Land of Opportunity:
Early Indicators of the Opportunity Zone Program's Impact on Real Estate Transaction Prices

By

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Abstract

In December 2017, the U.S. Congress passed into law the Tax Cuts and Jobs Act, including provisions for the Opportunity Zone (OZ) program, which would offer significant tax benefits for investments in designated low-income census tracts. I specify a repeat sales price index using a Bayesian random walk model in order to compare the transaction prices of properties located in designated and eligible OZ census tracts and determine the premium associated with OZ designation. I find a significant positive impact on price levels associated with OZ designation ranging from 20% to 22%. I then analyze the performance of properties in designated and eligible tracts relative to properties in census tracts that narrowly missed the eligibility requirements, as a robustness check and to determine any expectation effect from OZ program eligibility. I find that the estimated impact of OZ designation remains relatively consistent, and that the estimated expectation impact of eligibility was insignificant in the best fit models. To interpret different magnitudes of price effects, I offer a framework of likely market causes and the impact on various stakeholders.

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2. Introduction

Christmas came three days early for large corporate taxpayers in 2017. On December 22nd, the U.S. Congress passed the Tax Cuts and Jobs Act of 2017, including numerous widely publicized provisions to reduce corporate tax rates and modify income tax brackets for individuals. Many criticized the reform for increasing income inequality and deepening the US budget deficit.[1] However, the Act encompassed within it an economic development tool with significant potential to catalyze disruptive, be it positive or negative, changes in low-income neighborhoods across the country: Opportunity Zones (OZ).

The OZ program is meant as an economic development tool, designed to spur local development and job creation in distressed communities by offering location-based (census tract) tax breaks and deferrals to investors. The program offers incentives for investments in both real estate as well as businesses which hold a specified portion of their property and earn a specified portion of their revenue in the same qualifying census tracts. To date, most of the attention the program has garnered from investors and the media has focused on the real estate component.

The OZ tax incentive is targeted specifically at economically obsolete and/or heavily depreciated properties. In order for a fund's investors to qualify for the tax incentive, properties must undergo a capital improvement at least equal to the fund's initial acquisition expense within 30 months of purchase, thereby privileging new development and significant (gut) rehabilitation. Acquisition of existing properties in designated OZs does not in and of itself qualify an investor to receive tax benefits.

For investors, the program offers an attractive package of financial incentives. As a direct measure, OZ tax benefits can offer a significant increase in total post-tax cash flows and post-tax internal rate of return (IRR). In addition, through investments, future productivity might increase in designated OZs as a result of agglomeration economies, resulting in increasing land values. Over time, properties could benefit indirectly from their renovated neighboring properties (Lin et al., 2009). Assuming that real estate mar-

[1] `https://www.washingtonpost.com/outlook/2019/01/14/opportunity-zones-can-tax-break-rich-people-really-help-poor-people/`

kets are efficient, these future OZ tax benefits should be priced into property transactions (Smith, 2009).

Census tracts were eligible for OZ designation if the poverty rate was greater than 20% in said tract or the tract median family income was below 80% of that of the corresponding metropolitan area or state[2], or in limited cases if a census tract was located adjacent to a tract meeting these qualifications. From the approximately 42,000 eligible tracts, state governors were given the opportunity to nominate up to 25% of the eligible census tracts in their respective states to be designated as OZs. The nominations were then reviewed by the U.S. Treasury and Internal Revenue Service (IRS) to ensure compliance with the various requirements, and approximately 9,000 tracts were officially designated by the aforementioned agencies between April and July 2018.

As the OZ program was established only recently, it is too early to assess its long-term success or failure to stimulate economic development. Instead, I focus on the recognition of OZs among commercial property investors, examining the effect on commercial property prices. I test if the designation of OZs has had an (positive) impact on commercial property prices and if so, how price effects compare to future tax benefits. To ensure a clean identification strategy, I make use of the quasi-random allocation of OZs among eligible areas, using a difference-in-differences setup and comparing price trajectories between eligible and designated OZs.

For this analysis, I use commercial real estate transaction data, made available by Real Capital Analytics, Inc (RCA). To ensure a clean identification of price effects, distinguishing market movements from heterogeneity in real estate values between different types of commercial property, I focus on repeated sales only (properties for which I observe data on more than one transaction). However, the OZ program started only several months ago and repeated-sales observations are generally difficult to obtain. In addition, because the OZ program is specifically geared towards significant rehab, I work with an even smaller subset of the data that includes only depreciated properties most likely to be targeted for a redevelopment project. (I use these in lieu of vacant development sites, which are difficult to track in a repeat

[2] `https://www.enterprisecommunity.org/blog/`

sale context given they are typically purchased with the explicit intent for redevelopment prior to the next sale, and my data set does not permit a disentanglement of new capital expenditures from purchase price.)

In order to address the issue of small sample size, I employ a structural time series hierarchical repeat sales index, allowing for a simulation of observational gaps. In the precedent study, Francke and Van de Minne (2017) show that utilizing a hierarchical repeat sales methodology provides a reliable, smooth index on a detailed level for a data set with a low number of observations, specifically commercial properties in the Philadelphia/Baltimore area and residential properties in a very small subsection of Amsterdam. Although I work with properties on a national basis, the very short time frame since the OZ program came into existence, as well as the requirement that targeted properties be likely candidates for redevelopment, reduce the sample size of my data set, making hierarchical modeling an attractive mechanism to differentiate between signal and noise in my models.

Specifically, in order to identify the impact of OZs on real estate prices, I first create a common index using all repeat sale redevelopment site transactions in census tracts across the country that were either designated as OZs or eligible for designation as an OZ (see Section 6 for more details on filters). I then add a subtrend for each group (designated vs. eligible) to examine the ways in which the trends diverged prior to the announcement of the OZ program, finding that at no points were the subtrend index values significant at a 5% confidence level. I then introduce a separate variable, ω, to measure the one-time increase resulting from OZ designation for properties in designated areas. This setup utilizes a difference-in-differences specification of the model similar to that employed by Geltner et al. (2017), who employed hierarchical modeling in a difference-in-difference context to identify the premium associated with green retrofits in office properties. The authors similarly worked with a very small sample size of observed transactions.

As an extension of my core model, I also analyze the expectation effect caused by the announcement of census tract eligibility, prior to the time when specific tracts were designated. In order to identify this effect, I build upon the same hierarchical repeat sales framework, but introduce a new subtrend for properties in "runner-up" census tracts, or census tracts that exhibited socioeconomic characteristics placing them on the cusp of eligibility for the program.

In order to verify robustness of the results, I also test the assumption of parallel trends prior to the announcement of the OZ program. Specifically, while I do observe some differences between the performance of eligible and designated OZ properties prior to the time the program was announced, which is not surprising given the small sample sizes, I quantify the correlation between the two indices. I find high levels of correlation between index levels and relatively high levels of correlation between index returns, taking into consideration the fact that my index is monthly rather than annual.

In the resulting model with the most robust fit statistic, I document a small but insignificant expectation effect equivalent to a 3% price increase for properties in census tracts that became eligible OZs, compared to census tracts close to being eligible. Comparing designated and eligible OZs, I find a significant positive effect on property price levels after designation, ranging from 20% to 22% for the best fit models. In contrast, I study the impact of OZ designation on newer properties that are less likely to be redeveloped. In this case, the resulting estimated value of the OZ designation premium does not significantly differ from 0, and is actually slightly negative. This result suggests that the program has impacted real estate prices thus far not due to an expected increase in overall neighborhood values stemming from potential increased productivity of OZ areas, but due to a pass-through of tax benefits to existing landowners.

