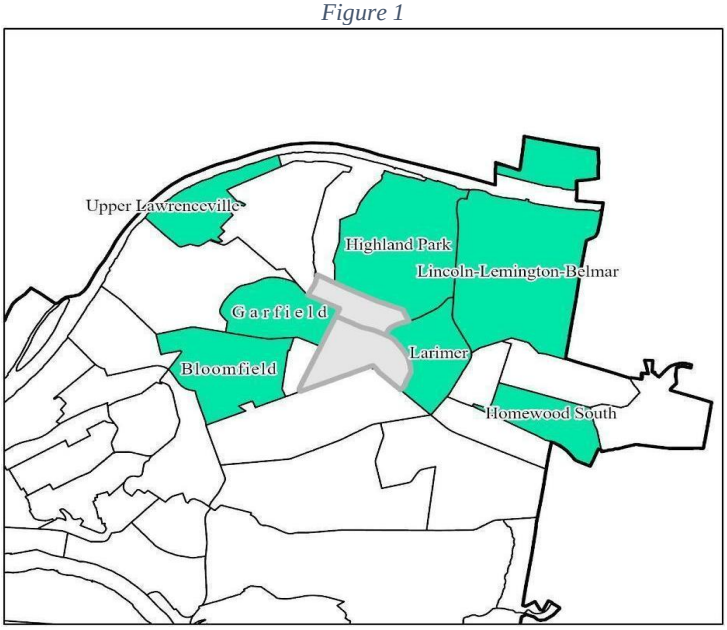
Table 1 lists the seven most common destinations for voucher households who moved out of East Liberty during the study period. Fifty percent of all moves were to these seven neighborhoods.

Table 1

Neighborhood	Total Moves to Neighborhood
Garfield	64
Highland Park	37
Lincoln-Lemington-Belmar	32
Larimer	28
Bloomfield	21
Upper Lawrenceville	20
Homewood South	19

Looking at the accompanying map in **Figure 1**, the first clear pattern that emerges from our analysis is that the majority of moves outside of East Liberty are to neighborhoods very near East Liberty.

Figure 1



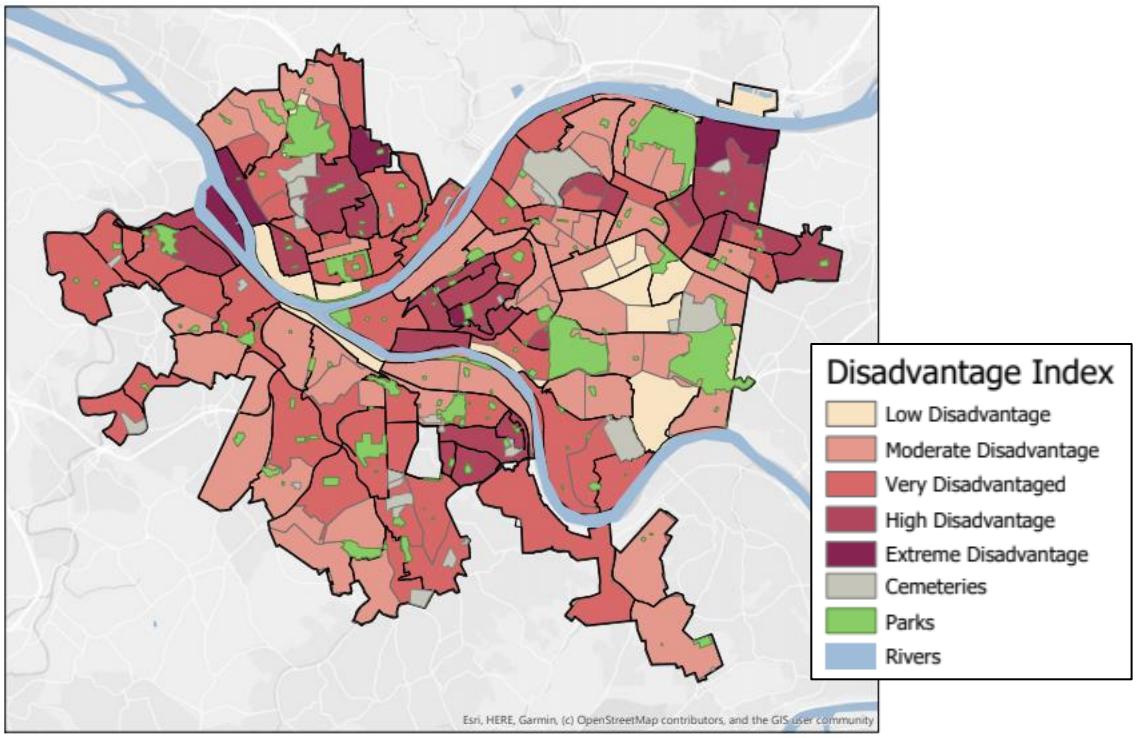
Based on methodology used by Dr. Lance Freeman at Columbia University (Freeman, 2005), we constructed a Community Disadvantage Index to compare the level of advantage associated with living in East Liberty to that of destination neighborhoods. Index data were taken from the 2000 and 2010 Decennial Censuses and from the Census Bureau's American Community Survey Data.

The index consisted of the following four variables:

1. percentage of families living below the federal poverty line
2. percentage of single female headed households
3. percentage of people over 25 years of age without a bachelor's degree
4. male unemployment for individuals over 25 years of age

For each year of the study period, each census tract's disadvantage score is the unweighted mean of these variables. To begin to construct the disadvantage index *scale*, we first looked at the "natural breaks" in the distributions of the disadvantage scores for each year. Natural breaks maximizes similarity within groups of the distribution while also maximizing dissimilarity between groups. To have interpretable results, however, we needed a consistent set of breaks in the scale for all years of the study period. We manually set the final break points in the scale with careful attention to maintaining as much intra-group similarity and inter-group dissimilarity as possible. Uniform break points then allowed for a consistent way of describing the distribution of disadvantage scores for each year of the study period. We use five classes of disadvantage—extreme disadvantage, high disadvantage, very disadvantaged, moderate disadvantage, and low disadvantage in subsequent sections. **Figure 2** shows these classes mapped onto census tracts for one year of our study period (2010).

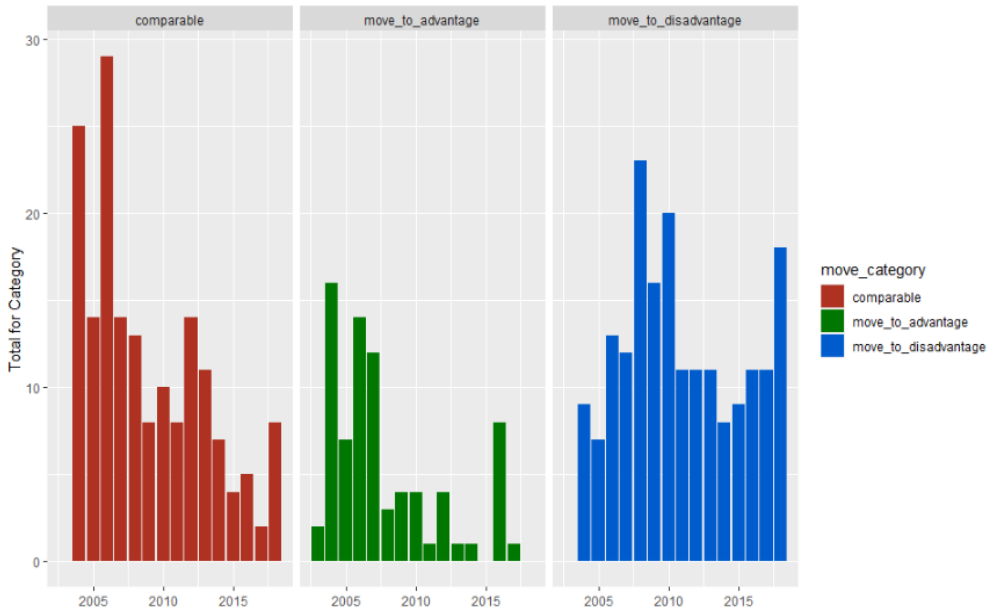
Figure 2



Each move was initially given a description of "move to advantage," "move to disadvantage," or "move to comparable advantage" based on the five break classes. For example, in **Figure 2** we see that the southern census tract of East Liberty was classified as "moderate disadvantage" in 2010 and the three census tracts in Garfield were classified as either "very disadvantaged" or "extreme disadvantage." Thus any move from the southern census tract of East Liberty to any destination in Garfield is described as a "move to disadvantage." Importantly, **Figure 2** also shows that East Liberty's northern census tract was classified as "very disadvantaged" in the same year. Therefore moves from the northern census tract to Garfield can be described either as "moves to comparable advantage" or "moves to disadvantage" depending on the census tract of the destination. We chose to analyze movements out of East Liberty by move category in order to be able to assess some moves as "moves to comparable advantage," a middle category that was eliminated later in our analysis when we began to assess moves based on the absolute difference in the disadvantage scores between origins and destinations.

Figure 3 shows moves by category for each year of the study period. Moves to disadvantage (the blue bars) are relatively stable across time in absolute terms. As a percentage of moves per year, however, they increased as the other types of moves declined. This graph suggests that moves to advantage and moves to comparable advantage both declined over time but does not provide any insight into 1) who, exactly, moved to advantage rather than disadvantage 2) the magnitude of difference between origins in East Liberty and destinations over time and 3) whether the disparity between East Liberty and destinations grew primarily as a result of improvements in East Liberty, a decline in destinations, or both. **Figure 3** also offers no insight into the advantage associated with moves *into* East Liberty over the study period. We look at each of these questions in turn below.

Figure 3



Who, Exactly, Is Moving to Advantage?

We created **Table 2** to describe which voucher households moved from East Liberty to better, comparable, or relatively worse destinations. Racial disparities in moves to advantage and disadvantage are clear: White households are nearly twice as likely to move to advantage as African American households. African American households are three times as likely to move to disadvantage as White households. The propensity to move to disadvantage is slightly worse when we limit the sample to female households. African American female households are 4.5 times more likely to move to disadvantage than White female households. White female households are also twice as likely to move to advantage as African American female households. These findings strongly suggest that whether a voucher household is able to move to advantage or if it faces a much more limited range of choices can be predicted by race.

