Was gentrification a factor in designation of Opportunity Zones: A study of 100 most populous cities with DC as a case study

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1. Introduction

Opportunity Zones, the new federal program, can potentially cause or speed up gentrification in many urban areas of the US.[1] Through this program, the federal government subsidizes investments in new businesses and commercial projects in the census tracts that received the Opportunity Zone (OZ) designation. Eligibility criteria for opportunity zone designation was broadly set by the federal government, and state governors and local politicians were given the authority to select which census tracts to designate as opportunity zones from the range of census tracts that met the opportunity zone designation criteria. For instance, in DC, out of 97 low income communities and 19 contiguous census tracts, 25 of them received OZ designation.[2]

The rules and regulations of the opportunity zone program are flexible (Marcin, 2020) and consequently, state governors and local political leaders could influence the selection process. Although the OZ program's main objective has been to attract more economic development to distressed areas, however, due to its broad and flexible rules, about 57 percent of census tracts in the US meet the set eligibility criteria (Gelfond and Looney, 2018). Therefore, census tracts in the early stages of gentrification could meet the eligibility criteria and receive opportunity zone designation, either by chance or through lobbying efforts by developers and their supporters in local governments. These census tracts are expected to receive more private investments than those located in non-gentrifying tracts. Gentrification, the replacement of low-income and less-educated

[1] https://www.brookings.edu/blog/up-front/2018/02/26/will-opportunity-zones-help-distressed-residents-or-be-a-tax-cut-for-gentrification/

[2] See https://dmped.dc.gov/page/how-dc-designated-our-opportunity-zones for information on OZ designation in DC.

population with those of higher socio-economic status, has been associated with higher returns for investments in businesses and real estate (Brummett and Reed, 2020).

This study, first, attempts to explore the role of gentrification in the selection of OZ census tracts. We use tract level business and residential vacancy rates and other economic variables such as unemployment rate, median income and poverty rate as indicators of the level of economic activity. Information on business and residential vacancy rates allow us to compare census tracts in terms of their economic potentials to attract new businesses and residents. Lower business and residential vacancy rates indicate that neighborhoods are attracting more residents and new businesses. Partially, these new investments could be driven by gentrification as businesses respond to the increasing demand for new goods and services driven by the inflow of higher income residents.

Following Card et al (2008) and Brummett and Reed (2020), we first, construct a gentrification measure for all census tracts in 100 most populous urban areas in the US. We match this data set with the list provided by the Internal Revenue Service (IRS) and then develop an empirical model to study role of gentrification in OZ designation. Identifying census tracts as gentrifying and non-gentrifying has not been problem free (Ding et al. 2016; Otabor, Kurban and Schmutz 2020). Without having access to finer geographical level data on the in-migration rate of the higher income population and the out-migration rate of the lower income population, it is not possible to accurately measure the displacement impacts of gentrification (Hwang, 2015). A recent study (Otabor, Kurban and Schmutz 2020) is an exception because it used address level income and real property tax data from the DC government to study impact of gentrification on internal migration within DC. Therefore, secondly, following Otabor et. al. (2020), using DC as a case study,

we use DC administrative data to analyze the relationship between gentrification and migration flows in the 116 census tracts that met opportunity zone eligibility criteria. Also, we use spatial analysis to study the impact of gentrification in the selection of the 25 census tracts that received opportunity zone designation. If gentrification played a role in receiving OZ designation, it is expected that these census tracts will receive higher share of new subsidized investments. We therefore seek to predict the investment flow across OZ tracts and gain initial insight into potential redistribution effects of OZ designation due to inclusion of gentrifying tracts.

Our descriptive analysis of the 100 most populous urban areas in the U.S. (100 CBSAs) indicates that the statistical relationships between gentrification and business and residential vacancy rates are stronger in OZ designated tracts. In DC, we found that gentrification has been spreading to more neighborhoods in OZ eligible neighborhoods and this process is mostly driven by influx of higher income residents. The in-migration rates of higher income residents are significantly higher compared to their out-migration rates, which caused displacement of the lower income residents.

Specifically, this study attempts to measure whether selection of opportunity zone census tracts will increase or decrease the speed of gentrification, using DC as a case study. Having access to administrative data will allow us to directly measure the year-to year pace of gentrification in OZ eligible census tracts. The empirical model of this study can be extended to other metro areas once data are available.

2. Literature Review

The study of gentrification is complex, and there is currently no consensus on its definition. The term gentrification was coined by urban sociologist Ruth Glass (1964) to

describe neighborhood change she observed in London. The first wave of gentrification literature focused on shifts in class and income taking place in neighborhoods (Glass, 1964). Freeman (2016) notes that the questions in this early wave centered around the amount, causes, and consequences of gentrification. Migration and displacement effects formed a significant part of this inquiry. Definitions of gentrification include increases in some measure of socioeconomic status (income, home values, rents, education), and or displacement of persons of lower socioeconomic status. Smith (1998), defines gentrification as a process characterized by investment and renewal within low-income central city neighborhoods, along with the in-migration of middle- and upper middle-class residents into these neighborhoods. In comparing the first wave of gentrification with a more recent gentrification (since the 2000's), Freeman (2016) highlights differences in scale, in characteristics and personal preferences of in-movers, the role of crime, and the policy response. This later wave of gentrification has received more of a policy response in terms of actions to monitor and address gentrification, given the shift in perceptions of responsibility due to the scale of the phenomenon. The literature has thus grown to include methods for identifying gentrification from its early stages. Chapple and Zuk (2016) explore a number of "toolkits" developed by cities and universities to detect the early warning signs of gentrification and analyze the implications for DC.

Another strand of gentrification literature examined the racial effects of gentrification, whereby those moving in tended to be primarily white and the moving out population tended to be minority, mainly African Americans. Card, Mas and Rothstein (2007) study racial segregation in housing, building on Schelling's (1971) idea of white flight from neighborhoods which have reached a critical "tipping point" of minority

presence as a share of the neighborhood. Using census tract level data over the period 1970 to 2000, they utilize regression discontinuity design to analyze this phenomenon. They find existence of this tipping behavior, with tipping points ranging from 5% to 20% minority share. At the same time, rents and housing prices are not found to exhibit such systemic non-linearities around the tipping point. Overall, the authors conclude that "One explanation for the prevalence and persistence of racial segregation is that white families are unwilling to live in neighborhoods with high minority shares." While gentrification and white flight appear to be opposite processes, there is a possibility that the same idea of white preferences is at play. However, this population arguably has a higher level of comfort with the minority population, and thus are not deterred from a beneficial investment in housing based on the current racial composition of the area. There is the anticipation and expectation that these neighborhoods will increase in value, and also change their composition, and those moving in, the early gentrifiers, stand to benefit from entering at the lower end of the market.

There has been a renewed interest, and broadening of factors deemed causal, in the process of gentrification. Hwang and Sampson (2016) explores a broader set of ethnic/racial minorities and argues that presence of a diverse set of minorities was a contributing factor in later gentrification (by whites). Whereas migration has been an area of interest from the beginning of the gentrification literature, the scope of this strand of gentrification literature has also expanded to examine questions on the social well-being of not just the in-movers or out-movers, but to compare outcomes between the groups.