Given an estimated total value of depreciated property transaction volume in designated OZs totalling $8 billion thus far, my findings translate into a total realized value increase of approximately $1.7B. In comparison, the Joint Committee on Taxation estimated that the total cost of the OZ program is approximately $1.5B per year for the coming years (JCT, 2018). Our results thus suggest that the program has the potential to be tax revenue-positive, or that at minimum a meaningful portion of the annual expenditure is already being recouped through higher values on existing properties. This effect is also worthy of attention given it implies a shift in the tax base from the federal level to a more localized level.

Based on the econometric results of my analysis, I go on to decompose the potential causes of various price increases that we might observe, as well as what the impact of each scenario would be on various local, as well as national, stakeholders. To this end, I build upon existing literature understanding the impacts of similar place-based programs on the outcomes of

various stakeholders, helping us to understand the question of "for whom" the OZ program was designed. I integrate the specific findings about the OZ program representing a pass-through of tax benefits to existing landowners with a new framework for understanding the beneficiaries of place-based incentives.

I subsequently arrive at the fundamental question of whether an increase in real estate values in an area is a normatively ideal outcome, and if so under what circumstances. To interpret this second-order question, I place the OZ program within the broader context of financialization, and attempt to decompose the various political forces behind a controversial, but seemingly bipartisan, program. Specifically, I propose that OZs may be the latest example of a broader homogenization of markets that is associated with financialization at the global scale. I then analyze how OZs simultaneously represent a retreat of the state traditionally associated with neoliberal policies through the initial reduction of tax revenue, yet at the same time an expansion of a post-Keynesian state which does not necessarily pursue redistributive goals. To this end, I build upon a framework described by Konings (2009) of the neoliberal era as actually strengthening the state through a redrawing of institutional power, as opposed to the more traditional understanding as neoliberalism representing a systematic decline in public sector influence.

To my knowledge, this is the first study estimating the causal impact of OZ designation on property prices. This paper is also among the first to show how place-based tax incentives translate into commercial real estate property prices, as opposed to socioeconomic indicators of residential real estate prices. There exists robust existing literature on the second-order impacts of similar place-based tax incentive programs, such as the federal and state Empowerment Zones and Enterprise Communities (EZ/EC) programs, or federal New Markets Tax Credits (NMTC). Specifically, many authors have focused on employment and changes in firm location based on the aforementioned programs (see Peters and Fisher, 2002; Forbes, 2006; Busso et al., 2013; Hanson and Rohlin, 2011a,b, 2013; Papke, 1993, 1994; Bondonio and Engberg, 2000; Elvery, 2009, among others). Other authors have addressed the impact of the said programs on property values, but primarily within the context of residential properties, again a second order effect resulting from overall neighborhood economic growth (see Boarnet and Bogart, 1996;

Engberg and Greenbaum, 1999; Krupka and Noonan, 2009; Freedman, 2012, among others).

In the case of OZs, it is too early to measure many of these impacts, some of which could eventually result as second-order impacts from changes in the real estate markets within designated areas, or potentially in the areas surrounding them as well through spillover effects. However, regardless of data constraints, the question of first-order impacts on property values is independently interesting as a research topic. In many cases authors have noted mixed results from prior subsidies on socioeconomic outcomes and on firm behavior, so it is worthwhile to determine whether that results from a failure of incentives to influence the real estate markets in the first place, or if real estate markets have then influenced second-order socioeconomic factors in unexpected ways.

3. Existing Literature

The existing literature discussing OZs is limited given the recent introduction of the program. To the best of my knowledge, no other studies have yet attempted to statistically or econometrically determine whether there has been a significant change in real estate transaction prices as a result of the program. Theodos et al. (2018) analyzed the differences in census tract characteristics between eligible zones and designated zones in order to understand if state governments had selected more distressed areas which could stand to benefit the most. Katz (2018) outlined a series of policy strategies for cities to maximize the social good that arises from the OZ program. Other literature to date has focused largely on understanding the various tax nuances of the program (see Fichtenbaum, 2018; McGalliard, 2019; Carter and Nair, 2018; Cohen and Haradon, 2018, among others).

However, I have built upon a robust set of prior studies examining the impact of similar place-based tax incentive programs both domestically and internationally. Specifically, the literature on the impacts resulting from state enterprise zones (State EZs), the federal Empowerment Zone/Enterprise Community (Federal EZ/EC) program, and the New Markets Tax Credit (NMTC) program offers a number of lessons for my present work in terms of methodology, as well as a range of perspectives on the types of impacts we might conceive that OZs could generate. These aforementioned programs all incorporate the two key elements of the OZ program, namely the use of tax incentives to stimulate investment, and some sort of place-based restriction. In addition, I reference studies looking at programs similar to OZs in the international context, including Urban Enterprise Zones in France, which possess a multi-tier structure of eligibility similar to the designated and eligible tiers for OZs. Finally, given the vast scale of designated OZs, at over 10% of the total census tracts of the country, the broader literature regarding tax rate maximization strategies, as opposed to solely place-based economic development, becomes relevant for my research. That is to say that OZs could eventually cause a noticeable reduction in the effective national capital gains tax rate.

3.1. State Enterprise Zones and Federal Empowerment Zones/Enterprise Communities

The state EZ and Federal EZ/EC programs are the most relevant predecessors to OZs. While the notion of the "Enterprise Zone," a place-based strategy for providing tax incentives to firms in order to spur economic development, came into being as a bill at the federal level in the 1980s, Congress initially failed to pass the measure, despite bipartisan support (Forbes, 2006). As a result, the initial entities to enact Enterprise Zones ended up being state governments. By 1990, an EZ program existed in some incarnation within 75% of all states across the country. However, the exact form of EZs, as well as the magnitude of incentives, differs measurably from state to state. For example, Illinois and Kentucky permit census tracts to qualify based on some form of household median income test, whereas New York requires census tracts to qualify based solely on the basis of poverty rate or unemployment standards (Peters and Fisher, 2002). The types of incentives also vary widely across the states, including varying combinations of capital investment tax credits (ITCs), wage tax credits for employees, property tax credits, and sales tax exemptions.

In 1993, the Clinton administration finally signed into law the federal EZ/EC program, a ten-year program providing wage tax credits for employees, as well as access to $100 million in block grant subsidy funds to be used for workforce training, counseling, and transportation, among other uses. At the onset of the program, six empowerment zones were announced, including locations in Atlanta, Baltimore, Chicago, Detroit, New York, and Philadelphia/Camden. A larger number of enterprise communities were announced with a less robust package of subsidies and incentives (Forbes, 2006).