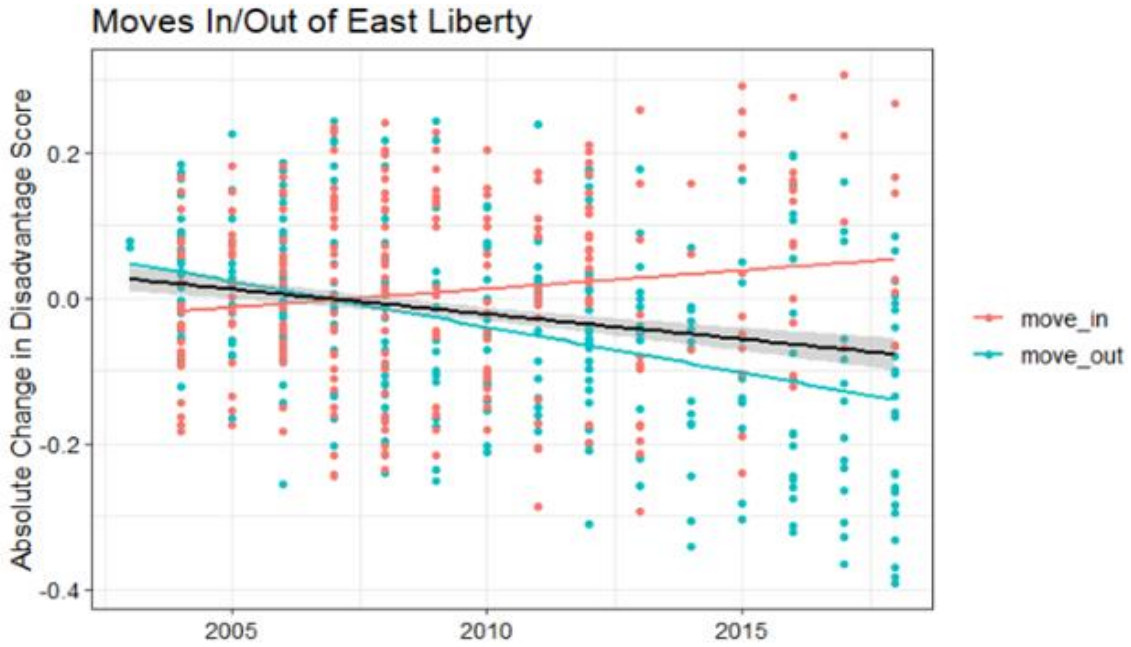
Table 2

Move Category	American Indian/Alaskan Native	Asian	Black/African American	White
Moves to Advantage	100%	50%	**17%**	**31%**
Moves to Disadvantage	0%	50%	**44%**	**15%**
Moves to Comparable Advantage	0%	0%	39%	54%

The Increasing Magnitude of Moves to Disadvantage

While we have been using categories to describe moves thus far, the magnitude of difference between an origin and destination is not captured by a categorical description like "a move to disadvantage." That is, the distinction between a move to *slightly* more disadvantage and a move to radical disadvantage is not captured by the label "a move to disadvantage." We computed the absolute change in the disadvantage score of the origin and destination for each move out of East Liberty in order to visualize the magnitude of these differences. **Figure 4** plots these absolute changes in disadvantage scores. The pink line is the regression line for moves in (n = 317), the blue line is the regression line for moves out (n = 440), and the black line is the regression line for all moves—both in and out of East Liberty.

Figure 4



The primary takeaways from **Figure 4** are that 1) advantage gained from moves into East Liberty was not offset by disadvantage incurred by moves out and 2) that moves to disadvantage became increasingly worse over time in terms of the degree of disparity between disadvantage at the origin and destination. Among other things, this disparity potentially speaks to a great deal of lost opportunity that may be associated with some or all of the moves out of an improving East Liberty.

Locating the Driver of Disparity between Origins and Destinations

Determining how much opportunity was "lost" by movers depends on how much of the increase in disadvantage associated with moves was driven by improvements in East Liberty rather than declines in destinations. More specifically, if East Liberty maintained a steady level of opportunity over time but destinations declined in opportunity, we would think differently about the future of households if they had remained in East Liberty. Rather than an expected upward trajectory, their futures would look more like a horizontal line that slopes downward at the time

of their move. By contrast, if the level of opportunity in East Liberty were improving over time, the counterfactual for households who might have remained in East Liberty (but did not) is a loss of expected gains in opportunity. This interpretation is consistent with an assumption that improvements to a neighborhood that are associated with greater opportunities (i.e., better schools that result from taxes paid on increasingly valuable property) are a gradual process that unfolds over time.

Figure 5 shows how moves would have been characterized over time if East Liberty's level of disadvantage had remained constant from the beginning to the end of the study period. The pink line is the regression line for moves in, the blue line is the regression line for moves out, and the black line is the regression line for all moves—both in and out of East Liberty. The black line is nearly horizontal, which suggests that moves into and out of East Liberty would have offset one another in terms of advantage lost and gained if East Liberty had not improved. The blue line is also nearly horizontal. In light of our previous finding that 50% of moves out of East Liberty were to a small set of nearby neighborhoods, we can conclude that the actual observed downward trend in the blue line (shown in **Figure 4**) was primarily driven by improvements in East Liberty rather than declines in destinations. Thus, at least 50% of moves out of East Liberty during the study period may be described as incurring the "cost" of lost opportunity described above.

Figure 5

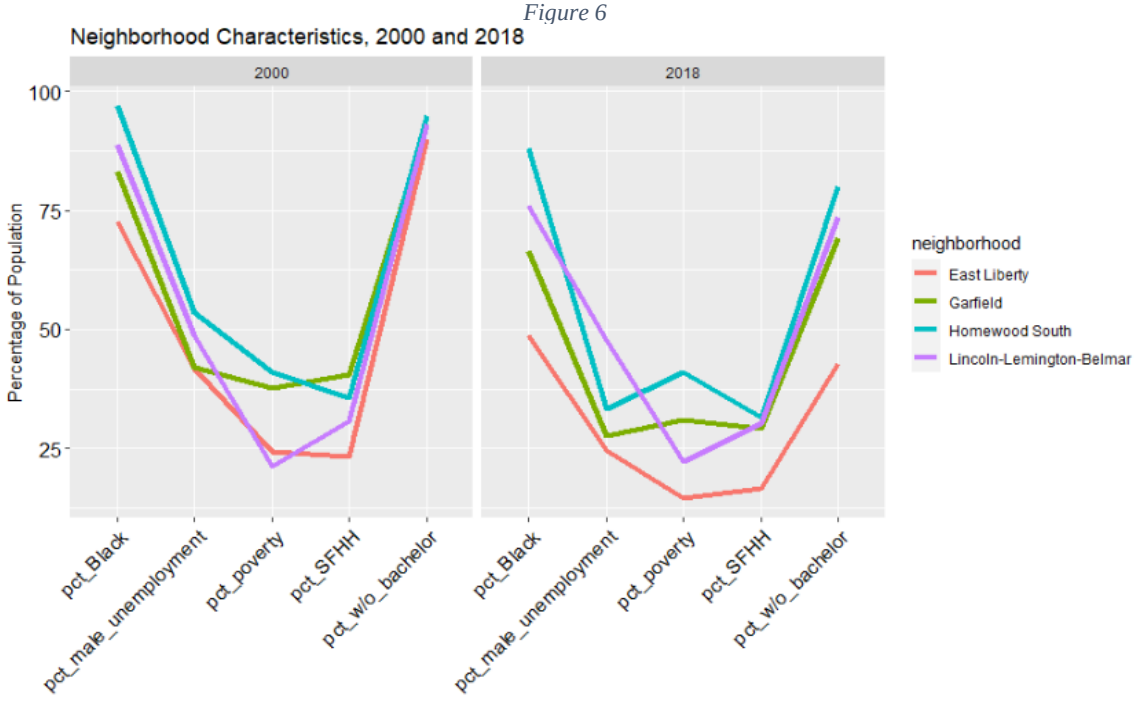
Discussions of differences in "moving to disadvantage" and "loss of opportunity" are similar concepts with key distinctions that require a more nuanced interpretation. Both metrics allow for different approaches to decision making with respect to time that should be taken into consideration when making comparisons. There are many factors that could influence why a household may move to disadvantage that occur outside the scope of our study. There are similar factors that many would not consider regarding a loss of opportunity after their move that cannot be captured ex post. Despite that, there is an immediate effect that can be attributed to a move to disadvantage, whereas the loss of opportunity may not be immediately evident. A move in early in the study window may look to be a contemporaneous move to advantage when in actuality it represents a massive loss of opportunity by the end of the study window

How Changes in East Liberty Compare to Changes in Other Neighborhoods Over Time

Our analysis of voucher household moves out of East Liberty suggests that these households consistently moved to a small number of destinations outside of East Liberty but that these moves cannot be consistently characterized as having the same "cost" in terms of disadvantage incurred and/or opportunity lost. Moreover, the increasing cost of moves out is primarily driven by improvements in East Liberty rather than declines in destination neighborhoods. In order to analyze the connection between the general trend in mobility that we observe in the data and "improvements" (i.e., development) in East Liberty, we conducted a meta-analysis of mobility trends in neighborhoods that resembled East Liberty at the beginning of the study period but did not experience development. These neighborhoods then served as a counterfactual estimate for movement in and out of East Liberty in the absence of development. Using propensity score matching, we selected neighborhoods from the East End that most closely resembled East Liberty at the beginning of the study period. (A detailed explanation of this method and the results can be found in the appendix.)