Brummet and Reed (2020) use longitudinal microdata data to study the impact of gentrification on the well-being of original residents. Based on work by Baum-Snow and

Hartley (2017) and Couture and Handbury (2017), they operationally define gentrification as "an increase in college-educated individuals' demand for housing in initially low-income, central city neighborhoods." They demonstrate that this measure of gentrification performs as well as other commonly used measures such as change in income, change in rent, and change in house value. Brummet and Reed (2020) point to the following benefits of the education variable: easier separation of cause and effect given the relative stability of college attainment after age 25; prior use of this variable in studying tipping (see Card et al. (2018) and Bohlmark and Willen (2020)); early detection possibility given that changes in education may be a precursor to changes in rent and income; and the recent "return to the city" has been driven by college educated individuals (Baum-Snow and Hartley (2018); Couture and Handbury (2019); Edlund et al. (2019); Su (2019)).

In addition to the effects on new and incumbent residents, there is interest in the effect on the changing neighborhoods. Gentrification is associated with higher incomes, and thus, greater levels of disposable income. While higher levels of disposable income can be thought of as generally positive for businesses, Meltzer (2016) explores the effect of gentrification on small businesses and finds mixed results. On the one hand she does not find higher levels of displacement in gentrifying neighborhoods, as compared with their non-gentrifying counterparts. However, conditional on a business leaving, the length of vacancy is longer for gentrifying as compared with non-gentrifying neighborhoods. She notes that "cities with less vibrant neighborhood retail markets could be more vulnerable to gentrification-induced displacement."

Though not conceptualized in relation to gentrification, the OZ policy is a place based economic program with a potential direct effect on businesses. Aimed at revitalizing

distressed areas across the US, its relationship with gentrification is still ambiguous given the recency of the program. In contrast, Kline and Moretti (2014) studying the long run effects of the Tennessee Valley Authority (TVA), one of the largest place-based policies in the U.S., which focuses on employment, found that on the one hand, employment gains in the agricultural sector did not outlive the subsidy, and in fact, were reversed; and on the other hand, employment gains in the manufacturing sector evidenced a strong and persistent boost, due in large part to agglomeration economies. It is of note however that the TVA involved direct investment into public infrastructure, whereas the OZ policy provides a tax subsidy for businesses. As such, the differences are significant in terms of the channels through which effectiveness can be achieved.

Additionally, Neumark and Simpson (2015) provide a thorough analysis of the approaches and lines of inquiry within the study of place-based policies. They discuss various empirical analyses of their impacts, and achievement with respect to stated goals. Among the suggestions for extending the evidence base is the question of "isolating specific features of policies that make them effective or that create unwelcome distortions;".

Our study aligns with Neumark and Simpson's (2015) suggestion for extending the evidence base with respect to place-based policy. Indeed, the lower levels of eligibility restriction in the OZ program, as compared to other place-based programs, opens the door for gentrification to be part of the selection process, and if it did, this may impact the effectiveness of the program in achieving its stated goals. As demonstrated by Kline and Moretti (2014), and concurred by Neumark and Simpson (2015), there is a need to evaluate "the aggregate welfare effects of these investment programs, not just those on the directly

affected areas, in order to fully determine the magnitude of any trade-off between aggregate efficiency and redistribution across regions". In this paper, we seek to predict the investment flow across OZ tracts and understand whether or not gentrifying tracts are predicted to capture more of the business investment, thus giving initial insight into potential redistribution effects due to inclusion of gentrifying tracts.

Literature on Opportunity Zones has tended to seek out early signals of the type of effect this designation is anticipated to have, although we are still in the very early stages of this policy and the effects are still unfolding. Chen, Glaeser, and Wessel (2019) estimate the effect of OZs on housing prices using data from the Federal Housing Finance Agency (FHFA) and the Urban Institute. The authors point out the potentially heterogenous impact of the OZ designation based on the specific type of space primarily benefitting from the subsidy, that is residential space or commercial space. While they emphasize the preliminary nature of their findings given the recency of the policy implementation, they do not at present find evidence of expectation, among homebuyers, of neighborhood upgrading. They conclude by questioning the effectiveness of capital subsidies as against "investments in human capital and neighborhood amenities" as the way forward for eligible tracts.

3. The Opportunity Zone selection process

Overall, 42,078 of the 73,070 census tracts in the US were eligible for OZ status, of which 8,687 received the OZ designation (U.S. Treasury, 2018). Although a much higher share of OZ tracts were Low Income Communities (LICs) compared to the eligible non-designated tracts (97.2 percent compared to 69.9 percent), analysis shows that many

of the designated tracts did not need the additional subsidy to attract new investment.[3] Thus, while the OZ program aims to spur economic activity in distressed areas, the impact of OZ designation may be affected by poor geographic targeting.[4]

Under the definition of "low-income community" (LIC), 97 census tracts within DC were eligible to be designated as OZ's. Based on the conditions for tracts contiguous with LIC's to be designated as OZ's, 19 additional census tracts were potentially eligible.[5]. In total, 116 census tracts in DC were potentially OZ eligible. Of these, 25 tracts were designated as OZ, which corresponds to the maximum number of tracts that DC could nominate.[6] Summary data made available by the Urban Institute[7] compares DC's OZ designated tracts with the eligible, non-designated tracts, and all tracts within DC. Across the economic, housing, demographic, education, and socioeconomic change characteristics compared, there exists an expected pattern with designated OZs having the lowest values on characteristics associated with positive neighborhood characteristics (such as median household income and median home value), followed by non-designated eligible tract, and then all tracts within DC. Conversely, designated OZ tracts had the highest values on characteristics associated with negative neighborhood characteristics (such as poverty rate and unemployment rate).

Due to federal tax benefits on capital gains, OZ designation incentivizes new investments to the selected census tracts. The economic and social impact on low-income

[3] Our calculation shows that 27% of census tracts designated as OZ were above average in their gentrification rating.

[4] https://www.brookings.edu/wp-content/uploads/2018/10/looney_opportunity-zones_final.pdf .

[5] https://www.cdfifund.gov/Pages/Opportunity-Zones.aspx.

[6]The OZ regulation instructs states to designate either 25 percent of all LICs census tracts or 25 census if the state has fewer than 100 LICs.

[7] See Theodos, Meixell, and Hedman (2018) which provides a link to state-level tract characteristics by Opportunity Zone designation status at https://www.urban.org/sites/default/files/urban_statesozs_update.xlsx.

and undercapitalized census tracts is potentially significant. At the same time, heterogeneity among residents of these areas suggests differential effects on them. The flow of investment toward OZs can positively influence neighborhood amenities, which may increase rents and housing prices and gentrification. On the other hand, given the choice between a gentrifying and non-gentrifying OZ, a gentrifying OZ may present a more attractive option for the investor given the comparison between the rate of return on investments. Indeed, in a Brookings blog post, Looney (2018) posed the question "Will Opportunity Zones help distressed residents or be a tax cut for gentrification?".[8]

4. Data and Methods

Gentrification, originally conceptualized by Glass (1964) as the replacement of the working class by the middle class, has been measured using increases in education levels, household incomes, rents and housing prices. Following Card et al (2008) and Brummett and Reed (2020) we use the change in the percentage of college graduates in a census tract between two time periods as our measure of gentrification. Specifically, the gentrification measure is calculated as the change from time t to t+1 in the number of individuals aged 25 or older with a bachelor's degree or higher living in census tract j in city c, divided by the total population aged 25 or older living in tract j and city c in year t:

$$gentjc \equiv \frac{bachelors25jc,t+1 - bachelors25jc,t}{total25jc,t} \quad (1)$$

The more recent wave of gentrification has been characterized by the flow of young college graduates to lower income neighborhoods. As such, this measure detects earlier stages of

[8] Adam Looney, "Will Opportunity Zones Help Distressed Residents or Be a Tax Cut for Gentrification?" Up Front (blog), Brookings Institution, February 26, 2018, https://www.brookings.edu/blog/up-front/2018/02/26/willopportunity-zones-help-distressed-residents-or-be-a-tax-cut-for-gentrification/.

neighborhood changes and improvements in neighborhood amenities (Brummett and Reed, 2020).