The research analyzing the impact of both state EZs and federal EZ/ECs has yielded mixed results. Some studies have shown statistically significant positive impacts. Busso et al. (2013) found that the federal EZ program had increased employment in selected zone neighborhoods, resulting in wage increases for local workers without triggering an increase in living cost. The authors employed a difference-in-differences setup, using as a control group the tracts that had applied for the program but were not ultimately designated. Results indicated that pretreatment levels of employment in both types of tracts closely mirrored each other, but after EZ designation, there was a 12 to 21% relative increase in total employment. Hanson and Rohlin

(2011a) found that EZs result in the attraction of 2.2 establishments per 1,000 existing establishments. The authors utilized an instrumental variable (IV) approach to control for indicators of political influence that could have resulted in the designation of certain tracts as EZs as opposed to declined applicants, thereby addressing potential selection bias between their treatment and control group. Hanson and Rohlin (2011b) added an additional element to the analysis of EZ economic development impacts by studying differential impacts on various types of industries as a result of tax incentives. The authors found that the program had a differential impact on industries based on their capacity to substitute capital and labor, utilizing a third order difference-in-differences setup. Hanson and Rohlin (2013) studied the spillover effects of EZs and found that areas similar to EZs or bordering EZs experienced a decline in number of establishments compared to areas similar to non-designated EZ applicants or bordering non-designated EZ applicants.

Looking at state EZs, Papke (1994) found that Indiana's program resulted in an 8% increase in the value of firm's inventories and a 19% reduction in unemployment claims. Papke (1993) also found that Indiana EZs increased zone resident employment by 1.5%, while Peters and Fisher (2002) showed that the direct revenue impact of state EZ programs on state budgets are prone to be negative, given that it was likely a low percentage of new jobs in EZs were jobs that would not have been created in the absence of tax benefits. The authors estimate an annual loss to state budgets of $1.5 million annually per average-sized state zone. Peters and Fisher (2004) explain some of the failures of EZs as stemming from the magnitude of benefits, as the benefits are typically too small to matter when a firm's wage expense may be over 11 times the size of its tax expense.

Indeed, a number of studies have yielded more pessimistic results regarding the economic development potential of EZ programs. Billings (2009) utilized a geographic borders-based approach to identify a control group surrounding designated state EZs in Colorado, and found that fiscal incentives had a positive impact on employment, but did not significantly impact business location decisions. Bondonio and Engberg (2000) determined that in a cross-sectional examination of five different EZ programs, there was no significant impact on employment, even after factoring in differing policy and incentive characteristics of the various programs. Elvery (2009) also found that state EZs in California and Florida had no impact on the probability of

employment for residents. Neumark and Kolko (2010) focused on state EZs in California, and found that EZs did not increase employment and did not result in a shift of employment towards lower-wage workers.

Some studies have yielded inconclusive or mixed results. Bondonio and Greenbaum (2007) provided additional nuance on the impacts of EZs, writing that there is some evidence businesses in EZs do grow faster than those outside, and that an overall null mean impact stems from zone-induced losses among firms that choose to leave the area. Similarly, Greenbaum and Engberg (2004) employed a propensity score matching difference-in-differences technique to show that EZs had a positive effect on the birth of new establishments, but a negative effect on retaining establishments. Ham et al. (2011) determined that federal and state EZs, as well as federal ECs (which are infrequently studied given the less robust incentive package) had a positive impact on unemployment and the poverty rate, as well as a positive, but statistically insignificant, spillover effect to neighboring census tracts. Oakley and Tsao (2006) utilized a propensity score matching strategy to estimate the impact of federal EZ/EC programs on socioeconomic trends, finding that even when there were significant positive indicators (homeownership and poverty rate), the effects were very modest, and there was an insignificant impact on household income, unemployment, and poverty. Rogers and Tao (2004) determined that small Florida cities with EZs did achieve a greater reduction of the unemployment ratio to population relative to other qualifying small cities, but the effects were not statistically significant.

When publishing an interim assessment of the program, Hebert et al. (2001) also noted mixed results, stating that while job growth occurred in 5 of the 6 original EZs, it was difficult to separate this effect from broader economic growth in the same cities. Somewhat worryingly, they wrote that only 11% of businesses in the areas reported using EZ wage tax credits, and more than half of those businesses using the credits reported that it was of little to no importance for them in their hiring and investment decisions. In addition, 65% of all businesses in EZs reported no benefits associated with being located in a zone.

Given the focus of federal and state EZ/EC policy on economic development and job creation, literature regarding the impact of the various programs on property values has been somewhat limited. Boarnet and Bogart (1996) estimated the impact of state EZ designation on property values in

New Jersey, finding no significant impact. Engberg and Greenbaum (1999) estimated the capitalization of state EZ zones on local housing markets, finding no significant effect. On the other hand, Krupka and Noonan (2009) found strong evidence for the effect of federal EZs on housing prices, but small or negative effects of federal EZs on other neighborhood quality characteristics. The authors modelled house prices in differences (repeat sales) to reduce heterogeneity between levels in various areas, similar to the approach taken in my research (see Section 5).

Although not explicitly within the category of Enterprise Zones, research regarding the Gulf Opportunity (GO) Zone is directly related. The GO Zone was a unique place-based set of regional tax incentives that was introduced in the New Orleans metropolitan area following Hurricane Katrina. Williamson and Pender (2016) applied a difference-in-differences modeling framework to analyze the economic impacts of the GO Zone, finding a positive impact on per capita personal income, but no strong causal relationship with employment or population growth. Bunker (2013) studied the impact of the GO Zone on economic outcomes in surrounding geographies to determine if the program had a negative impact on economic growth in those districts (i.e. zero sum), but did not find any evidence to support such a conclusion.

Boarnet (2001) writes that part of the reason for the vast disparity in the literature about EZs is methodological inconsistency. The author describes varying approaches to dealing with the quasi-random selection challenge posed by the existence of designated enterprise zones and eligible zones. While the selection is in many ways an idiosyncratic process, it is not fully random but rather quasi-random, meaning the usage of eligible zones can constitute only a starting point for a more robust experimental methodology that accounts for differences. In my study, I have attempted to address this issue by modeling prices in differences rather than levels, which removes unobserved variable bias that may further differentiate eligible and designated zones, but still does not control for varying growth rates between locales. To address that latter issue, I have included differing growth rates for market regions in order to control for any geographically-specific growth trends, although I was not able to use city-specific trends given the potential for collinearity with our small sample size. Finally, I also selected a narrower subset of census tracts along socioeconomic lines, and verified the assumption of parallel trends by testing for any significant differences in eligible and

designated OZ properties prior to the time of designation, as well as assessing trend correlation.

3.2. New Markets Tax Credit (NMTC)

The NMTC program differs in important ways from OZs and EZs, but the literature on the impact of NMTCs on economic indicators nonetheless provides a valuable perspective for my research. In 2000, the Clinton administration signed into law the NMTC program as a component of the same year's Community Renewal Tax Relief Act (Forbes, 2006). The NMTC provides a fixed allocation of tax credits for qualifying investments, with $3.5 billion of allocation in 2018 and $54 billion in aggregate since the program's inauguration. For each dollar of investment in a qualifying company up to the amount of NMTCs "allocated" to that company, an investor receives a 39 cent tax credit (so, rather confusingly, the actual subsidy and tax expenditure is only 39 percent of the $54 billion allocated since inauguration).

NMTCs are competitively awarded to certified Community Development Entities (CDEs), which receive their certification from the Community Development Financial Institutions (CDFI) Fund. A typical allocation award for an individual CDE might be in the range of $20 to $100 million. CDEs then typically divide their allocation into a series of new entities referred to as "sub-CDEs." CDEs will select real estate projects or companies meeting their own social impact criteria and the federal NMTC regulations, and will allow third-party investors to invest into or lend to those projects through their sub-CDE as a pass-through. A project will qualify to receive NMTC-eligible investment or lending only to the extent that it is located in a low-income community (LIC) as defined by the federal government.