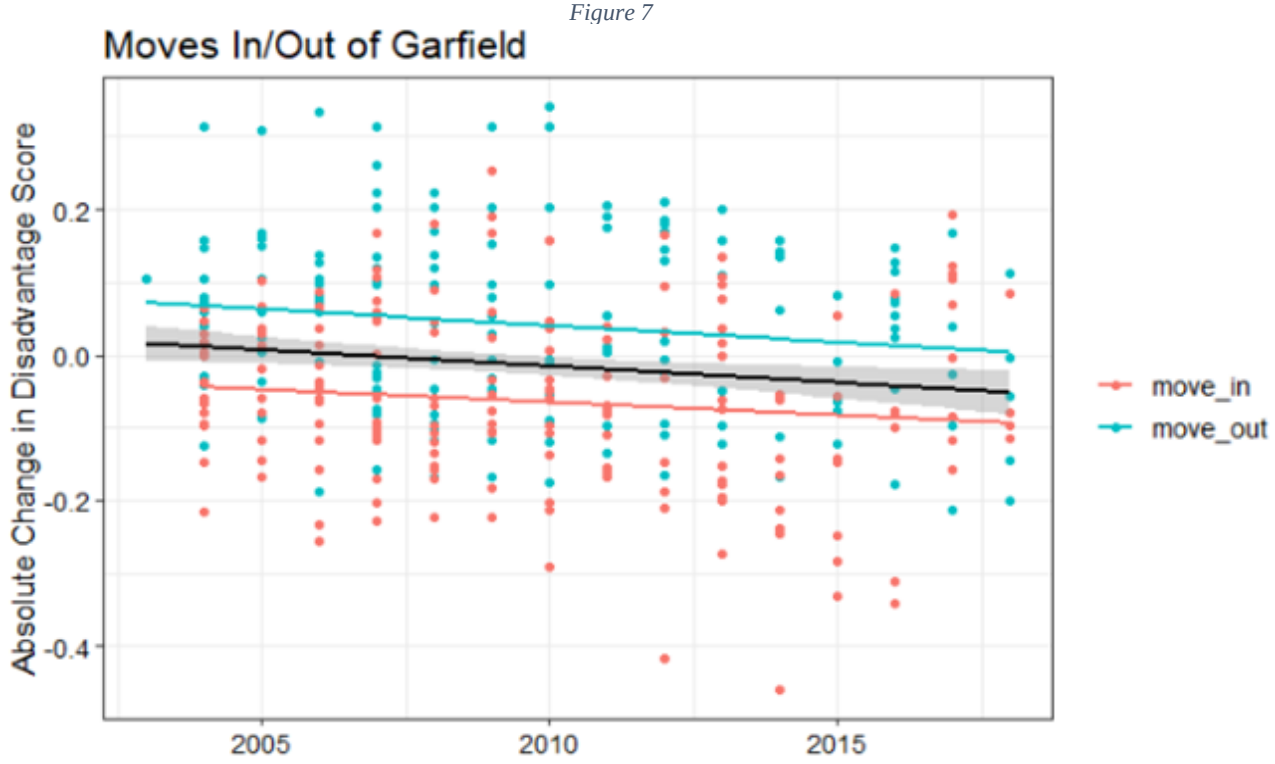
Figure 6 shows how East Liberty compared to the three neighborhoods selected by the propensity score matching model (Garfield, Lincoln-Lemington-Belmar, and Homewood South) in 2000 and in 2018 on five covariates (percentage of population who are Black, percentage of unemployed males, percentage of families living in poverty, percentage of single female headed households, and percentage of adults without a bachelor's degree). These same covariates are often used as direct or indirect signals of a neighborhood's gentrification status or eligibility to gentrify. (Lin, 2017) (Richardson, Mitchell, & Franco, 2019)

Figure 6



The left pane of **Figure 6** shows that East Liberty (red line) closely resembled Garfield, Homewood South, and Lincoln-Lemington-Belmar in 2000. Where it did not explicitly overlap with each of these neighborhoods on each covariate in 2000, East Liberty was at least closely clustered with them on four of the six covariates. By contrast, the right pane shows that East Liberty had diverged from the cluster of comparison neighborhoods by 2018 in a direction that is consistent with gentrification. To begin to bridge the gap between voucher household mobility and neighborhood differences, we then compared the general pattern of household movement in and out of East Liberty (shown in **Figure 4** above) with the general pattern of household movement in and out of each comparison neighborhood. Voucher household movement in and out of East Liberty (**Figure 4)** shows a distinctly different trend from **Figure 7**, a similar type of graph for the neighborhood of Garfield. We also observe differences between East Liberty's household movement in **Figure 4** and comparable graphs for Homewood South and Lincoln-Lemington-Belmar.[4]

Figure 7



We conclude our discussion of the analysis of voucher households in East Liberty with two broad takeaways from **Figure 6** and **Figure 7**. The first is that East Liberty is now distinguishable from nearby neighborhoods like Garfield, Lincoln-Lemington-Belmar, and Homewood South, though this was not true in 2000. The second is that the defining difference between East Liberty and these once comparable places may have driven the difference in movement patterns for voucher households in East Liberty. Qualitative evidence from project-related interviews and local experts suggest that this defining difference is East Liberty's having undergone extensive development (i.e., having undergone gentrification). (Taylor, 2020) **Figure**

[4] See Appendix (Additional Visualizations) for similar Moves In/Out graphs from comparison neighborhoods.

6 broadly suggests this, but we will now turn to our explicit analysis of the relationship between voucher household movement and development in East Liberty.

IV. Analyzing the Relationship between Voucher Population Movement and Development in East Liberty

The team used three statistical models, two regression analyses and an event study, to explore the causal relationship between voucher household movement out of East Liberty (and in the East End more generally) and large development projects in these same areas. In this section we describe our modeling methodology and results. Though we did not find a statistically significant relationship between out migration of voucher households and development, we end by suggesting several reasons for this lack of finding and provide suggestions for future studies. A key concept for this part of the analysis is the following: we did not attempt to assess whether voucher households have been displaced from their neighborhoods, very generally, over time. Our question was much more specific: we asked whether these households had been displaced *through the mechanism of development* over time. As we suggest below, displacement that occurred through other causal pathways (i.e., through housing stock deterioration, etc.) would not have been captured in our models. We will also clarify the meaning of development as a "treatment," as this is essential to understanding our results.

In this phase of the project we sought to quantify the extent to which development activity induced voucher residents adjacent to development projects to move relative to their likelihood of moving in the absence of development. To approach this question, we broadened our scope to include all of Pittsburgh's "East End" with the exception of the Downtown and Oakland neighborhoods. Broadening our analysis allowed us to include voucher resident data for a greater number of residents who did not live in close proximity to development, which in turn gave a better measure of the comparative outcomes for voucher residents near developments relative to those who did not live near developments.

Defining Voucher Residents Who Are "Treated" by Development

A key challenge of this analysis was to define an appropriate "treatment range" around development projects within which a voucher resident would be considered affected by the development. In practice, this meant defining a geographic range within which we would consider any voucher household to be heavily impacted by the potential negative side-effects of development (i.e., increased rental prices and displaced businesses).

In all treatment range permutations we exclude voucher residents on the physical parcel of land that experienced development. In certain specific cases, such as the demolition of the Penn Circle apartments prior to the construction of the East Liberty Target on the same plot of land, the out-migration of voucher residents is clearly linked directly to the future development project. When out migration does not immediately precede construction, however, it is not straightforward to causally link out migration with a future development on the same parcel. It may be the case that properties that are already experiencing out migration of voucher households are attractive to development, or conversely that the potential profit of future development causes the accelerated

removal of residents (through tactics ranging from deliberately withheld building improvements to direct evictions). By excluding voucher households who reside on the same parcel as a development project, we avoid having to differentiate between these two possibilities, and instead focus on the indirect effects of development on neighboring properties.[5]

We considered two possibilities for defining the geographic treatment range of a development. First, we considered assigning treatment to all voucher residents located within the same census block group of a development project. Census block group boundaries are typically defined along existing roads and physical barriers.

Figure 8

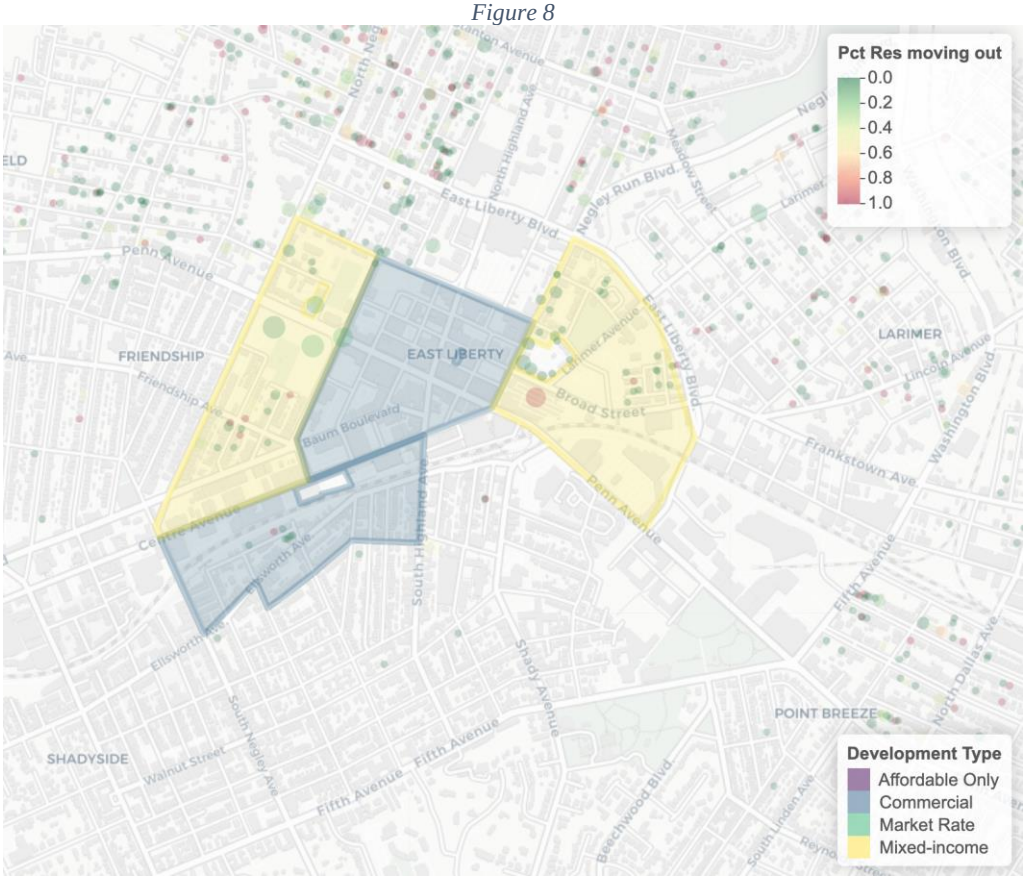


Figure 8 shows the treatment range for developments completed in 2007 if the treatment range is defined as the census block group boundary. The circle markers correspond to voucher residents; the color of the markers indicates the share of voucher households living at the physical structure who moved in 2007. As the figure shows, in many cases development occurred on the edge of a census block group. We therefore decided against this method of defining the treatment range because it potentially classified households in close proximity to development projects as

[5] We recognize that movement patterns of residents co-located with past or future developments are also meaningful and informative, despite not lending themselves to straightforward inclusion in our econometric models. To assist future analyses of these voucher residents, we developed an interactive web application to allow analysts to view the movement patterns of residents over time on parcels of land that experienced development. The web application can be found here: https://dkori.shinyapps.io/visualize_direct_displacements/

untreated. Instead, we ultimately defined our treatment range in terms of a geographic radius around development projects. We chose appropriate treatment ranges qualitatively by mapping their extents.

Figure 9

In **Figure 9**, the map on the left shows radial treatment ranges set at 200 meters around developments completed in 2007. The map on the right shows radii of 400 meters. Ultimately, any treatment range is imperfect, so we chose to run the analysis using multiple definitions of the treatment range.