The education and population variables used to calculate the gentrification measure are from the American Community Survey (ACS) 5-year estimates. Additional characteristics of the census tracts used in the analysis of the 100 most populous CBSAs are also from this source. For the case study on DC, income, home value and migration characteristics are sourced from the DC government's individual income tax and real property tax administrative records. The other DC data points are retrieved from the ACS.

Gentrifying and gentrified neighborhoods attract higher-income residents, and therefore are associated with higher levels of median household income. Because of the increased purchasing power or disposable income, the neighborhoods at the various stages of gentrification are more attractive to many businesses than non-gentrifying ones. We use residential and business vacancy data from the US Postal service as a proxy for business attractiveness. This measure is used to predict where the new OZ investments will flow. Vacancy data for businesses and residents is collected by the U.S. Postal Service (USPS) and aggregated by the U.S. Department of Housing to provide quarterly information on census tract level vacancies for various time intervals, with durations varying from 3 to 36 months or longer (HUD, 2016).[9] This data will be referred as USPS-HUD throughout the paper. Additionally, based on the notion that household investment is a precursor to nonresidential business fixed investment (Fisher, 2007), we use building permit data, as an alternate proxy in predicting the flow of new business investments for DC analysis.

[9] The USPS identifies a vacant address as one to which mail has not been delivered for more than 3 months (GAO, 2011). In HUD-USPS data long-term vacant and inhabitable addresses are labeled as "no stat". They may reflect either the units under construction or those demolished or abandoned. To avoid measurement errors, we exclude "no stat" addresses from our vacancy counts.

Specifically, we use construction permits over the period 2011 to 2015. Permit data is retrieved from the DC government's open data website.[10]

Our contribution is three-fold. First, using our gentrification and OZ designation we explore the role of gentrification in OZ designation of the census tracts. Our OZ data are based on the summary tables produced by the Urban Institute and information on OZ designation from the IRS. The IRS data provided our initial list of OZ designated census tracts. Data from the Urban Institute additionally indicated all eligible tracts, as well as the criteria on which this eligibility is based (low income community (LIC) or non-LIC contiguous tract. Second, we use USPS-HUD vacancy data to predict the flow of new business investments across OZ census tracts. Additionally, following Brummet and Reed (2020), we use longitudinal microdata from the DC government, specifically the individual income and real property data, to explore neighborhood change in OZ eligible tracts in DC between 2011 and 2015. Annual in- and out-migration and demographic data for DC residents in OZ eligible tracts allows us to observe how this migration affected gentrification and displacement of the lower income population in the city.

5.1. Model Specification

Our primary regression specification is a fixed effects OLS model. Equation (2) represents the specification for the 100 most populous CBSAs, and equation (3) represents the specification for DC:

$$\Delta Y_i = \beta_0 + \beta_1 \text{ gent} + \mu + \varepsilon \quad (2)$$

$$Z_i = \beta_0 + \beta_1 \text{ gent} + \beta X + \gamma + \varepsilon \quad (3)$$

[10] https://opendata.dc.gov/search?q=building%20permits

In equation (2) ΔY is our outcome variable representing the rate of change. Depending on the regression, this represents the change in either the residential vacancy rate or the business vacancy rate in census tract *i*. For the regressions on the 100 most populous CBSA's the change is over the period 2010 to 2016, and CBSA fixed effects are included, denoted by μ. For the regressions on DC, in equation (3) we employ a panel design, with our dependent variable as the number of permits for the years 2011 through 2015, denoted Z_i. We include year fixed effects, denoted by γ. In both equations, gent is the education-based measure of gentrification as calculated in equation (1)

For the DC regressions, X represents a vector of socioeconomic factors for which we control. The following section first presents summary statistics and regression results for the 100 most populous CBSA's, followed by summary statistics and regression results for DC, in which we detail the included controls.

5. Summary Statistics and Results

5.1. 100 Most Populous CBSAs in the U.S.

Table 1 presents the census tract level summary statistics for the most populous CBSAs in the U.S. On average about 10 percent of the census tracts in these CBSAs were granted the OZ designation (Table1). Our gentrification measure shows that, on average, the share of the over 25 population holding a bachelor's degree or higher in the census tracts within these CBSAs increased approximately 2% between 2010 and 2016. However, Table 2 shows that gentrification does not appear to directly play a role in the selection of OZ in the CBSAs because non-OZ census tracts and OZ census tracts have similar percentages of the share of tracts in the gentrification spectrum.

Table 1: Summary Statistics of Census Tracts in the 100 Most Populous CBSAs

	N	Mean	St. Dev.	Min	Max
Median Household Income (2010), $	37,615	61,576.94	30,250.42	5,000.00	249,194.00
Median Home Value (2010), $	36,568	287,008.80	191,838.10	11,000.00	1,000,000.00
Median Gross Rent (2010), $	38,067	534.07	469.26	0	8,017
Population below 100% of the Poverty Level (2010), %	37,698	14.09	12.91	0.00	100.00
Median Household Income (2016), $	37,571	65,878.09	33,101.39	3,250.00	249,597.00
Median Home Value (2016), $	36,857	289,710.50	230,363.80	10,200.00	2,000,000.00
Median Gross Rent (2016), $	36,851	1,169.32	467.68	114.00	3,500.00
Population below 100% of the Poverty Level (2016), %	37,717	15.55	13.06	0.00	100.00
Opportunity Zone Rate	38,067	0.10	0.30	0	1
Gentrification Rate	37,938	0.02	0.22	-1.84	39.90
Residential Vacancy Rate (2010)	28,115	0.04	0.05	0.00	1.00
Business Vacancy Rate (2010)	28,086	0.09	0.08	0.00	0.80
Residential Vacancy Rate (2016)	37,845	0.03	0.05	0.00	1.00
Business Vacancy Rate (2016)	37,829	0.08	0.08	0.00	1.00

Source: American Community Survey ACS 2010 and ACS 2016-5-year average.

Table 2: CBSA Opportunity Zone Status by Gentrification Category (%)

	Opportunity Zone Status		
Gentrification Category	Eligible, Non-Designated	Designated OZ	Total
Non-Gentrified	42.86	48.01	43.84
Below Average	27.92	25.94	27.54
Above Average	29.22	26.05	28.62
Total	100	100	100

Source: Author's calculation from ACS and IRS data

We focus not only on the OZ census tracts but include the OZ eligible census tracts because they have been a focal point of the gentrification debate. The regression specification used for the CBSAs is run separately on four types of census tracts: designated OZ tracts, non-designated but OZ eligible tracts, OZ eligible (all eligible tracts, whether LIC or eligible non-LIC but contiguous tracts), and non-eligible tracts. Results for

the four models for which the dependent variable is the change in residential vacancy rate, are shown in Table 3 below. Model 1 shows the effect of gentrification on the change in residential vacancy rates for OZ census tracts. A one unit increase in the gentrification measure is associated with a -0.05-unit change in the residential vacancy rate. This result is significant at the 1 percent level. Model 2 shows a significant positive but small effect on residential vacancy rates for non-OZ tracts. The coefficient of 0.01 is significant at the 1 percent level.