The criteria for designation of LICs closely mirror those for OZs, with a requirement that an area have a poverty rate of above 20% or a median family income below 80% of the reference geography (although the NMTC regulations do not allow any tracts to qualify for incentives based on adjacency to a qualifying tract). However, the main difference between the two programs to highlight is that a project does not generate NMTC tax benefits on an as-of-right basis due to a location in a qualifying LIC. Rather, in order to generate benefits, a project must be individually selected by a CDE, and so the scale of the program is potentially much more limited than the scale

of OZs.

Results on the impact of the NMTC program on socioeconomic outcomes have also been mixed. Harger and Ross (2016) examined the impacts of the NMTC program on employment within specific sectors by comparing census tracts that were either barely eligible or barely ineligible for NMTC investment, with those selected as a treatment group and those that were not selected as a control. The authors found a positive impact from census tract eligibility for NMTC investment on employment within certain sectors, and a negative impact on employment within other sectors, which they attributed to rent-bid curve dynamics among industries.

Freedman (2012) analyzed the impact of NMTCs on home values, poverty, and employment. The author found a significant effect of small magnitude on poverty and employment, and an impact on home values that is almost significant. Of note, I have adopted Freedman (2012)'s fuzzy discontinuity approach, which took advantage of the multiple means by which a given census tract can qualify as a low-income community. Specifically, it is possible to find census tracts on both sides of the eligibility boundary which are otherwise comparable on other dimensions. Because OZs were designated based on either poverty rate or median family income, I was able to compare designated and non-designated tracts which fall within the same poverty rate range by including designated tracts which qualified based on median family income or adjacency alone.

Tempering the optimism of these results, Freedman (2015) used a calculation of commute distance rise after NMTC investment to suggest that positive outcomes may be due to changes in neighborhood composition rather than an improvement in living conditions for existing residents. Freedman (2018) found a modest but positive impact on the entry of supermarkets into low-income areas due to the NMTC program. Using an interview-based methodology, Abravanel et al. (2013) wrote that one could reasonably conclude that 3 to 4 of every 10 NMTC projects would not have come to fruition without the subsidies. This is the ostensible policy objective of the program, as well as many other place-based programs like OZ, namely to provide financing for projects that would not proceed "but for" the subsidy.

Finally, of note to us given the need for capital investment to spur redevelopment activity in OZs, Gurley-Calvez et al. (2009) found that the

NMTC program has resulted in an increase in investment funds available to low-income communities, and that this change has been caused not by an increase in the overall investment levels of firms, but through a substitution in favor of low-income areas. The authors utilized a combination of a propensity score approach and an IV approach to address non-random participation in the NMTC program.

3.3. Broader Tax Response Literature

As noted above, the scale of the OZ program is so large relative to the overall number of census tracts in the U.S. that, if there is significant uptake, there could be significant consequences for the federal capital gains and local real estate tax base. (In contrast, in the first round of designation there were only 6 federal urban EZs across the entire country). As a result, we can invoke the broader literature about how changes in tax rates affect corporate responses more broadly, in addition to the literature already discussed about highly targeted incentives in the most distressed areas.

Hall and Jorngeson (1967) conducted one of the first major studies of the impact of tax incentives on firm behavior, specifically looking at a tax credit for expenditure on equipment. The authors found that in response to a liberalization of depreciation rules in 1954, firms made a shift from equipment to structure investment, whereas a new investment tax credit (ITC) and depreciation guidelines in 1962 caused a shift back to equipment. On a similar foundational level, Lindsey (1987) studied the response of taxpayers to U.S. personal rate reductions, and showed that federal income tax revenue would have been maximized at a rate of 35%, and total income tax revenue would have been maximized at a rate of 40%.

Looking at tax policy on the state level, Bartik (1985) was among the first to suggest that state taxes do have an impact on business location decisions. Bartik (1991) calculated the elasticity of business activity and tax rates, finding a result of between -1 and -3, suggesting that state tax policy could be an efficient lever for spurring economic development in specific locations.

Holmes (1998) did not look explicitly at state tax policy, but classified states into pro- or anti-business states based on whether or not they had a right-to-work law that would ban the existence of union shops. The author determined that the manufacturing share increased by about one third when

crossing from an anti-business state into a pro-business state. The author employed a model looking at counties within 25 miles of a state policy change border. The classification based on right-to-work laws was, however, meant as a proxy to determine the business climate of different states, and so the study has implications for state tax policy as well.

In contrast, Bruce and Deskins (2012) found that state taxes do not have an impact on entrepreneurial activity. While higher top marginal tax rates on personal income did exert an influence on entrepreneurial stock, the base tax rate was not impactful. The authors used a panel regression approach to look at statewide rates of entrepreneurial activity. Duranton et al. (2011) found a corollary result for the relationship between local taxes and firm entry and employment in the English context, with local taxes negatively impacting hiring but having no significant impact on firm entry.

Knittel (2007) looked at the corporate response to bonus depreciation incentives available between 2002 and 2004. The study found that, somewhat counterintuitively from a net present value (NPV) maximization perspective, corporate take-up rates ranged from 54% to 70%. The authors acknowledged that for firms with existing high tax losses, they would likely realize little cash flow benefit from the proposition, but this still does not fully explain the low take-up rates. The authors concluded that the bonus factor was not sufficient inducement for firms to defer tax liability to a later year. The study is particularly salient for a study of OZs, given that the OZ benefit also consists of a similar tax deferral that will increase later year tax liability but increase current cash flow for investors.

Even within the broader literature on firm and personal responses to changes in the federal and state tax rate, real estate studies again remain sparse. However, Bradbury et al. (2001) studied the impact of Proposition $2\frac{1}{2}$ in Massachusetts, which placed a cap on the effective tax rate in some cities and towns at 2.5%, and limited nominal annual growth to 2.5% as well. The authors found that in addition to constraining spending, the proposition also held back gains in property values, and house prices performed worse overall in communities that had a slower increase in spending.

3.4. International Place-Based Incentives

While somewhat less relevant to my current research, the literature on international place-based incentives is at least worth briefly mentioning. Of particular note, Corentin et al. (2012) performed a related analysis of Urban Enterprise Zones in France. Specifically, the authors studied the impact of tax incentives on Urban Enterprise Zones, which are selected from an initial subset of Deprived Urban Areas, similarly to how designated OZs were selected as a subset from a larger pool of distressed eligible zones. The authors utilized a difference-in-differences framework with the larger subset of eligible zones as a control group, combined with propensity score matching techniques, finding a significant positive impact from the program on employment and business location decisions.

In addition, Bondonio and Greenbaum (2003) compared the U.S.'s federal EZs with place-based incentives in the European Union associated with the European Regional Development Funds (ERDF). Specifically, the ERDF provided assistance to areas across the E.U. with high unemployment and declining industrial production, offering workforce training and capital support for restructuring. The authors used a probit model to understand the characteristics of selected zones in both geographies, and found that in both instances a dilution effect caused subsequent rounds of designation to less precisely target distressed areas.

3.5. Contribution to Literature

In summary, a robust literature exists studying the impact of place-based incentives (capital and tax) on the economic development prospects of distressed areas. Studies of state EZs and federal EZ/ECs, as well as NMTCs, have yielded generally mixed or modest results regarding the impact of the programs on measures of economic development, as well as within a smaller subset of studies property values and socioeconomic indicators. However, somewhat unsurprisingly, the broader literature on state and federal tax policy has suggested that changes in policy at both levels are effective levers for encouraging behavioral changes among firms.