Simple Regression Design and Results

We began by running a simple regression of a voucher households' likelihood of moving against the accumulated number of developments near the household. We constructed a panel dataset wherein each row corresponded to an instance of a voucher household living at a specific address in a given year. For each row, households were encoded to have an outcome of one if they moved in the same year and zero otherwise. To prevent a household from appearing twice in a given year if they moved twice (for both their old and new address in that year), only the first row associated with an individual in a year was retained. Our analysis therefore does not analyze more than one move per year for any household.

Our independent variable was the number of accumulated developments for each row in our panel dataset. This corresponds to the count of developments occurring prior to or in the row year for which the row address is in the geographic treatment range around the development. Using this panel dataset, we ran both Ordinary Least Squares and logistic regression models. In both, the coefficient of accumulated developments can be interpreted as the percentage point increase in the likelihood of moving associated with an additional development completion near the household. The logistic regression forced predicted outcomes to fall between zero and one. All models included both year and neighborhood fixed effects, which should account for year-specific factors that affect the entire sample and time-invariant factors that affect neighborhoods, respectively.

Table 3

Table 1: Regressions: Probability of Movement

	Dependent variable:					
	Voucher Resident Movement in Pittsburgh's East End					
	OLS			*logistic*		
	(1)	(2)	(3)	(4)	(5)	(6)
'Accumulated Developments'	0.002**	−0.002*	0.0005	0.035	−0.038*	0.003
	(0.001)	(0.001)	(0.001)	(0.032)	(0.022)	(0.017)
Treatment Radius (meters)	200	300	400	200	300	400
Rows treated	5,626	8,753	11,434	5,626	8,753	11,434
Observations	53,740	53,740	53,740	53,740	53,740	53,740
R^2	0.197	0.197	0.197			
Adjusted R^2	0.196	0.196	0.196			
Log Likelihood				−14,078.370	−14,077.470	−14,078.900
Akaike Inf. Crit.				28,236.730	28,234.940	28,237.810

Note: *p<0.1; **p<0.05; ***p<0.01

All models include year and neighborhood fixed effects. Standard errors for OLS models are robust and clustered at the neighborhood level. The outcome variable is equal to 1 if an individual living at an address in a given year moves during that year; 0 otherwise. Each treatment range is a circle around a redeveloped parcel that excludes voucher residents located on the physical parcel where redevelopment occurred.

Table 3 shows the results of the OLS and logistic regressions at various levels of treatment. These results suggest that there is little correlation between the number of accumulated developments and the likelihood of nearby voucher households moving in the same year. These results are also vulnerable to omitted variable bias. If unobservable variables are correlated positively with the number of accumulated developments and correlated negatively with likelihood of moving, our estimates of the impact of accumulated developments would be biased downward.

The Event Study Research Design

We next attempted to use a design that more closely approximates an experiment to rule out the possibility for omitted variable bias. We employed an "event study"[6] design, where each completed development event is treated as its own experiment. For each event, rows for voucher residents within the treatment range of a development in years after the development was completed serve as the treatment group, while rows corresponding either to voucher residents

[6] Event studies are a special kind of difference-in-difference study that allow for modeling treatment effects occurring at different points in time for different observations. Event studies, like difference-in-difference models, can be used to estimate the causal effect of a treatment when key assumptions are met. This is true even when treatment and control conditions are not randomly assigned, as in our study. Our event study model measures the causal effect of large development projects (i.e., the construction of a new apartment complex or the construction of commercial establishments like Home Depot or Whole Foods stores) on voucher households' decisions to move or to stay in their rental unit *when the development is nearby*. Because large developments are constructed in different places at different points in time, the event study model is an appropriate model tool for this research question.

living outside the treatment range, or within the treatment range but for years prior to the event completion, serve as the control group.

Time is operationalized into "event time" in event study designs. Event time allows observations to receive treatment in different time periods. Large development constructions projects, for example, are undertaken at different times. Whether a household resides in proximity to a large development project thus cannot be defined using a single point in time (i.e., 2007) but necessarily differs for individual households across the study period. We measure the beginning of the treatment period from the completion time of the project because these dates are frequently more reliable than accounts of when projects were begun.

In practice, the event study starts with the same panel dataset as used for the previous simple regression. We next construct a set of "event time dummies", where the dummy for event time X is equal to 1 for a given row if the row address is in the treatment range and the row year is X years removed from the development completion date. For example, for a row corresponding to the year 2008 with an address within the treatment range of an event completed in 2007, the event time dummy for one-year after the event will be equal to 1, and the dummies for all other event times will be equal to zero.

For a treated household, the completion of the nearby construction project is "event time period zero" or "T_0." Treatment events are thus normalized to zero depending on when they occur for individual households. "Event time period one" or "T_1" corresponds to the year following treatment *for the same household*. "Event time period two" or T_2 corresponds to the second year following treatment for the same household and so on. Modeling event time requires a positive and negative operationalization of time. Pre-treatment time periods are negative. For example, T_{-1} corresponds to the year prior a household's receiving treatment and T_{-2} corresponds to two years prior to the same household's receiving treatment. In our model, event time ranges from T_{-6} to T_6. It is possible for households to be treated multiple times in the model, hence it also captures the cumulative effect of exposure to multiple treatments.

Event studies rely on an assumption of a lack zero pre-trends for causal interpretation. This means that in negative event time, that is rows for years prior to a development's completion date, there should not be a substantial difference between outcomes for observations in the treatment range and other observations. Visualizations of event studies can easily show whether this key assumption is met. For event studies, we plot the difference between the levels of outcome variables for each event time year relative to event time zero, the year of development completion. If our assumption that our development events are as good as random holds, we would expect these differences to all be very close to zero for negative event time years.

If we hypothesize that a treatment has a significant effect on the treatment group, we will expect the difference between our outcome variable in positive event time, and event time zero, to also be positive. That is, in a clearly defined post-treatment time period, we expect the trend line in an event study to be significantly greater or less than zero and observable with standard error bars. The sharper and more pronounced the treatment effect, the more the trend line should diverge from zero in the post-treatment period of an event study. A distinct advantage of using an event study model is the ability to capture pre- and post-treatment trends on a time-period by time-

period basis. In contrast, standard difference-in-difference models use average pre- and post-trends and thus do not capture treatment effects for individual time periods. This subtle difference matters when a treatment effect is expected to increase or decay over time. Thus, in theory our event study model is capable of capturing the treatment effect of large construction projects on voucher households' mobility even if those effects increase significantly only over time, perhaps as a result of slowly rising post-development rental prices.

Event Study Formulation

Out event model was defined with the following formulation:

$$Y_{i,ht} = \sum_{\tau=-q}^{m} (\beta_\tau D_{i,h,t}^{\tau}) + \theta_h + \psi_t + \epsilon_{i,h,t}$$

The dependent variable $Y_{i,ht}$ is interpreted as the probability that household i in neighborhood h moves during event time t. If large development projects have a causal effect on nearby voucher households (compelling them to move), the $ß_T$ coefficients should be positive and statistically significant in at least some of the positive event time periods (i.e., those in the post-treatment period). On the other hand, we expect to see $ß_T$ coefficients very close to zero in the pre-treatment period as a way of confirming that voucher household moves were caused by the developments and not by other endogenous factors. If $ß_T$ coefficients are very close to zero in the pre-treatment period and remain essentially no different from zero in the post-treatment period, large development projects did not have a causal effect on voucher household movement. We structure our model to allow for a separate set of $ß_T$ coefficients for dummy variables associated with additional development that may affect an address to measure the impact of accumulated development.[7]

The model includes neighborhood-level fixed effects, $\theta_{h,}$ which control for any fixed, time-invariant differences across neighborhoods that are observed or unobserved. A few examples of factors controlled for by neighborhood-level fixed effects are the perception of voucher households in the general neighborhood population and the physical geography of the neighborhood.

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[7] In a typical event study, rows will be treated by at most one event. However, in our study, a voucher resident address can be within the treatment range of multiple events. To address this, we include separate sets of event-time dummies for the first, second, and third event treating a given address. Our event-time dummies include dummies for negative event time, which indicate that the year of a row with an address in the treatment range is earlier than the completion date of the development event. These negative event time dummies allow us to test the validity of using development events as quasi-experiments by allowing us to assess pre-trends. If there are omitted variables that tend to systematically affect voucher resident movement prior to development completion, the coefficients associated with the negative event time dummies will be significantly far from zero. If the coefficients of all of the negative event-time dummies are close to zero, it gives us some evidence that there are no unobserved factors that are systematically affecting voucher resident movement prior to the completion of development events. We bin the year event-time at 6 years prior to or after an event. This means rows within treatment range that are more than 6 years prior to the development completion are assigned 1 for the event time dummy for -6, and rows that are more than 6 years after the development completion are assigned 1s for the event time dummy for positive 6.

The ψ_t variables are year fixed effects which control for observed and unobserved differences that vary across time periods but not across neighborhoods. A few examples of changes that are controlled for with year fixed effects are citywide zoning law changes, macroeconomic shocks, and programmatic changes affecting eligibility for the voucher program.

Including neighborhood fixed effects in the model corrects for trend differences between the treatment and control groups that are due to unchanging neighborhood differences alone. Including time fixed effects in the models corrects for changes over the study period that are due to time alone and are expected to affect all neighborhoods equally. In practice, fixed effects serve to smooth out unnecessary differences in the dependent variable values between treatment and control groups that are not attributable to the treatment. This smoothing enables us to visualize true treatment effects, if any, more clearly.

We chose to cluster the standard errors at the neighborhood level rather than at the individual level to reduce serial correlation at both the neighborhood and the individual household level.

Event Study Results

Figure 10 shows the effect of a single treatment on nearby voucher residents' mobility; the overall trend in the post-treatment period is not significantly differ from zero, suggesting that living in proximity to major development projects does not cause voucher households to move away from the development, through spillover effects or otherwise. The coefficients in negative event time are statistically indistinguishable from zero, giving us confidence that there are no pre-trends complicating the causal interpretation of our results. We also find that for subsequent developments after the first event, post-event-time effects do not substantially differ from pre-event time effects, which suggests that exposure to more than one event does not appear to have cumulative effects that induce moves. This second finding is however complicated by the fact that we see significant pre-trends for the second event, which suggest that we cannot consider these subsequent events to be as good as random for the purposes of making causal inferences.