Table 3: Regression Results for Residential Vacancy Rate

VARIABLES	(1) OZ	(2) Non-OZ	(3) Eligible	(4) Non-Eligible
Gentrification	-0.0480***	0.00617***	-0.0123***	0.0177***
	(0.0153)	(0.00233)	(0.00462)	(0.00212)
Constant	-0.0113	-0.00674***	-0.00565	-0.00836***
	(0.00969)	(0.00214)	(0.00368)	(0.00205)
Observations	2,935	25,127	15,074	12,988
R-squared	0.147	0.082	0.118	0.066
CBSA FE	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Model 3 shows a negative and significant effect on residential vacancy rates for eligible tracts (-0.01), which is significant at the 1 percent level. We also see that the effect is smaller compared to Model 1. That is, gentrification has a larger effect on residential vacancy rate in OZs than eligible census tracts. Model 4 shows a positive and significant effect (0.02), which is significant at the 0.1 percent level. These results suggest that increases in the gentrification measure decrease the residential vacancy rate for OZ and eligible census tracts but increase the residential vacancy rate for the population of ineligible tracts. When considering the universe of tracts which are non-OZ (to include

both non-eligible tracts, as well as eligible tracts which did not receive the OZ designation), the effect of gentrification was positive and significant as in the case of the non-eligible tracts, however the size of the effect was an order of magnitude smaller.

Considering models for which business vacancy rate is the dependent variable, Table 4 shows results for the same group of populations. Like the negative and significant effect of gentrification on residential vacancy rate for the OZ population, the effect on business vacancy rate is negative and significant, and in this case, of a larger magnitude than the effect on residential vacancy rate.

Model 1 shows that a one unit increase in the gentrification measure is associated with a -0.08-unit change in the business vacancy rate. This result is significant at the 1 percent level. In contrast, the effect of gentrification on the non-OZ population (Model 2) is practically zero (-0.0002). For the eligible population (Model 3), the effect of gentrification on the business vacancy rate is similar in magnitude to the effect on the residential vacancy rate. Model 4, which covers the non-eligible population is also 0.

Table 4: Regression Results for Business Vacancy Rate

VARIABLES	(1) OZ	(2) Non-OZ	(3) Eligible	(4) Non-Eligible
Gentrification	-0.0772***	-0.000195	-0.0140*	5.27e-05
	(0.0265)	(0.00150)	(0.00790)	(0.00148)
Constant	0.0522***	0.00506	0.0299***	-0.00975
	(0.0168)	(0.00537)	(0.00748)	(0.00691)
Observations	2,932	25,094	15,061	12,965
R-squared	0.095	0.049	0.066	0.047
CBSA FE	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Overall Tables 3 and 4 suggest a significant correlation between gentrification and attractiveness of OZ designated census tracts to potential residents and businesses. Federal subsidies toward new investments in OZ tracts are expected to accelerate this process. The economic benefits of the OZ subsidies could be captured by the new affluent residents who could replace the incumbent lower income residents.

5.2. DC Case Study

Table 5 presents summary statistics for the census tracts within DC. In DC, about 14 percent (25 out of 179) of census tracts have OZ designation, compared to the average share OZ designated tracts in the 100 most populous CBSAs. The gentrification rate for DC was double the rate for the 100 most populous CBSA's (0.04 compared to 0.02).

Access to individual income tax and residential property tax data from the DC government allows us to provide answers to the displacement effects of gentrification on lower income populations. Due to data limitations, previous studies have relied on limited

Table 5: Summary Statistics of Census Tracts in DC

	N	Mean	St. Dev.	Min	Max
Median Household Income (2010), $	175	63,425.41	35,154.07	15,119.00	213,889.00
Median Home Value (2010), $	167	433,329.90	182,856.50	143,400.00	924,000.00
Median Gross Rent (2010), $	178	769.24	515.56	0	3,204
Population below 100% of the Poverty Level (2010), %	176	19.41	13.99	1.30	91.20
Median Household Income (2016), $	175	78,623.75	43,276.66	14,692.00	235,517.00
Median Home Value (2016), $	173	506,302.90	266,187.40	88,600.00	1,498,300.00
Median Gross Rent (2016), $	173	1,402.02	489.09	395.00	2,557.00
Population below 100% of the Poverty Level (2016), %	178	18.88	13.67	0.00	66.30
Opportunity Zone Rate	178	0.14	0.35	0	1
Gentrification Rate	178	0.04	0.09	-0.06	1.14

Residential Vacancy Rate (2010)	162	0.04	0.03	0.00	0.17
Business Vacancy Rate (2010)	162	0.08	0.06	0.00	0.29
Residential Vacancy Rate (2016)	178	0.03	0.03	0.00	0.11
Business Vacancy Rate (2016)	178	0.06	0.05	0.00	0.24

Source: ACS 2010; ACS 2016

samples from the U.S. Census Bureau and the IRS. We use kernel density estimates, to analyze the relationship between migration into and out of OZ eligible census tracts, and gentrification. In the context of possible displacement by the inflow of higher income residents and out flow of lower income residents, we focus on the section of the distribution at or below the 25th percentile of income distribution and at or above the 75th percentile of income distribution. The figures below show the year-to-year changes in gentrification, and in-and-out migration in DC census tracts for the period 2011 to 2015, for the income group below the 25th percentile and above 75th percentile. In the case of those at or below the 25th percentile (Figures 1a-1d), there was an increase in both the number and share of census tracts experiencing growth in their college graduate population between 2011 and 2015, which suggests that gentrification affected more neighborhoods during this period. As shown in the graphs in Figure 1 below, the out-migration rate for the lower income population is consistently above their in-migration rate. In terms of directionality in the relationship between outmigration and gentrification, Figure 1(a) shows that between 2011 and 2012 outmigration for the 25th percentile or lower of income, increased with the rise in gentrification. Figure 1(b) shows an almost flat line between 2012 and 2013, followed by decreases in 2013-2014 (Figure 1(c)) and 2014-2015 (Figure 1(d)). The difference between the out migration and the in migration for the 25th percentile and lower income group gets bigger where the gentrification measure is larger than zero. From year to year as more

college graduates moved in, progressively more lower income incumbent residents were displaced.

Figure 1a. Kernel Density Estimates, 25th percentile and below income groups in DC, 2011-2012

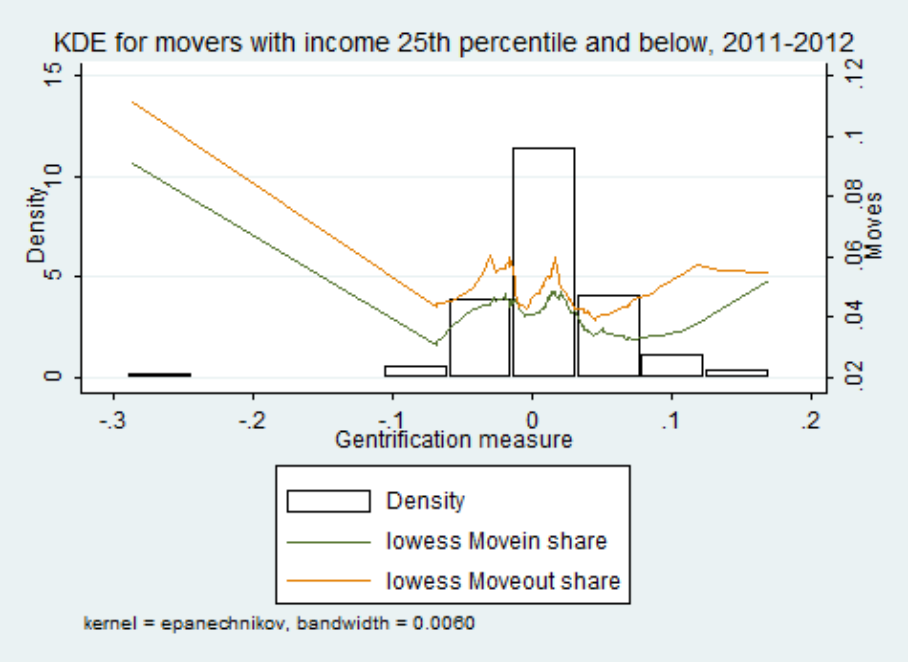


Figure 1b. Kernel Density Estimates, 25th percentile and below income groups in DC, 2012-2013