The literature is constrained by the usage of a wide variety of quasi-experimental methodological approaches, which has been criticized for lack of consistency. Nonetheless, I do find that the existing literature offers a

robust menu of control group selection methodologies which I have been able to adapt and modify for the unique context of OZs. My adaptations have accounted for the comparative novelty of the OZ program, with barely six months elapsed since tracts were all officially designated, as well as my study topic of commercial real estate, which together significantly reduce the available sample size of observations. As mentioned above, I have primarily attempted to create a robust quasi-experimental framework by using a model in differences (repeat sales), combined with regional control variables, restrictions on socioeconomic indicators in census tracts and verification of parallel growth trends prior to the announcement of the program, which is required for establishing causality even within a cross-sectional analysis. Given the focus of my study is on commercial real estate prices, ensuring the comparability of growth trends among real estate properties is of primary importance, while comparability of growth trends among socioeconomic indicators increases our robustness but is potentially not as pivotal as for studies of changes in employment and demographic indicators.

It is also worth highlighting that none of the studies mentioned here have analyzed the impact of state-based tax or capital incentive programs on changes in commercial real estate transaction activity. The literature on changes in property values is already limited, but those studies that do exist focus primarily on home values. This trend is somewhat surprising, given that none of the incentives mentioned are targeted to individual homeowners on a first-order basis, but are geared to firms and institutional investors. It would seem that the relevant scale for analysis of a program like the NMTC, which encourages the construction of new buildings in the multi-million dollar cost range, would be at the commercial real estate level. One might also argue that before analyzing the secondary effects of programs like the NMTC on measures of economic development, we should first look at the primary impact of these programs on encouraging changes in the built environment, which given the nature of these programs is the requisite means by which positive economic development outcomes will theoretically be achieved.

However, the heterogeneity of commercial real estate has likely made such studies difficult in the past, and perhaps explains the minimal coverage this topic has received in the place-based economic development literature, despite its obvious relevance. In Section 5, I discuss the various strategies employed here to address heterogeneity through a repeat sales framework.

Given that a repeat sales specification reduces the number of properties included in my data set, as only properties which transact more than once can be studied, I then discuss the Bayesian hierarchical modeling framework used to mitigate issues of small sample size.

4. Background on Opportunity Zones

Bernstein and Hassett (2015) first proposed a framework for the OZ program as a response to previous state and federal place-based tax incentives (like EZ/EC) that had yielded mixed results in terms of stated goals to increase employment and investment in distressed communities. Specifically, the authors referenced work that suggested programs such as state EZs and the federal NMTC suffered from complexity of tax regulations and shallow subsidy levels that failed to sufficiently spur increased investment, among other structural issues, and proposed the framework of a federal OZ program as an alternative. See Section 3 for more details on the outcomes of many of these programs.

Prior to being passed as part of the larger Tax Cuts and Jobs Act in December 2017, OZs were first formally introduced at the federal level within the Investing in Opportunity Act in February 2017.[3] Similarly to other federal tax incentives that leverage private sector capital to spur investment, such as the Low-Income Housing Tax Credit (LIHTC), OZs have significantly benefited from bipartisan support, given they in theory reduce the size of government through reduced tax revenue while at the same time, again in theory, achieving a redistributive goal.

The process of designating census tracts as OZs across the country involved two steps. First, based on the Tax Cuts and Jobs Act, qualifying census tracts were deemed eligible. Census tracts were required to meet one of a number of eligibility requirements, specifically a poverty rate of greater than 20% or a tract median family income below 80% of that of the corresponding metro area or state. Based on the eligible tracts, state governors were given the opportunity to nominate up to 25% of the eligible census tracts in their respective states to be designated as OZs. In addition, up to 5% of a given state's designated OZs were permitted to be simply contiguous with an eligible tract. The designation process was bespoke in different states, with a wide array of political factors influencing decisions, including existing economic development efforts underway within a given tract. Based on confirmation of states' nominations, tracts were officially designated by the U.S. Treasury and Internal Revenue Service (IRS) in cohorts between

[3] `https://eig.org/opportunityzones/history`

April and July of 2018.

We can identify various different means by which states chose their designated census tracts from the larger subset of eligible ones. The State of Washington emphasized the importance of a transparent process and set a specific quota of tracts that would be selected by each county, each of the state's federally recognized tribes, and other eligible entities such as cities, towns, housing authorities, and port districts [4]. In contrast, New York State provided significantly less detail on their process, simply stating in a press release that the final list of designated tracts was made based on recommendations from the state economic development and housing agencies, along with regional economic development councils [5].

Other states used a more explicit formula-based approach. New Jersey calculated a Municipal Revitalization Index that took into account socioeconomic indicators such as poverty rate and unemployment, along with transit access, existing investments, and geographic distribution [6]. Illinois also adopted a quasi-formula based approach, choosing for each of the state's 88 counties at least one zone that ranked highest in terms of needs (i.e. most distressed) [7]. Both states qualified, however, that final outputs of the formula were reviewed in concert with local governments and community entities in relevant geographies in order to make a final determination on designations.

The OZ program offers three main incentives to investors who deploy capital through an Opportunity Fund (OF), an investment vehicle set up for making qualified investments in OZ-designated census tracts. Specifically, investors are permitted to defer taxes on any capital gains invested until the earlier of 2026 or the date on which the investment in the OF is sold. This benefit is broader than, but in many ways similar to, the popular benefit provided through Section 1031 of the Internal Revenue Code, which allows for a deferral of capital gains taxes upon selling real property and subsequently reinvesting proceeds within the same tax year in other real property. In contrast, in OZs investors may defer any prior capital gains, such as from the sale of public equities, as opposed to only capital gains generated from

[4] http://www.commerce.wa.gov/

[5] https://esd.ny.gov/opportunity-zones

[6] https://www.state.nj.us/dca/

[7] https://www2.illinois.gov/dceo/

the sale of real property.

In addition to a deferral of capital gains, investors receive a reduction of 15% on the amount of prior capital gains tax when it finally comes due (t_p), provided the investment in the OF is held for more than 7 years (there is a 10% discount if the investment is held for between 5 and 7 years). If the investment is held for at least 10 years, the investor also receives an increase in tax basis equal to the investment's fair market value upon sale, effectively eliminating the exit tax due from any new capital gains (t_n) generated by the OF's investment activities.

Investors may avail themselves of the aforementioned tax benefits only to the extent an OF successfully makes qualified investments in OZs. Most importantly for OF investments in real estate, properties must undergo a capital improvement at least equal to the OF's initial acquisition expense within 30 months of purchase, thereby privileging development and significant rehab over acquisition. Certain types of facilities are also excluded from the OZ program, including golf courses, country clubs, and sin businesses such as casinos. However, overall the scope of the program allows for a wide range of asset classes without any blanket restrictions, and so can be used to finance industrial facilities, hotels, commercial space, and residential, to name a few. In contrast, the NMTC program does not permit the use of funds for housing projects, although it is often paired with Federal Low-Income Housing Tax Credits (LIHTC) by separating a building into multiple legal condominiums.