To test the robustness of these results, we reran the results using a variety of treatment ranges, as well as excluding certain types of development events. The results of these alternative specifications do not differ significantly from **Figure 10.**

Figure 10

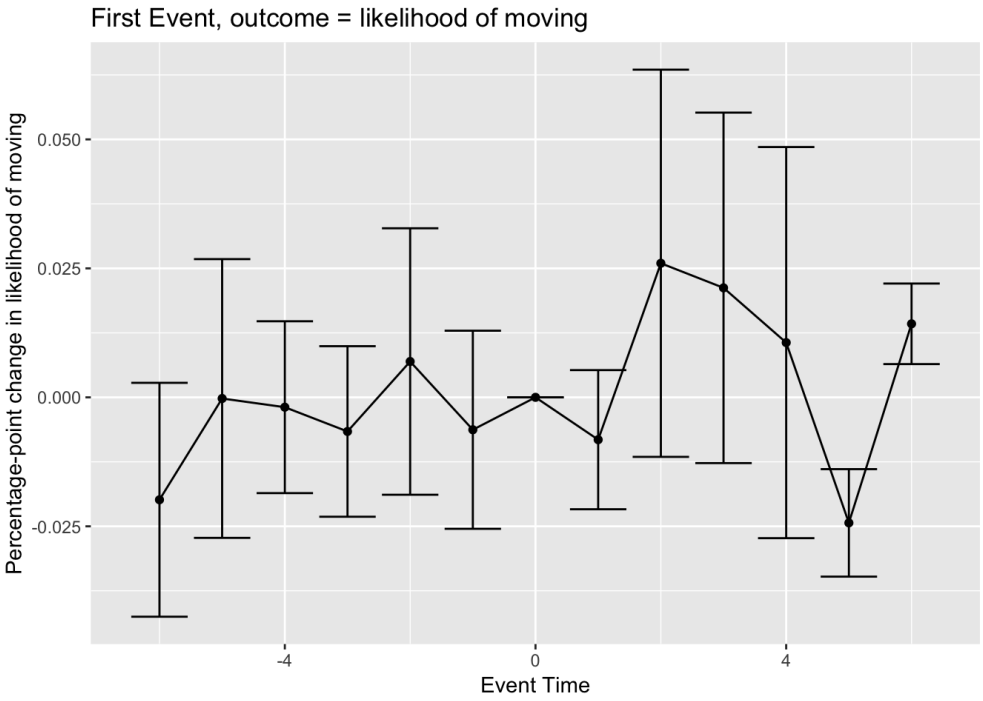
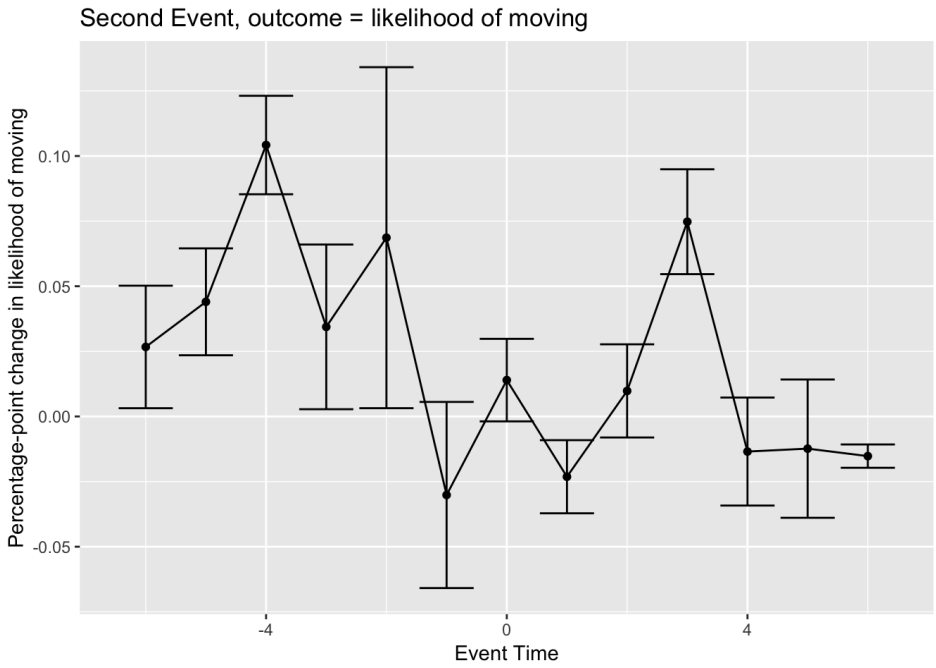


Figure 11



Lack of Displacement Findings -- Known Challenges and Potential Insights

The significant effect in our causal study results provide some evidence that voucher households have not been displaced from East End neighborhoods through the mechanism of proximal development. This negative finding of displacement could be attributable to any of the following:

- **model specification errors:** our implementation of an event study may not be appropriate for this research question, or we may have inappropriately defined the treatment boundaries of events
- **insensitivity to project impact:** our approach treats all observed developments equally regardless of the cost, size, or footprint of development projects
- **missing developments:** if we have missed large-scale developments that actually did displace residents, these movements would be expressed in the baseline movement rates, biasing our observed effects toward zero
- **incorrect timing:** our model considers the date of a developments completion to be the treatment year, when displacement may actually be triggered by an earlier phase in the development process
- **alternate displacement mechanisms:**
    - Landlords may respond to higher-level expectations of development trends
    - Smaller-scale "pop-ups" may be the real driver (especially in north East Liberty)
    - Voucher residents may be so choice-limited that price shocks from development are drowned out
- **protective effect of vouchers:** participation in the voucher program may insulate holders from displacement forces that affect low-income residents without vouchers

We could not find a comprehensive development data set (i.e., a complete list of construction projects undertaken in the East End during the study period), so we compiled our own data set of construction projects. This was mainly accomplished by reviewing news articles and searching private databases for information about key East End addresses. A potential limitation of our data set is that non-residential construction projects that were not "newsworthy" are not included. Thus, failing to find a relationship between voucher household moves and development could be the result of relying on a limited and incomplete data set for modeling. This is especially likely to be true in the northern census tract, which experienced a greater absolute loss of voucher households than the southern census tract. The northern census tract of East Liberty is a predominately residential area and did not experience *any* large construction or development projects in the study period that we were able to find. The relatively large number of voucher households who moved out of the northern census tract were thus either acting voluntarily or responding to changes not captured by the event study model.

Qualitative observation of the neighborhoods in the northern census tract reveals that while the neighborhood has not been affected by any large-scale developments, several formerly single-family homes seem to have been demolished and replaced with higher-end multi-unit "pop-ups." It is possible that these smaller scale development events are in fact drivers of displacement. A key limitation, then, of our study is the relatively narrow definition of "events" that the model explicitly measures or controls for with fixed effects and time dummies. We find it likely that other types of significant events were taking place in East Liberty simultaneously and perhaps also affecting the movement patterns of East Liberty voucher households. If development events that we fail to observe actually did have an impact on voucher recipient movement, these impacts will effectively show up in the "control" group rather than the event treatment group, biasing the effect we observe toward zero.

Our models only looked at whether or not landlords and voucher recipients responded to proximal development in the years after a development was completed in a way that manifested itself in short-term increases in voucher recipient movement. It is possible that any actions taken by landlords to spur the net out-migration of residents are in response to longer-term expectations of the neighborhood's developmental trajectory, which would not show up as the short-term proximal shocks that we tested for. Conversely, for voucher recipients, it is possible that their decisions to move are driven by much more immediate and pressing concerns, such as better access to familial or community network resources, that overshadow any impact of indirect price increases due to nearby developments.

Time constraints severely limited our exploration of the possible protective effects of housing vouchers – that voucher households are truly not being displaced – but we did find some indirect evidence of this hypothesis. One measure of housing stability is the rate at which populations move from one residence to another, with more frequent moves suggesting either greater instability or relatively high disposable incomes that allow households to follow their preferences for proximity to amenities. The team did not explore the possibility that voucher households move as a matter of preference given the structural features of the program and other obvious reasons. We did, however, search housing displacement literature for a counterfactual mobility rate for the voucher population in East Liberty. Remarkably, we found a 2016 study done by the Federal Reserve Bank of Philadelphia that measured mobility rates among high- versus low-income residents in gentrifying versus non-gentrifying neighborhoods in Philadelphia between 2002 – 2014. This study approximates our own in key ways, including the authors' use of individual-level data and the study window, which nearly overlaps with our own.

The Federal Reserve of Philadelphia found that 8.5% of low-income residents of gentrifying and non-gentrifying neighborhoods move annually in Philadelphia, with no significant difference in gentrifying neighborhoods. (Ding, Hwang, & Divringi, 2016) Importantly, voucher households were excluded from the sample in this study. We can compare this mobility rate to the 5.5% of voucher households in East Liberty who move annually. This superficial comparison of two low-income, predominantly African American populations suggests that the vouchers might have a stabilizing effect on mobility for the voucher population. Of course, this comparison only holds if we assume that the two populations are more or less identical except for the voucher condition, which is unlikely to be true. Nevertheless, such an effect would be consistent with our finding that development has not caused voucher household displacement in East Liberty. However, it conflicts with one of our most fundamental assumptions--that moves to disadvantage are not ordinarily undertaken by choice. We suggest that a subsequent research team investigate the potentially protective effect of vouchers on East Liberty residents using a counterfactual population from Pittsburgh.[8]

V. Ideas for Future Research / Policy Recommendations

[8] One note for future researchers would be to consider how to best incorporate new information from the 2020 U.S. Census, as well as any changes it might bring to tract boundaries, data descriptions and dissemination, should that information be relevant to their study.

In addition to researching a counterfactual population in Pittsburgh, the team has other recommendations for policymakers and analysts based on the results from our study and interviews with local housing advocates. Interviews conducted by the team showed concern about the lack of voucher-accepting housing and the loss of naturally occurring affordable housing in the East End.

One area the team has struggled with in measuring where housing voucher populations were moving was the lack of available data on voucher-accepting apartments in East Liberty and throughout the city. When voucher recipients were moving out of East Liberty, was an attributing factor the inability to find a voucher-accepting apartment within the 60-day window? Unfortunately, we were not able to study this, as the team was unable to find reliable data on which apartments were likely to accept vouchers at present, let alone dating back to 2003. The city or county housing authorities are better equipped to provide a review of housing units dating back to 2003.

Housing units accepting voucher options was not the only concern of some residents, as there are considerable hurdles to housing vouchers that keep many low-income residents from receiving them. As with the potential loss of voucher accepting housing, there are many examples of major naturally occurring affordable housing units closing down – most notably Penn Plaza in 2015. This formerly deed-restricted housing unit, which lapsed in 2006, was demolished in less than 10 years following the end of their obligation according to one former resident. (Taylor, 2020) Another source of frustration for the team was finding information on small scale "pop-up" developments. It is possible that enough small developments, which would not turn up in our development data sourcing, could make a large impact on the supply of housing units within East Liberty and beyond. The Affordable Housing Task Force Findings and Recommendations report from 2016 notes that over 1,700 deed restricted units would expire before 2021. (Lavelle & Gastil, 2016) Reviewing a dataset of former deed-restricted units over the past 30 years could provide more substantial understanding of the housing development process with East Liberty and the city as a whole.