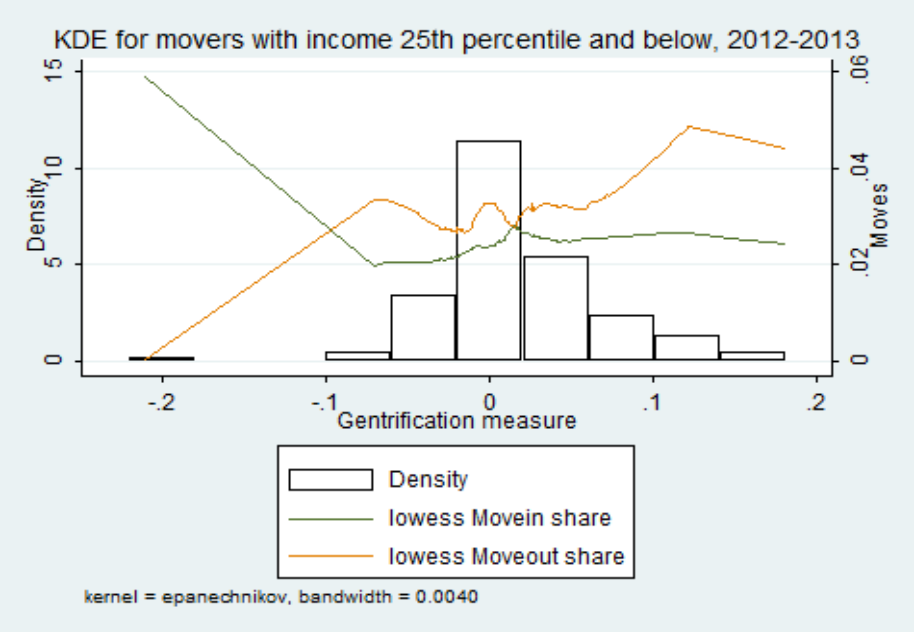


Figure 1c. Kernel Density Estimates, 25th percentile and below income groups in DC, 2013-2014

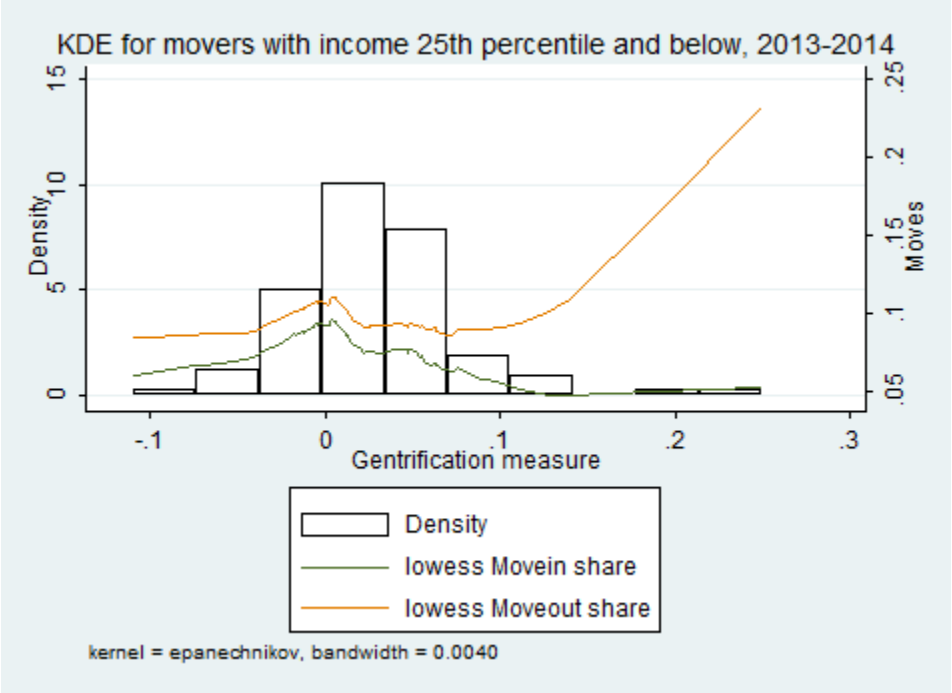
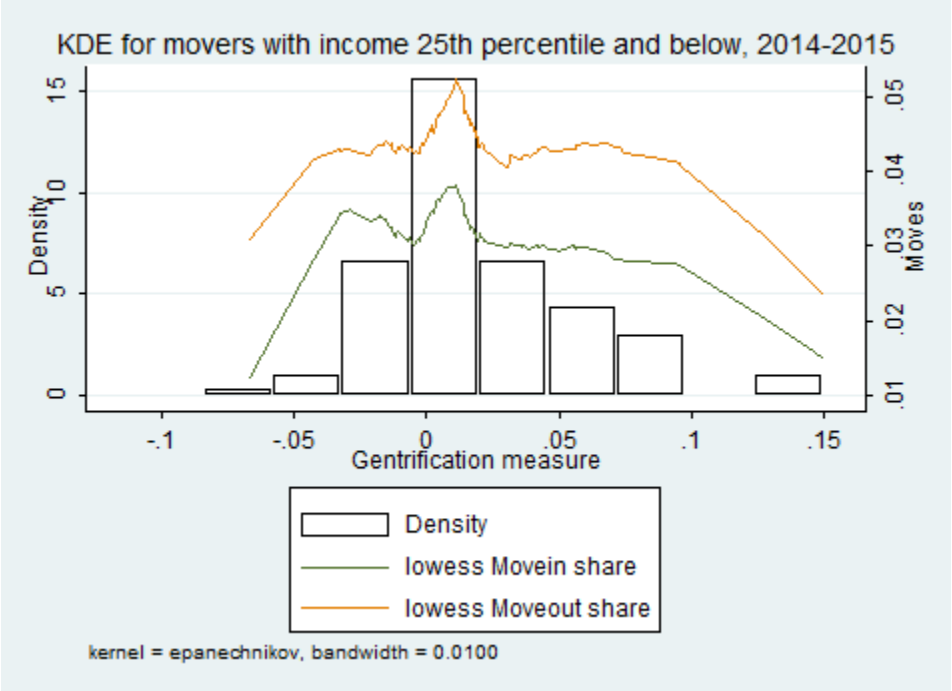


Figure 1d. Kernel Density Estimates, 25th percentile and below income groups in DC, 2014-2015



Figures 2a-2d display the inflow and out flow higher income residents to/from the OZ eligible neighborhoods in DC. Figure 2a-2d points out to two important results: First, in this time period, gentrification spread to more lower income neighborhoods in DC. Second, the rate of the inflow of higher income residents to these neighborhoods was significantly higher (about three times larger) than their outflow rate. OZ designation, therefore, is expected to accelerate gentrification.