In addition to real estate investments, OZ incentives can be applied to operating businesses located in the same census tracts. In order to qualify, any such business needs to hold at least 70% of its tangible property in the qualifying OZ and must earn at least 50% of its gross income from activities taking place in an OZ (NKF, 2018). However, most of the initial excitement from investors regarding OZs has taken place firmly in the real estate sector, which some commentators have speculated is due to the minimum required 10 year hold in order to realize the full incentive. In contrast, venture capital or private equity investors might target a shorter hold period for a corporate equity investment [8]. One other plausible scenario is that investors view it as too risky to invest in an operating business, given that it in most cases

[8] `https://www.novoco.com/periodicals`

Table 1: Opportunity Zone Cash Flows ($millions).

	Opportunity Zone						
	Investment	t_p	**Income**	t_{income}	**Sale**	t_n	**Total**
2018	-10.0	0.0	0.0	0.0	0.0	0.0	-10.0
2019	0.0	0.0	0.7	-0.1	0.0	0.0	0.6
2020	0.0	0.0	0.7	-0.2	0.0	0.0	0.6
2021	0.0	0.0	0.7	-0.2	0.0	0.0	0.6
2022	0.0	0.0	0.8	-0.2	0.0	0.0	0.6
2023	0.0	0.0	0.8	-0.2	0.0	0.0	0.6
2024	0.0	0.0	0.8	-0.2	0.0	0.0	0.6
2025	0.0	0.0	0.8	-0.2	0.0	0.0	0.7
2026	0.0	-1.8	0.9	-0.2	0.0	0.0	-1.1
2027	0.0	0.0	0.9	-0.2	0.0	0.0	0.7
2028	0.0	0.0	0.9	-0.2	18.3	0.0	19.0
Total	-10.0	-1.8	8.0	-1.7	18.3	0.0	12.8
IRR							**10.0%**

	Non-Opportunity Zone						
	Investment	t_p	**Income**	t_{income}	**Sale**	t_n	**Total**
2018	-10.0	-2.1	0.0	0.0	0.0	0.0	-12.1
2019	0.0	0.0	0.7	-0.1	0.0	0.0	0.6
2020	0.0	0.0	0.7	-0.2	0.0	0.0	0.6
2021	0.0	0.0	0.7	-0.2	0.0	0.0	0.6
2022	0.0	0.0	0.8	-0.2	0.0	0.0	0.6
2023	0.0	0.0	0.8	-0.2	0.0	0.0	0.6
2024	0.0	0.0	0.8	-0.2	0.0	0.0	0.6
2025	0.0	0.0	0.8	-0.2	0.0	0.0	0.7
2026	0.0	0.0	0.9	-0.2	0.0	0.0	0.7
2027	0.0	0.0	0.9	-0.2	0.0	0.0	0.7
2028	0.0	0.0	0.9	-0.2	18.3	-1.7	17.3
Total	-10.0	-2.1	8.0	-1.7	18.3	-1.7	10.8
IRR							**7.7%**

All cash flows assume an initial outlay of $10 million in equity, with the assumption being that capital gains taxes due under the non-OZ scenario are paid from a separate source. t_p refers to taxes due for prior capital gains being invested and is calculated as 21% times the initial equity investment. t_{income} refers to taxes on annual taxable income (assumed to equate NOI in this unlevered scenario). t_n refers to capital gains taxes generated from the new investment (in an OZ or non-OZ) and is calculated as the difference between the terminal exit value and the initial equity outlay. Cash flows are unlevered for simplicity. Assumed yield-to-cost of 7% and exit cap rate of 5%, with annual NOI growth of 3%. Based on a discount rate of 10%, the difference in the NPV of the non-OZ scenario and OZ scenario cash flows equates to 19.4% of the initial investment. Assumes same opportunity cost of capital (OCC) for both scenarios, although in reality the difference in value could be higher as the longer required hold period of the OZ investment results in a higher OCC.

it can be hard to guarantee what portion of gross income will be generated in the OZ. Lambie-Hanson (2008) observed a similar effect regarding the NMTC program, commenting that the requirement for a certain amount of tangible property to be held in a low-income community may have caused the tilt towards real estate investing within that program as well. As of 2008, approximately 66% of total NMTC investment dollars had gone into real estate transactions.

As shown in Table 1, OZ tax benefits can offer a significant increase in both total post-tax cash flows and the post-tax internal rate of return (IRR) received by an investor. Based on an illustrative investment with a going-in 7% yield-on-cost and a 5% exit capitalization rate, the post-tax IRR could increase from 7.7% to 10.0%.[9] Based on an NPV analysis of these simulated cash flows assuming a discount rate of 10%, the increase in investment (and land value) could be as high as 19% and the investor's return would be held constant. Alternatively, if the seller does not increase the price of the land or economically obsolete property at sale, the additional post-tax profit could accrue entirely to the company developing on the site (or redeveloping the economically obsolete property).

It is worth noting that in comparing this increase with empirically observed land value changes, we assume a pro rata split between land value and capital expenditures (structure), but we cannot confirm such a split a priori. Sage et al. (2019) provide additional theoretical background as well as a sensitivity analysis of varying changes in the NPV of investment based on OZ tax incentives.

It's worth noting that the OZ program potentially provides a much deeper subsidy at a larger scale than existing programs. While the NMTC provides a moderately deep subsidy equal to 39 cents per dollar invested in a qualifying entity, NMTCs are available based only on a fixed annual allocation of competitively awarded credits ($3.5 billion in 2018, and $54 billion in aggregate since the program was inaugurated in 2001). This can significantly impede the ability for the program to impact neighborhoods, as designation for a specific project occurs through one-off discussions between a developer

[9] Assumes tax rate of 21%. t_p assumes 100% of invested capital constitutes capital gains from a prior transaction.

or company and a qualifying CDE. On the other hand, the federal EZ/EC program and state EZs generally did not cap the amount of benefits that could accrue to companies in qualifying zones, as discussed in Section 3, but the incentives were often of such low magnitude that they did not even factor into companies' investing decisions. In contrast, there is no statutory cap on total tax benefits awarded by the federal government under the OZ program, and the economic benefits are of a magnitude that can be significant to firms or developers.

In order to qualify for the benefit mechanically, a partnership or other investing vehicle needs only to self-certify to the IRS its status as an eligible OF concurrently with filing its federal tax return. NCS (2019) reported that as of December 2018 53 legal entities across the country had certified as OFs, with total capitalization of nearly $15 billion. A breakdown of fund typologies using data provided by NCS (2019) is provided in Table 2. There is limited geographic concentration, at least at the national scale, as between 40 and 49 funds are currently operating in each of the 6 major regions across the country. Average fund capitalization within each of those regions also does not vary significantly (from $261 million to $310 million).

However, there is somewhat more heterogeneity when it comes to the focus of funds on different asset classes. Somewhat unsurprisingly, the asset classes covered by the most funds include commercial real estate, multifamily residential housing, and mixed-use projects. Of note, among the OFs profiled there is almost no interest in industrial properties, with the exception of a few small funds targeting agriculture or renewable energy, and one small fund targeting warehouses. (Note that this doesn't mean such a fund wouldn't purchase a depreciated industrial property and then convert it into another use in line with its stated asset class focus). This is somewhat surprising given the focus of the predecessor EZ/EC program on stimulating business activity in OZ areas, often with an implicit policy focus on industrial businesses. In this sense, one can view the OZ program as a significant departure from the EZ/EC program, as OFs appear to be geared far more towards stimulating consumer activity within designated zones.