Our approach to trying to find a causal link between large scale developments and voucher movements required that we exclude instances of voucher residents living on the same physical parcel of land that at any point experienced a redevelopment event. This omission, while necessary for our methods, likely misses an important part of the puzzle of displacement. The interactive web application that we developed to facilitate further research provides some hints as to how these residents may have been impacted by redevelopment. Using the web application, we observed:

- For voucher residents who live in structures that were later redeveloped, such as the Penn Plaza and Penn Circle apartments, we find surprisingly that move-out patterns tend to occur over a time-span of several years. Residents of Penn Mall were not given official move-out orders until 2016, but the number of voucher residents in the building had steadily declined since prior to 2010. We believe this provides some evidence that the property owners, anticipating the long-term redevelopment trends of East Liberty, may have taken adverse actions to discourage voucher resident occupancy of these units.

- In the case of four specific mixed-income development projects, we see that the number of housing voucher residents soon after the development completion is initially fairly high (between 15 and 25 residents) but declines to almost no residents remaining over the course of several years. We see this pattern for the developments of Fairfield I and II, Penn Manor, and East Liberty Place North. This suggests that while these projects may have been initially constructed in principle to inclusively provide some housing for low-income, these projects appear to fail to provide a long-term affordable housing option for voucher residents.

In both cases, targeted qualitative study of these development projects may reveal why we see these patterns of a slow erosion of housing voucher usage, either before or after development completion.

VI. Conclusion

In this paper, we present potentially conflicting findings from a study of housing voucher household movement patterns in East Liberty, a neighborhood of Pittsburgh that has undergone significant changes in the past two decades. Changes in East Liberty include the construction of several major apartment complexes, the construction of luxury/high end condos, the influx of major commercial businesses like Home Depot, Target, and Whole Foods, and numerous socio-economic and demographic changes. We hypothesized that these changes would have contributed, directly or indirectly, to the displacement of low-income, vulnerable households, but we did not find evidence of this with statistical modeling. This lack of significant evidence of voucher household displacement is potentially at odds with an additional, very conclusive finding that voucher households who migrated out of East Liberty during the period did so at the apparent "cost" of moving to disadvantage. That is, these households moved to neighborhoods that were not simultaneously improving and did not offer the assumed long-term opportunities of living in East Liberty. (We have been careful to describe these "moves to disadvantage" as defined by our own operationalization of disadvantage using a community disadvantage index. Though we recognize that households who appear to be moving to disadvantage could actually be moving to advantage based on their individual circumstances, we did not assume that this accurately represents a significant portion of the observed moves out of East Liberty.) These moves to disadvantage were accompanied by a rapid decline of *in movement* of voucher households in the study period, which suggests that conditions in East Liberty were indeed less and less favorable for voucher households as the neighborhood changed. In other words, though we cannot conclusively determine that voucher households were displaced from East Liberty through the mechanism of development, their movement pattern suggests an increasing *lack of ability to choose* to rent in East Liberty as well as *an ongoing, very restricted set of destination choices* for those who ultimately relocated outside of the neighborhood. We would be operating under an unrealistic meaning of "choice" if we described these movements, as a whole, as voluntary simply because we do not have conclusive evidence that they were forced.

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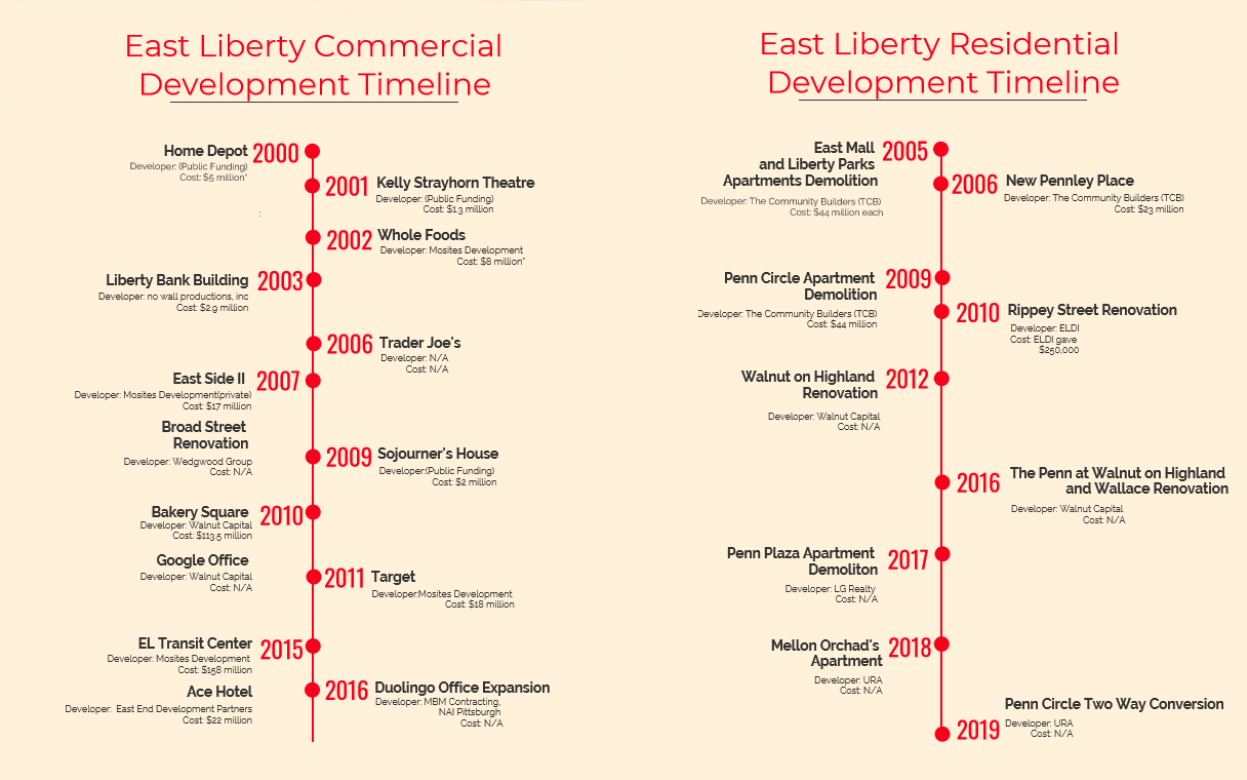
VIII. Appendix

A.I Additional Visualizations

Figure 12



Commercial Development Citations:
Home Depot: (HR&A Advisors, 2015)
Kelly Strayhorn: (Rawson, 2000)
Whole Foods (HR&A Advisors, 2015)
Liberty Bank Building: (Small Change, n.d.)
Trader Joe's: (Carpenter, 2006)
Broad Street Development: (Boren, 2007)
Sojourner House: (Sojourner House, 2020)
Bakery Square: (Carpenter & Todd, 2014)
Google Offices: (Soper, 2018)
Target: (HR&A Advisors, 2015)
East Liberty Transit Center:
(Urban Redevelopment Authority, 2012)
Ace Hotel:
(Urban Redevelopment Authority, n.d.)
Duolingo Office Expansion:
(MBM Contracting, n.d.)

Residential Development Citations:
East Mall and Liberty Parks Apartment Demolitions: (Fitzpatrick, 2001) (Luce, 2016)
New Pennley Plaza: (PR Newswire, 2000) (Fitzpatrick, 2001)
Penn Circle Apartments Demolition:
(Emporis, n.d.)
Rippey Street Apartments (Young, 2007) (Young, 2010)
Walnut on Highland: (HR&A Advisors, 2015)
The Penn at Walnut on Highland:
(HR&A Advisors, 2015)
Penn Plaza Apartment Demolition:
(Vrabel, 2018) (Taylor, 2020)
Mellon's Orchard Apartments:
(HR&A Advisors, 2015)
Penn Circle Two Way Conversion:
(Bidnet, n.d.)

Figure 13

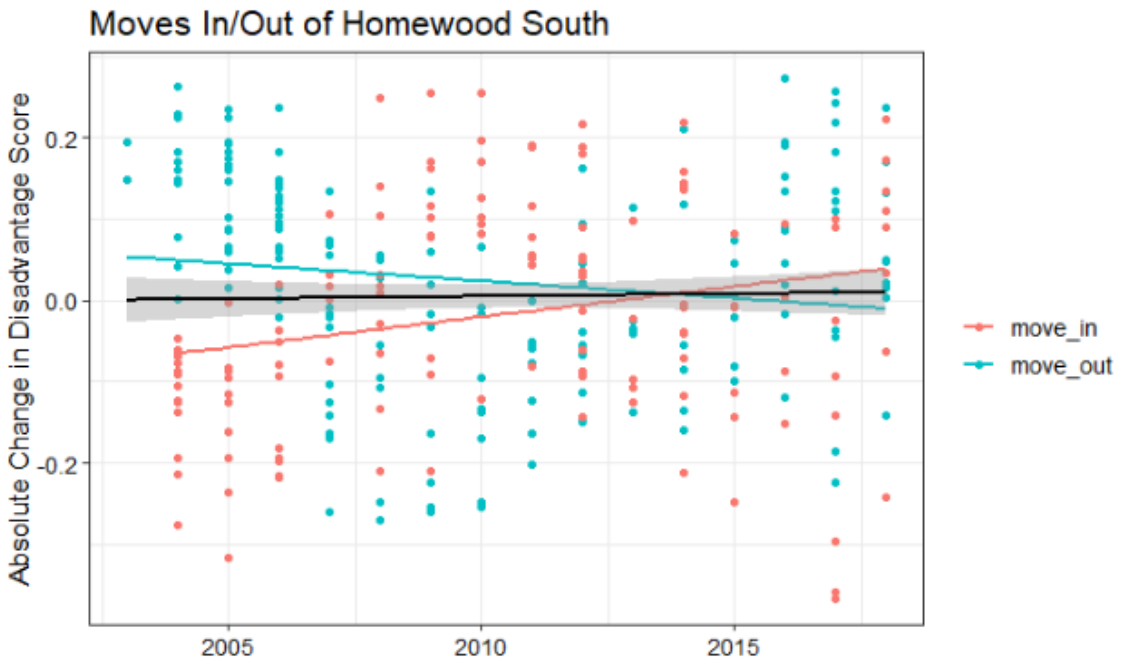
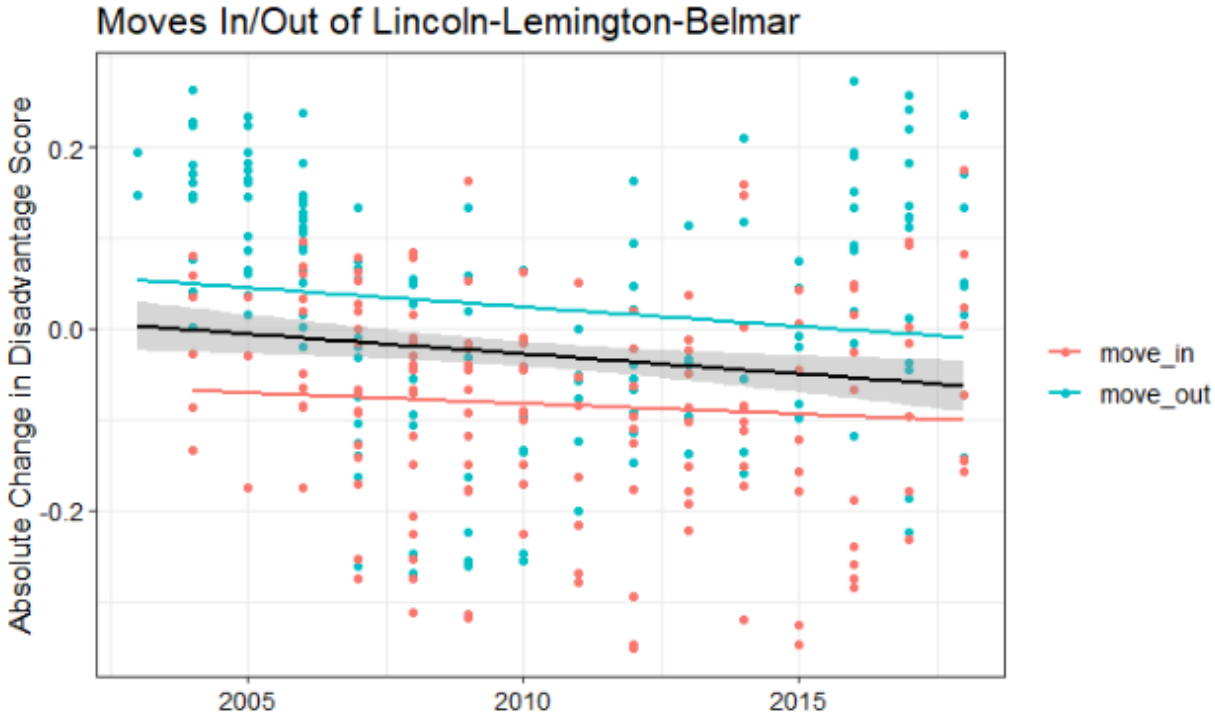