Figure 2a. Kernel Density Estimates, 75th percentile and above income groups in DC, 2011-2012

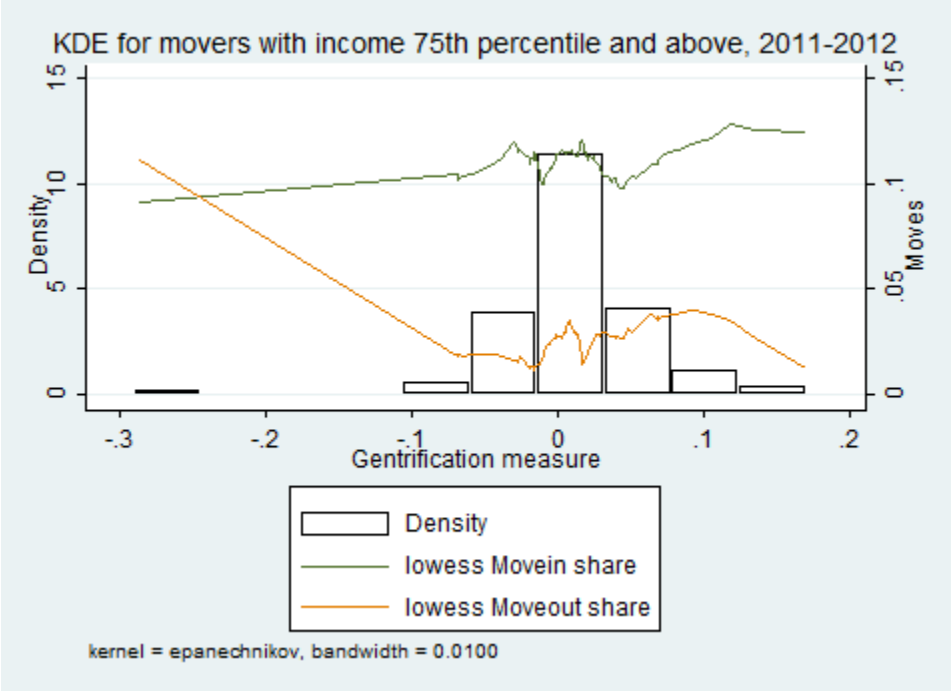


Figure 2b. Kernel Density Estimates, 75th percentile and above income groups in DC, 2012-2013

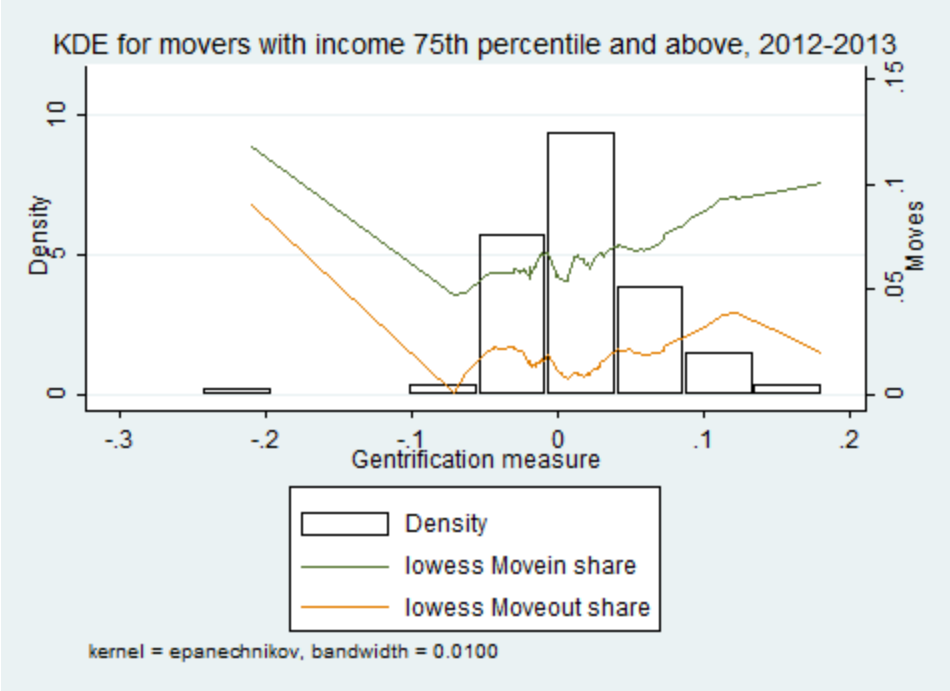


Figure 2c. Kernel Density Estimates, 75th percentile and above income groups in DC, 2013-2014

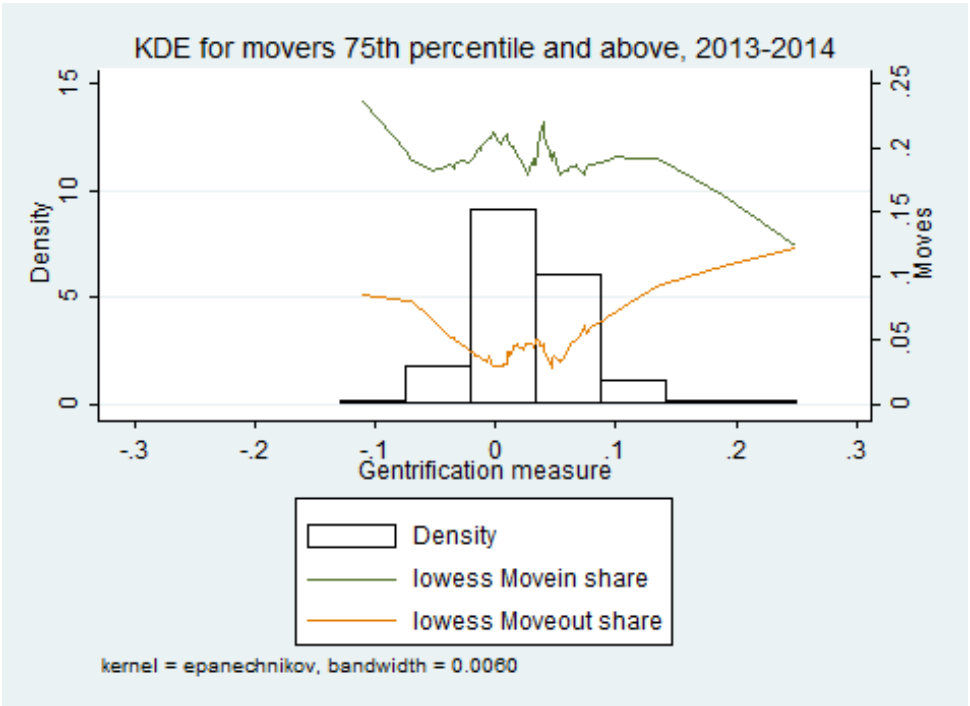
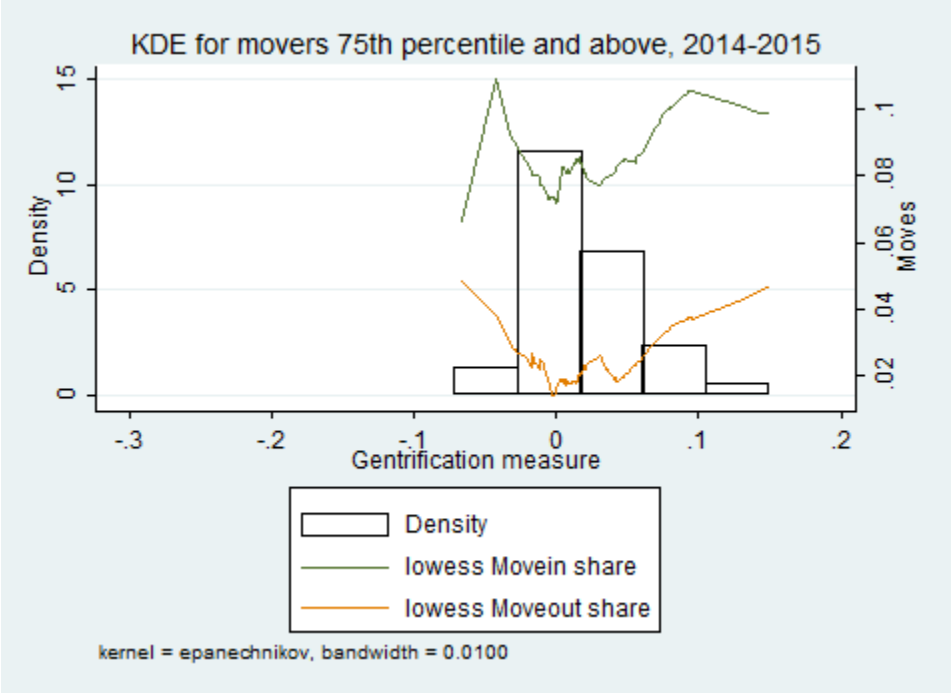