It should be noted, however, that a significant degree of investing activity was already taking place in OZs prior to the announcement of the program. NKF (2018) noted that the top 3 largest OZ property buyers in 2017-2018 were Blackstone, Brookfield, and Wind Creek Hospitality.

Table 2: OZ Fund Characteristics by Geography.

Market	**Number of Funds**	**Average Cap. ($mm)**
Northeast	49	261.3
Southeast	46	310.2
Southwest	45	271.6
Mid-Atlantic	40	309.5
Midwest	44	292.3
West	42	284.5
Asset Type	**Number of Funds**	**Average Cap. ($mm)**
Affordable Housing	30	215.2
Commercial real estate	60	263.8
Community revitalization	34	161.3
Controlled Environment Agriculture	2	24.5
Economic development	32	174.8
Hospitality development	27	276.7
Infrastructure investment	11	200.0
Mixed-use development	52	264.2
Multifamily residential	56	248.2
Renewable energy investment	11	190.9
Senior housing	1	35.0
Single family residential	13	177.8
Small business development	25	126.6
Sports Stadiums and Arenas	1	500.0
Student housing	22	231.1
Warehouse	1	10.0
Workforce housing	24	208.2
Other	8	124.9

5. Methodology

For modeling and tracking the prices of heterogeneous goods, such as real estate, a widely-used model is the so-called pooled hedonic model (Rosen, 1974), given by;

$$y_{it} = \beta_t + \gamma X_{it} + \varrho Z_{it} + \epsilon_{it} \tag{1}$$

where y is the (log) transaction price at time t of property i, X are observable characteristics, and Z are unobservable characteristics of property i, with parameters γ and ϱ respectively. The latter is understood to be part of the cause for changes in price levels, but by definition cannot actually be estimated.

Holding constant for the cross-sectional differences in properties, parameter β gives the longitudinal price changes, i.e. the index. Typically, our objective is to identify β by sufficiently controlling for the observable and unobservable characteristics of each property, allowing us to determine historical, and potentially forecast, overall market trends across a specific real estate market or submarket.

Parameter β is typically modelled as a dummy matrix, with a '1' if a property sold in a given year. To avoid the dummy trap of perfect collinearity (where our model is unable to disentangle between the magnitude of coefficients for two variables which represent the same effect), we typically leave out the first year of study. The residuals are provided by ϵ, which are assumed to be normally distributed around 0.

The downside of the hedonic model is that it is very sensitive to missing characteristics in Z (Bailey et al., 1963; Deng and Quigley, 2008). This is especially problematic for commercial real estate (our application), given the high degree of heterogeneity among properties, conjoined with few observable characteristics in the data (Van de Minne et al., 2019). Specifically, for residential housing, we can typically explain the majority of attributes which factor into sale price using widely available data (e.g. square footage, number of floors, year built). In other words, the residential housing market is more heavily commoditized. For commercial real estate, we often lack information on pivotal factors contributing to heterogeneity, such as the credit quality of a large tenant, specific building amenities, etc.

In order to address these issues, we frequently will instead use a differ-

enced hedonic model, known as the repeat sales model. Essentially, by modeling the change in prices over time for a given property, we control for the other idiosyncratic factors that make that property unique. By differencing Eq. (1), both the observed characteristics X and unobserved characteristics Z drop out.

The standard repeat sales model is therefore given by;

$$y_{ist} = \beta_t - \beta_s + \epsilon_{ist} \tag{2}$$

where subscript s denotes the time a property was purchased, as opposed to t, which gives the time of sale. Thus, we analyze the ways in which the property appreciated or depreciated during the hold period of a given investor.

Note that the dependent variable y_{ist} now represents the (log) price return, i.e. the change in price levels, of property i. For identification purposes we restrict $\beta_1 = 0$. Thus, after converting the resulting index from log price levels into price levels, we compare all changes to a baseline value of 100 in the first period of observation, a standard practice for indexing.

The repeat-sales model is a widely popular method to produce property price indexes, such as the House Price Index of the Federal Housing Finance Agency, based on Case and Shiller (1987), and the RCA price index for commercial real estate, based on Van de Minne et al. (2019). While it is particularly useful for commercial real estate, given the higher levels of heterogeneity, it is nonetheless also helpful for residential property as well, where all the desired data fields may not always be available, and where there will still exist some unobserved heterogeneity.

The repeat-sales model is much less vulnerable to model mis-specification and omitted variable bias compared to the hedonic price model. In the hedonic price model, we must find ways of addressing missing data points, even within observable characteristics. For predictive modelling purposes, there are numerous ways to address missing data, including through estimating the missing data based on a distribution around mean values for the remainder of the data set. However, in order to identify causal effects, we typically filter out these missing observations. This can even occasionally result in fewer observations compared to the repeat sales model, depending on the

characteristics at hand.

Nonetheless, the drawback of the repeat sale methodology is generally the loss of observations, given that it requires properties with multiple transactions. In general, the frequency of commercial real estate transactions is already very low given investors' typical hold periods. This is exacerbated when we then further filter the data to include only properties for which we observe more than one transaction. Finally, because of the short time frame elapsed since the OZ program was announced, it was necessary to analyze transactions on a monthly rather than annual basis in order to understand movements immediately before and after zones were designated in a given state. Thus, problems of volatility stemming from a small sample size are potentially exacerbated.

5.1. Bayesian Structural Time Series Framework

Given these constraints, as well as the fact that we were focused on the subset of OZ properties targeted for redevelopment, it was necessary to utilize a structural time series rather than a more traditional ordinary least squares (OLS) approach, which in this context would produce a highly volatile estimate with no clearly discernible signal. Instead of using traditional year dummies for β_t, we utilize a random walk structure. Francke (2010) were the first to use structural time series modelling in the repeat sales context, given by:

$$\beta_t = \beta_{t-1} + \zeta_{t-1}, \qquad \zeta_{t-1} \sim N(0, \sigma^2_\zeta), \tag{3}$$

This model assumes that the (log) price level in t is roughly similar to the (log) price level in $t-1$, plus/minus some increment or a random effect, with estimated variance σ^2_ζ. This prior assumption smooths the movement we observe in the data from month to month, depending on what types of properties transacted.

Structural time series modeling for commercial real estate is becoming an increasingly common and accepted practice in the industry . RCA's commercial property price indexes are estimated using an autoregressive model introduced by Van de Minne et al. (2019), Street Easy estimates local rent indexes using the hierarchical repeat sales model introduced by Francke and Van de Minne (2017), and Propstack publishes an Indian rent index using

stochastic volatility models (Bokhari et al., 2017).

Structural time series fall within the broader statistical subcategory of Bayesian estimation. While a thorough summary of Bayesian thought is beyond the scope of my study, at a high level, it's worth noting the concept of the prior in order to better convey how our repeat sales methodology incorporates Bayesian statistics. Specifically, within a Bayesian framework, as indicated by the name which references Bayes' well-known theorem of probability, we predict the distribution of a potential variable as a conditional probability based on a prior belief regarding that variable's distribution. In the case of our study, we utilize Bayesian estimation as it permits us to construct hierarchical models, but select uninformative priors, or priors that assume normal distributions around 0 and thus do not vastly influence the final results derived from our models, known as the posteriors.