Figure 14



A.II History of East Liberty

Out of the many New Deal era legislation were the National Housing Act of 1934, which created the Federal Housing Administration and the Federal Savings and Loan Insurance Corporation to slow the rate of bank foreclosures on family houses. (University of Richmond, n.d.) As such, the federal government became a larger player in the home loan market and needed a system of classifying neighborhoods on their loan potential. (Hagerty, 2012) The Federal Home Loan Banking Board was established to do just this, and rated neighborhoods from Type A, "most desirable" to Type D, "hazardous and least desirable."

While the intended effort the system was meant to rate neighborhoods on their potential for paying off federally backed loans, it worked in effect to keep minority and working class neighborhoods for accessing credit. In 1937, East Liberty was rated a Type D neighborhood, on the basis of "an infiltration of Italians and Negros," a very heavy amount of "relief families," poor conditions of structures and a general lower class populace. (University of Richmond, n.d.) The only factors in favor of East Liberty were its good transportation infrastructure, its high employment, and level terrain. (University of Richmond, n.d.)

In order to stimulate growth following the Great Depression, Pittsburgh sought to create a second renaissance through a process of "blockbusting" and "urban renewal" in many of the previously redlined neighborhoods. (Krauss, 2018) Nowhere was this more prevalent than the East Liberty neighborhood and the Hill District. City planners proposed turning the commercial district of East Liberty into an outdoor, pedestrian mall around the two major roadways: Penn and Highland avenues. (East Liberty Development Inc., n.d.) This transformation required the demolition of dozens of blocks within the neighborhood – about 250 acres of land. Over the course of urban renewal efforts, the city demolished 1,200 homes and destroyed over one million square feet of the commercial district. (Tierney, 2019) This resulted in over 4,000 residents and nearly 600 businesses being displaced – predominantly in the lower income African American populations of the neighborhood. (Tierney, 2019) During the same period, wealthier white families were leaving the city for the suburbs south of Pittsburgh leading to a hollowing out of the middle class that built the East End. What was left by the 1970s were high rise housing projects and an empty commercial district. (Hagerty, 2012)

The leftover husk of East Liberty continued to shrink following the completion of the urban renewal projects. The vibrant and diverse community from before the Great Depression was now predominantly African American, low income, and subject to increasingly high crime rates. (Tierney, 2019) The City of Pittsburgh was experiencing the collapse of the steel industry, and significant economic and population decline. Despite the many problems within the neighborhood and city as a whole, this period also marked the beginnings of community led reinvestment strategies. East Liberty Development Incorporated, a nonprofit community development dedicated revitalization would become a major player in the economic development process was founded in 1979. (Hagerty, 2012) The Urban Redevelopment Authority within the City of Pittsburgh, leaders of the urban renewal strategies of the 1950s, began to take new shape following the collapse of the steel industry with broader goals of equity and development for disadvantaged communities. (Urban Redevelopment Authority, n.d.) These organizations, both

public and private, would lay the foundation for new developments in East Liberty in the coming decades.

The development strategies of ELDI, the URA, and other investment leaders began to pay off with the first major retailer returning to East Liberty in 2000 with Home Depot at the former Sears location. (Hagerty, 2012) Additionally, in 2002 Whole Foods Market opened in the Eastside Development partnership between ELDI and a local private developer. (Hagerty, 2012) As development returned to East Liberty, new concerns about gentrification have been raised by long-term residents. By 2012, the high crime rates of the 1980s and 90s had dropped, investment continued to accumulate, and middle/upper class residents began to return. (East Liberty Development Inc., n.d.) Many had considered what had occurred to be gentrification, (Eustis, 2019) with the effect of displacing the typically poorer, African American long term residents. (Jones, 2019)

The National Community Reinvestment Coalition released a report in 2019 examining which census tracts had experienced gentrification and displacement. NCRC defined areas eligible for gentrification as tracts with a population above 500, which scored below the 40th percentile in median household income and median house value in the 2000 Census. They were deemed gentrified if the median household income and median home value increased to the 60th percentile and saw an increase in percent of college educated residents to the 60th percentile by the 2010 Census. (Richardson, Mitchell, & Franco, 2019) Although neither East Liberty tract met the definition for gentrification using the 2010 Census or 2009-2013 American Community Survey five year estimates – we would expect to see both tracks of East Liberty having reached these marks by the 2020 Census.

A.III Benchmarking Comparison Neighborhoods

We chose the “East End” as the geographical unit on which to run a propensity score matching model. The East End is generally considered to consist of the following twenty-four neighborhoods: East Liberty, Homewood South, Homewood North, Larimer, Point Breeze, East Hills, Swisshelm Park, Garfield, Squirrel Hill North, Squirrel Hill South, North Oakland, Central Oakland, South Oakland, Bloomfield, Friendship, Highland Park, Greenfield, Hazelwood, Glen Hazel, Lincoln-Lemington-Belmar, Lower Lawrenceville, Upper Lawrenceville, Central Lawrenceville, Morningside, and Stanton Heights.

Several of these neighborhoods contain more than one census tract. For example, East Liberty contains two census tracts and Bloomfield contains five. In 2000, the baseline year of our study, there were a total of thirty-seven census tracts in the East End. Prior findings allow us to assume that East Liberty had not begun to change in substantial ways until after 2000, making this a suitable year in which to select comparison neighborhoods.

Propensity score models require observations to be classified as part of the treatment or control conditions. For our model, the East Liberty census tracts belong the treatment condition and all other census tracts to the control condition, allowing us to find the closest match to each East Liberty census tract in the candidate pool of East End census tracts. Matches were made according to the following five covariates: percentage of single female headed households,

percentage of families living in poverty, percentage of residents without a bachelor's degree, percentage of residents who are Black, and percentage of unemployed males.

According to the model, East Liberty census tract 1115 most closely resembles Homewood South census tract 1303. East liberty census tract 1113 most closely resembles Garfield tract 1114. To determine "second best" matches for each East Liberty census tract, we removed the best matches (1114 and 1303) from the candidate pool and ran the model again. The second-best match for East Liberty 1115 is Homewood South 1304. (Homewood South consists of two census tracts—1303 and 1304—both of which closely resembled East Liberty 1115 in 2000.) The second-best match for East Liberty 1113 is Lincoln-Larimer-Belmar tract 1203. The matches appear to be well-balanced across covariates, as shown in the **Table 4** below.

Table 4

Neighborhood Tract	East Liberty 1113	Garfield 1114	East Liberty 1115	Homewood South 1303
% SFHH	23.7%	32.2%	23%	31%
% Black	69.1	86.2%	75.4	96.5
% Poverty	15.1%	24%	33%	32.5%
% wo Bachelor	89%	91.5%	91%	95.6%
% Male Unemployed	31.6%	35%	51%	54%

A.IV Development data descriptions and related documents

This research was highly qualitative in nature and required piecing together information from a variety of sources, given that no public commercial development dataset was obtained. Each of the Urban Redevelopment Authority's (URA) Annual Reports were searched to compile a list of major projects. The URA has played a major role in funding many of the projects that transformed East Liberty. Reports were available for the following years projects from 2002-2016. The same analysis was done for East Liberty Development Incorporated (ELDI) through their Annual Reports. ELDI served as a cross reference to validate findings from the URA Annual Reports.

Preliminary searches were helpful in allowing the team to identify significant development projects and provided data points like costs and participants associated with the development projects. In terms of development costs, it was decided that at least $1 million in development costs had to be incurred for a project to be included in our dataset. That being said, there were a few developments that we included where we could not find explicit costs but could safely assume reached our threshold. Next, these projects were cross referenced with news stories to confirm the project's impact in East Liberty and to search for information on other variables, like dates, address points and project descriptions. Solidifying dates for the bulk of the projects remained elusive until this point.

Previous editions of the Pittsburgh Post-Gazette, Pittsburgh Tribune Review, and other local newspapers were heavily relied on, since these articles provided the most accurate and detailed content. Most of the data points on dates were only confirmed in yearly terms through these articles. Address points were verified through Google Maps and Emporis, which served as an online building directory. (Emporis, n.d.) Emporis was especially useful if the names or addresses of buildings were already known. The website offered a general profile of a building including aspects like the building's main address, status, and usages.