Figure 2d. Kernel Density Estimates, 75th percentile and above income groups in DC, 2014-2015



Next, we examine the relationship between OZ location decisions and gentrification in DC. Table 6 shows that gentrification does not appear to directly play a role in the selection of OZ. Compared to non-OZ census tracts, OZ census tracts have a higher percentage of non-gentrified census tracts and gentrified tracts below the average rate of gentrification, and lower percentage of gentrified census tracts above the mean gentrification rate of 0.04.

Table 6: DC Opportunity Zone Status by Gentrification Category (%), 2010-2016

	Opportunity Zone Status		
Gentrification Category	Eligible, Non-Designated	Designated OZ	Total
Non-Gentrified	31.87	35.00	32.54
Below Average	22.25	38.00	25.65
Above Average	45.88	27.00	41.81
Total	100.00	100.00	100.00

Source: Author's calculation from ACS and IRS data

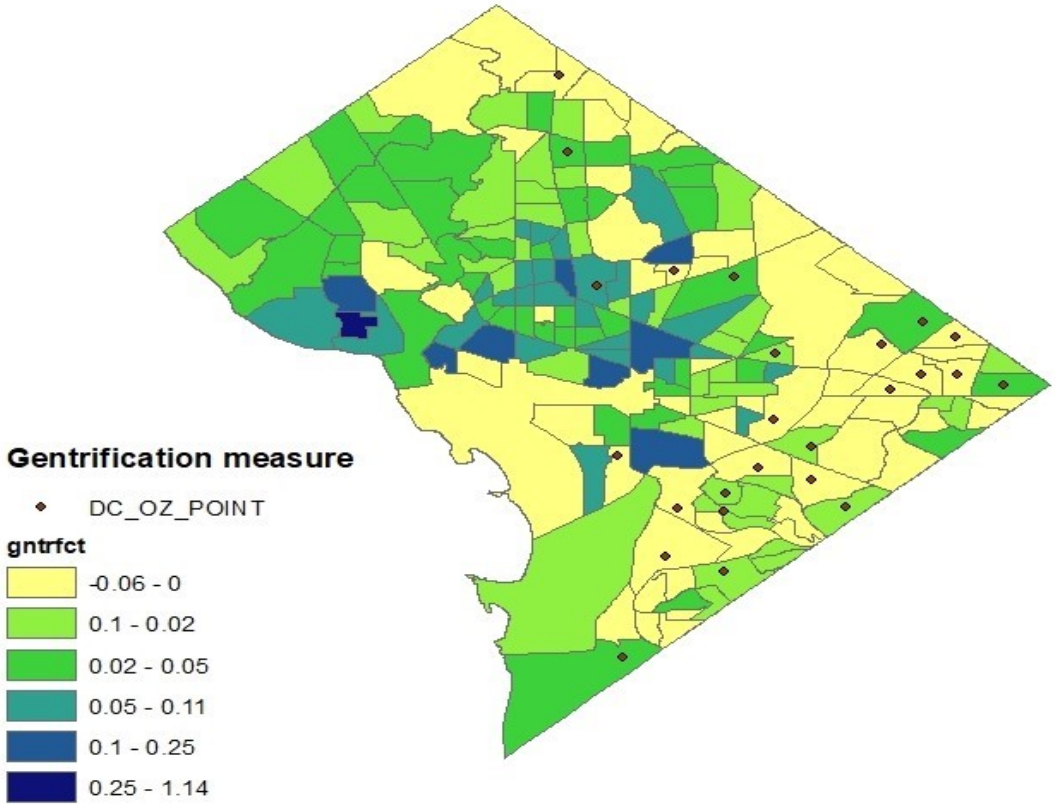
However, Figure 3 shows that there could be a spillover effect between gentrifying tracts and the location of OZ designated tracts. Figure 3 shows DC census tracts on the gentrification scale, with yellow indicating lack of current gentrification, and the colors light green through to dark blue showing increasing levels of gentrification, over the period 2010 to 2016. The points on the map indicate census tracts designated as OZ. Of the 25 OZ census tracts, 12 are gentrifying, corresponding to 48 percent of OZ census tracts. Thus, conditional on being an OZ, a census tract is only slightly more likely to be non-gentrifying than to be gentrifying. An additional 5 census tracts are bordering two or more gentrifying census tracts. Thus, 68 percent of DC OZ census tracts are either gentrifying or surrounded by gentrifying census tracts. The aim of the OZ program was to generate economic activity in distressed areas, areas with difficulty attracting investment. Because most of the OZ are located next to gentrifying tracts, there may be spillover investments that will go to these tracts.

Additionally, Appendix figure A1 shows year-to-year changes in gentrification in DC. From these maps, we observe some of the census tracts which were subsequently selected as opportunity zones did not experience any form of gentrification, whereas most had increases and were in the early phases of gentrification.

After our spatial analysis of OZ location and gentrification, we then try to predict which OZ census tracts will receive higher investments using a fixed effects OLS regression focusing on OZ eligible tracts in our analysis. Our preferred specification has as the dependent variable the number of construction permits from 2011 to 2015, with gentrification, residential and business vacancy rates as the main independent variables of

interest. We use construction permits as a proxy for investments to develop an area. We also control for neighborhood, and individual characteristics.

Figure 3. Gentrification Scale and Designated Opportunity Zones in DC, 2010-2016



As shown in Table 7, the coefficient on the gentrification variable is negative and large across all models, however in all cases the effect is indistinct from zero. The effect of average business vacancy rate is negative, significant, and relatively stable across models at an approximate value of -0.6. The coefficient on average residential vacancy rate is negative, but insignificant. The coefficient on net migration rate per 100 is positive and significant.

Although not significant in the regression results, the map shows some correlation or spillover effects between gentrification and business investments which merits further exploration. However, in predicting which census tracts will be favored in the allocation

of OZ investment our findings suggest that investment will flow to census tracts with positive net migration, and which have lower business vacancy rate.

Table 7: Regression Results for DC Construction Permits

VARIABLES	(1) Permits	(2) Permits	(3) Permits	(4) Permits	(5) Permits	(6) Permits	(7) Permits	(8) Permits
Net migration rate per 100								0.308*
								(0.162)
Assessment							-6.34e-06	-6.42e-06
							(6.89e-06)	(6.87e-06)
Income						-0.000270	-0.000257	-0.000317
						(0.000278)	(0.000297)	(0.000297)
Unemployment rate					0.216	0.175	0.253	0.265
					(0.410)	(0.413)	(0.423)	(0.422)
Poverty rate				0.0820	0.0742	0.0694	0.0947	0.0719
				(0.215)	(0.215)	(0.216)	(0.232)	(0.231)
Hispanic			33.09	31.05	30.80	35.78	23.14	23.11
			(45.86)	(46.23)	(46.28)	(46.57)	(48.78)	(48.59)
Black			-18.92	-21.04	-23.82	-19.84	-21.94	-19.41
			(35.40)	(35.87)	(36.30)	(36.53)	(39.60)	(39.47)
Gentrification	-8.022	-7.432	-9.549	-8.787	-9.292	-8.154	-6.132	-2.227
	(17.37)	(17.28)	(17.36)	(17.50)	(17.54)	(17.58)	(20.71)	(20.73)
Ave vacancy rate business		-0.634**	-0.655**	-0.657**	-0.656**	-0.664**	-0.671**	-0.649**
		(0.289)	(0.291)	(0.292)	(0.292)	(0.292)	(0.299)	(0.298)
Ave vacancy rate residence		-0.328	-0.361	-0.382	-0.388	-0.349	-0.326	-0.286
		(0.759)	(0.760)	(0.763)	(0.763)	(0.765)	(0.822)	(0.819)
Constant	56.40***	63.41***	74.87***	74.51***	74.79***	81.29***	85.93***	86.71***
	(1.645)	(4.344)	(27.86)	(27.91)	(27.95)	(28.74)	(30.99)	(30.87)
Observations	464	464	464	464	464	464	447	447
R-squared	0.123	0.138	0.142	0.143	0.143	0.146	0.151	0.160
Number of census tracts	116	116	116	116	116	116	112	112
FE	yes	yes	yes	yes	yes	yes	yes	yes

6. Conclusion

The Opportunity Zones policy is still in its early days and the long-term effects of the program is yet to be determined. Still, in this paper we explore the interaction between Opportunity Zones and gentrification, a process whose effects have been studied for over 50 years.

Specifically, in this study, we look at the interaction between opportunity zones and gentrification in CBSAs. Next, we use DC as a case study to further analyze the relationship between gentrification and opportunity zones. First, we examine the migration patterns of movers in and out of opportunity zone eligible census tracts. Additionally, we use spatial analysis to analyze the relationship between gentrification and the census tracts designated as opportunity zones. Then we attempt to predict where investments will flow in the opportunity zone eligible census tracts.

Our analysis of the 100 CBSAs shows a positive growth in migration and business activity as opportunity zones move further into the gentrification process, through the decrease in residential and business vacancy rates.

Next, we perform a case study of the relationship between migration flow and gentrification in OZ eligible zones in DC. The case study shows that the further an OZ eligible tract advances into gentrification, the more we observe out-migration among low income movers (in the 25th percentile and below of income) and in-migration of movers with income in the 75th percentile and above.

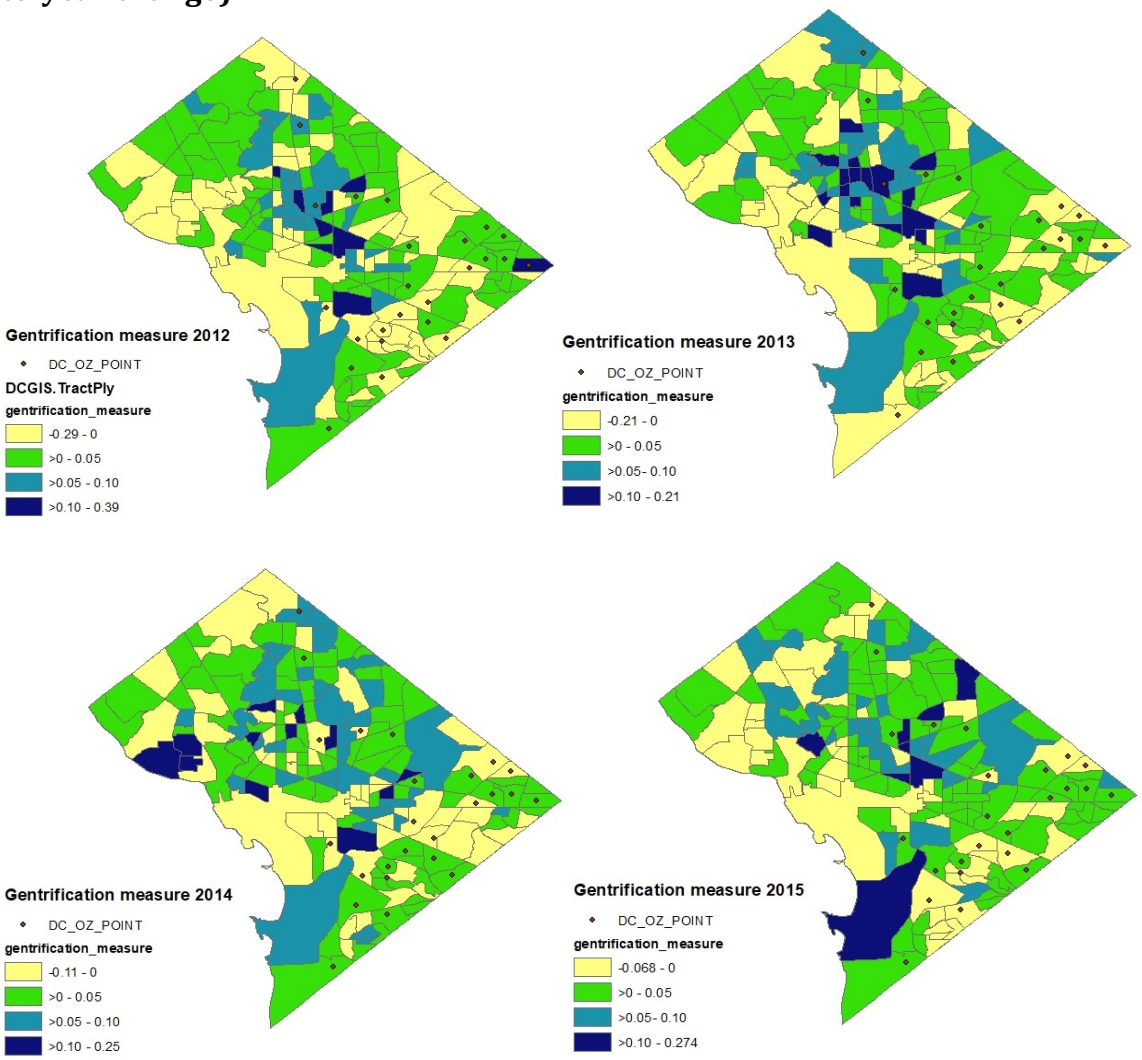
Furthermore, using spatial analysis, we find that there is a correlation between gentrification and the selection of OZ census tracts, given that 68 percent of the OZ census tracts were either gentrifying or adjacent to two or more gentrifying tracts. Additionally,

using regression analysis to predict the destination of new investment among OZ eligible census tracts, we show a negative correlation between the number of permits and business vacancy rates. Thus, if a census tract is gentrifying, and has a lower business vacancy rate, we predict greater investment flow to that census tract. Given the literature on the effect of investment and public policy in facilitating gentrification, our finding suggests that the selection of gentrifying and gentrification adjacent census tracts as OZ could increase the rate of gentrification in these tracts.

Finally, the effect of opportunity zones on local economy is still in its infancy. We will know more about its impact when additional data become available. While the OZ program is a place based-policy, the general equilibrium distributional effects, as well as the heterogenous effects on the incumbent residents and business is of great interest, and merits further exploration.

Appendix

Figure A1: Gentrification Scale and Designated Opportunity Zones in DC (year-to-year change)



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