In order to identify development projects that directly impacted voucher holders, a list of residences that housed multiple voucher holders throughout the study period was compiled. This list included 107 addresses of properties that housed between 5 and 134 voucher holders over time. These 107 addresses were then cross referenced with Lexus-Nexis and Google to identify if any newsworthy project occurred at that site at any time between 2003 and 2019. If so, the date the development was initiated, the date the development was finished, the cost of the project, and project's developer were recorded as the information was available. Of the properties surveyed, 98 on the list did not show up in any news sources and of the 10 that did, one was not in East Liberty and only five were not identified in the previous steps.

Project descriptions were verified through visits to the websites of the developers and real estate agencies that were involved in the renovation, construction, or demolition of buildings. The major parties involved in development in East Liberty, aside from the Urban Redevelopment Authority (URA), were:

1. The Community Builders (TBC)
2. East Liberty Development, Inc (ELDI)
3. MBM Contracting
4. Walnut Capital
5. Mosites Development
6. Pennley Park South
7. The Wedgwood Group
8. LG Realty

All this information was compiled into an Excel Spreadsheet that features sections for commercial and residential development projects that fell within our study period. Rows represent the individual projects and columns represent the variables of interests, which include date (beginning and end), development cost (if publicly available), address, associated developers or real estate owners, a project description, and source. through our research we

identified 16 major commercial projects and 16 major residential projects, 3 of which are heavily transportation related. The associated projects are included in **Figure 12**. Only relying on "big name projects" (BNPs) means the team could have likely missed out on smaller projects that could still have affected voucher holders and increased rents, so it should be safe to assume that the information presented may be incomplete.

A.IV Data Cleaning Methodology

The team was given access to Allegheny County DHS data regarding the two major housing voucher programs: The City of Pittsburgh Housing Authority and the Allegheny County Housing Authority datasets. These datasets included deidentified, unique records of voucher holders within the program from beginning in 2003 and 2006, respectively. The data was pulled from each month of DHS's records and would only show new addresses if a resident moved within the program or potentially left the program. It consisted of over 150 thousands rows, and 12 columns generating the unique client ID, current addresses, destination addresses, move-in dates, move-out dates, and other relevant information. The goal of cleaning was to remove errors in primary address fields that would interfere with accurate geocoding, and to observe different households properly within the same building location. Additionally, certain addresses marked as "do not use" within the dataset were removed by the team.

A large amount of time was given to cleaning this data to make sure that the addresses (both current and destination) were accurate to minimize duplication errors in the data. This included, but was not limited to, cleaning primary and secondary address fields, creating consistent abbreviations, removing ancillary terms and excess characters, imputing proper secondary address information, and imputing contradicting move-out dates within a single unique record. Before cleaning had taken place, the data held 51,585 unique heads of households associated with 32,558 unique physical addresses. Additionally, there were 16,399 missing move out dates associated with the datasets. After cleaning, the team had identified 48,424 unique heads of households, 22,860 unique physical addresses, and 12,937 missing move out dates. The cleaned, unique records tend to match the general demographics of the voucher program – notably a majority of African American participants (over 70%), with a sizable white minority population (about 27%) and a nontrivial amount of Native American, Native Hawaiian, Asian, and Multi-Racial residents.

When looking at the voucher population for anyone associated with East Liberty, we have a population size of 440 individuals. Of those individuals, roughly 85% of East Liberty voucher residents are female, and about 96% are African American. This tracks with the general characteristics of our entire voucher population.

A.V Interviews (Selected)

Jeffrey Lin, Vice President and Economist, Federal Reserve Bank of Philadelphia

Jeffrey Lin is a member of the Gentrification and Displacement in East Liberty Systems Project's Advisory Board and specializes in the study of cities, regions, and their growth. He is an economist at the Philadelphia Federal Reserve Bank, co-executive director of the Philadelphia

Federal Statistical Research Data Center and edits the *Regional Science and Urban Economics* publication.

With respect to an event study, Dr. Lin informed the team that they would need to be thoughtful about determining how wide to draw the bandwidth of time being analyzed, as decision makers (landlords, residents, developers) may begin to change their behavior one to two years in advance of shovels actually entering the ground. The best way to identify the time lags in the data is to plot it and see what it shows. If there is no clear pattern that emerges, the team should be hesitant to try to push it further, however there is potential to use the Penn Plaza closure to identify anticipation effects for not just the property itself, but surrounding properties as well.

With respect to displacement, Dr. Lin explained that not much research has been done about the effect of displacement on social connections. Researchers don't know the cost of losing social connections to friends, family, a neighborhood, or its institutions. He explained that it could be interesting for the team to explore if after being displaced East Liberty residents are moving to the same neighborhoods or if they are widely dispersed. The latter could indicate that one effect of displacement is the loss of social capital however it could be hard to find evidence that residents interacted in the first place.

Mr. Lin advised the team not to be overly worried about missing important changes happening in the study area because of the incorrect selection of gentrification indicators. He explained that all of the factors the team is considering, the change in education level of residents, median income, demographics etc. are correlated with each other and are all signs of the shift in demand for particular neighborhoods. Therefore, whether or not the team uses just one indicator, or a combination of indicators, it is likely that a similar story will be told. Therefore, he suggested that the team pick one and then explore the robustness of that choice with supplementary indicators. He did caution that there may be differences in timing related to when these different measures change and gave the example that housing values incorporate people's expectations of what will happen in the future. Therefore, in gentrifying neighborhoods housing values are the first thing to increase in relation to other indicators.

Elaine Magil, Director of Affordable Housing Advisory and Transaction, TCAM

Elaine Magil is the Director of Affordable Housing Advisory and Transactions at TCAM (Tax Credit Asset Management). She is an expert on affordable housing as an industry and community development. Her role involves working on behalf of stakeholders within various projects and ensuring that their expectations are met in terms of return on investments, that loans are repaid or that an organization's mission was fully realized.

Though only having worked in Pittsburgh in this capacity for about two years, Elaine was able to provide insight into the trends that dominated the affordable housing industry in Pittsburgh. She has observed that unlike other similar cities, Pittsburgh lacks influential community development corporations that promote affordable housing measures, aside from ELDI. A majority of the players that have transformed development in East Liberty neighborhood and Pittsburgh overall tend to be large for-profits or nonprofits entities that are based outside of the area. However, what is unique to Pittsburgh is the significant amount of investment made by philanthropic

entities like the Mellon and Heinz Foundations. This could explain the lack of local organizations devoted to affordable housing in the city.

When asked if it were possible to develop an area without displacing long-term residents, Elaine admitted that this was still a point of contention for many stakeholders, but she was optimistic that the right policy approach could mitigate such issues. Two suggestions she made was the need to facilitate the creation of deed-restricted and affordable housing that encouraged mixed-income living as well as the need for housing and education policy to work on solutions together. With the former approach, when cities do not encourage mixed-income housing, she observed that deed restricted housing were used by low income residents, while market rate housing was geared towards higher income earners. However, there were not many options in the middle of this spectrum and if these extremes were maintained, it could prove detrimental to the quality of neighborhoods. Her proposed second policy solution asserted that housing and education advocates should work together to truly impact neighborhoods. While states could encourage the development of many affordable housing structures and get people housed, what could be more transformative for a low-income family was access to quality schools. Associated improvements in this respect could ultimately enhance income diversity in neighborhoods, though the potential for displacement would still exist.

Our conversation with Elaine confirmed that we were not headed down the wrong path with our analysis and led the team to want to explore what types of landlords accepted Voucher holders. More specifically, we were interested in learning how many properties were deed-restricted or fell into other property types. We also considered what types of housing were made available to low-income residents versus Voucher holders, and how Voucher programs functioned. Given the time left to complete the project, these questions may have to be explored by future student teams.

Mr. Randall Taylor, Penn-Plaza Support and Action Coalition Member and form Candidate for City Council

Randall was a long term East Liberty resident up until the Penn Plaza Apartments demolition in 2017. He had moved from Homewood to East Liberty at the age of six and spent decades in East Liberty, witnessing its transformations. After Penn Plaza was demolished, Randall moved back to Homewood due to the increasing rents in East Liberty and is currently renting a home that he hopes to purchase and rent out. Randall was a part of the Penn Plaza Support and Action Coalition that protested LG Realty and elected officials for their decision to demolish Penn Plaza without offering much assistance to the displaced residents. He also participated as a voting member of local school boards to encourage or resist development efforts using tax breaks that would impact lower income residents in East Liberty.

Initially, Randall and other Penn Plaza residents were not aware of LG Realty's intentions to demolish the Penn Plaza apartments. Reportedly, LG Realty had decided in 2012 that the apartments would go but continued to accept new renters until months before the building was taken down. Randall asserted that the local building staff cared for tenants and were efficient and prompt in their work as well as understanding of tenant issues and LG Realty virtually played little role in the maintenance of the building. The apartments were affordable and well-

maintained, and the building population was made up mainly of lower income workers and voucher holders. By mid-2015, tenant leases were running out and they found that they were not allowed to renew them.

Up until this point, residents had been feeling safe considering that many other apartment complexes had been seeing renovations around East Liberty and did not think that LG Realty would have taken much of an interest in Penn Plaza Apartments. However, they did not know that in 2006, LG Realty was released from its obligation with the city to house Section 8 voucher holders and maintain affordable apartments. LG Realty was now free to do with the building what they liked. The city, involved local government officials and LG Realty had development aspirations for the land that Penn Plaza sat on and pushed for its demolition. They did this without providing much in the way of support for the many working class residents that would inevitably be displaced.

Randall believes that development in East Liberty has not been conducted correctly. Non-profit developers, like East Liberty Development Incorporated (ELDI) or government development agencies, like the Urban Redevelopment Authority (URA), have not adequately worked with long-term residents when implementing their long-term strategies for the neighborhood. So far, many projects have displaced working class and predominantly African American residents. Randall believes that between 2014 and 2018 alone, 10% of the African American population was forced out of East Liberty and Pittsburgh. Meanwhile, higher level income earners were targeted and encouraged to move into the transforming East Liberty. The only exception that benefited everyone was the creation of the busway or the eITRID development, that succeeded in connecting East Liberty to more affluent neighborhoods and retailers, Target, and Whole Foods, as well as the surrounding areas.

Randall could not name any construction projects in Pittsburgh that have managed to include an equitable ratio of affordable/non-affordable housing and is not sure whether the city has gotten any closer to implementing such policy recommendations. He was certain that the displacement of Penn Plaza residents due to its demolition as well as the COVID-19 outbreak have made it so that the topic of affordable housing is on the agenda for many local officials in Pittsburgh and in cities around the US. More importantly, the need for genuine community involvement in development projects and presence of outside housing developers that can serve as a voice for those being negatively affected are paramount. This echoes the sentiments of Elaine Magil, who stated the importance of community based developers, other than ELDI, the URA and philanthropic organizations, to be involved in developments that encourage affordable housing.