The usage of Bayesian estimation techniques and local linear trend models for the construction of real estate indices has received significant attention in the existing literature. Goetzmann (1992) first introduced the usage of Bayesian time series for real estate indexing, specifically through a random walk with drift and an uninformative Gaussian prior specified for the log price return. Francke (2010) built upon this work by specifying a local linear trend model for the model's trend component. Similarly to the case at hand, these models were developed out of a need to create smooth highly-granular indices in situations where OLS models would typically underperform. The need for such smooth, granular indices was previously expressed through smoothing mechanisms described by Cleveland (1979) and Clapp (2004).

The usage of local linear trend model-based Bayesian real estate structural time series was further extended to hierarchical models by Francke and DeVos (2000) and Francke and Vos (2004), who applied it to a hedonic model framework. Francke and Van de Minne (2017) then further built on this work by applying similar Bayesian hierarchical time series to a repeat sales context, where the price levels are modelled based on a common trend with cluster-based subtrends.

Structural time series models of this type are typically estimated using full Markov chain Monte Carlo (MCMC) simulations. The MCMC technique allows us to sample from the posterior distributions without actually calculating them formally. I analyze a number of standard metrics of fit to assess

how well the MCMC estimation has converged upon a specific value based on a specific number of samples. I describe these metrics further in Section 7. It's worth noting that MCMC is not the only approach for Bayesian inference, and other popular techniques in the literature include the Empirical Bayes Method, or Kalman filter. My estimation strategy is explained further in Section 5.5.

5.2. Difference-in-Differences Framework

My model includes both properties located in tracts that were designated as OZ (our treatment group) and properties located in tracts that were eligible, but not designated (our control group). The difference-in-differences setup is frequently used in the literature on place-based incentives as a mechanism for determining similar metrics of out- (or under-) performance (albeit in past studies with respect to employment), and many authors have also used eligible, but non-designated, zones as a naturally occurring control group, or at least as the starting point for further refinement to create a control group (see Corentin et al., 2012; Harger and Ross, 2016, among others). Boarnet (2001) writes about some of the challenges faced by this approach given potential selection bias, even if the designation of the final zones is a quasi-random process.

Indeed, others have even commented that designated OZs show signs of being more distressed than eligible OZs across a number of socioeconometric metrics (Theodos et al., 2018). While the process for designation varied significantly from state to state, as described in Section 4, some states did take a formula-based approach to designation that could negatively impact the interpretation of my results.

Therefore, I adopted a number of strategies in order to attempt to mitigate selection bias between the control and treatment group. First, by modelling in differences, I immediately remove a certain degree of heterogeneity between the different types of census tracts. Even if there was heterogeneity in the price levels between the different areas, which I discuss in Section 6, it no longer impacts our estimates. Rather, we only need to concern ourselves with the potential that the actual movements between the different areas differed significantly, violating the assumption of parallel trends. While our analysis is cross-sectional rather than longitudinal, we nonetheless require

the assumption of parallel trends to be verified in order to ensure the veracity of any cross-sectional divergence we observe after the treatment (in this case OZ designation). As a mitigating factor, I verify that same assumption by separately estimating a simple repeat sales (SRS) model for properties in eligible zones and a separate one for properties in designated zones. I find a high degree of correlation between the two property groups in Section 6.

In addition, I have removed properties in tail zones by restricting the subset of zones analyzed to those with a poverty rate of between 10% and 40% and a median family income below $80,000 annually. While additional restrictions may have been desirable, it will likely be unfeasible to estimate in this fashion until more time has passed and there are more observations, as the sample size analyzed is already very small.

5.3. Difference-in-Differences within Repeat Sales Models

In order to control for omitted variable bias, it was necessary to employ a difference-in-differences setup within the structural hierarchical time series framework. To this end, I drew on work by Geltner et al. (2017), who utilized a Bayesian hierarchical repeat sales model to analyze the difference in risk-return profiles between green and non-green properties, and specified a non-temporal dummy variable to capture the one-time premium associated with LEED certification. I have built a similar model framework to analyze the effect of the OZ program on property price levels.

The simplest model employed is the structural time series repeat sales model, given by Eqs. (2) – (3), augmented with a 'differenced' dummy variable (ω) that indicates if the property got 'treated' between sales. The measurement Equation is thus given by;

$$y_{ist} = \beta_t - \beta_s + \omega_{ist} + \epsilon_{ist} \tag{4}$$

As described above, in this equation β represents the price level at a given point in time. I am most interested in the value of dummy ω, which takes up value 0 if the property was bought and sold in a tract with the same status (even if the property was bought *and* sold within a designated OZ)[10] and

[10] Although in reality, given the limited time that the OZs have been in place, this would

only takes up value 1 if the property was bought in a census tract without the OZ designation, and sold with OZ designation. In other words, given I am modelling changes of price levels in differences, I look at whether a property went from being a "non-OZ" property to an OZ property over the course of a repeat sale pair.

Given the assumption of parallel trends in β_t, parameter ω distinguishes the price premium in census tracts that were designated as OZs from other movements that affect both trends. I designate this model the difference-in-differences repeat sales model (DRS).

Those familiar with the difference-in-differences setup may ask why we do not include a static dummy variable for inclusion in the control group versus the treatment group, as ω essentially represents the typical "interaction" variable between time and membership in a specific group. The reply is that because we are modelling in differences, the membership in each group is "differenced away," as we described with respect to observed and unobserved heterogeneity in the beginning of this section.

In the next model, I relax the assumption of fully parallel trends between the treatment and control groups, and specify a hierarchical model with two separate subtrends (α^j), with $j = \{\text{non OZ census tract}, \text{OZ census tract}\}$. Again, note that all transactions are in census tracts that were *eligible*, including those that went on to become designated and those that did not. There is one common trend going though all the properties, and the subtrend for the treatment and control groups are each specified as a random walk deviation from that common trend.

Given that the timing of the OZ designation was different for the different tracts, it is relatively straightforward to identify the non-temporal price premium associated with OZs without significant concerns about collinearity between ω and the individual subtrends α for designated and eligible tracts, which represents monthly indices.

The model is given by;

---

have rarely happened.

$$y_{ist} = \beta_t - \beta_s + \sum_{j=1}^{J} d_i^j(\alpha_t^j - \alpha_s^j) + \omega_{ist} + \epsilon_{ist}, \tag{5}$$

$$\alpha_t = \alpha_{t-1} + \varsigma_{t-1}, \tag{6}$$

where ς is assumed to be normally distributed with variance σ_ς^2. The selection row vector d_i^j has dimension n_j and consists of zeros and a one to select the appropriate element of cluster j for observation i. Cluster j represents membership in the designated or non-designated (but eligible) OZ cluster.

To retrieve the log trend of designated OZs, one must add the estimated common trend with the OZ subtrend, or: $\hat{\beta}_t + \hat{\alpha}_t^{j=\text{OZ}}$.

The corollary holds true for estimating the subtrend of eligible, but non-designated, OZs. Note that again, both $\beta_1 = 0$ and $\alpha_1 = 0$ for identification purposes. I designate this model the one cluster hierarchical repeat sales model (1HRS).

One critique of the models laid out above is that neither controls for regional differences sufficiently. Indeed, OZs are designated all over the United States, and for example, capital price appreciation in one region might be completely different compared to other areas in the US. This could introduce a sample selection bias because of differences in price level *movements*, even though we have already controlled for differences in the actual levels with the repeat sales framework. For example, if prices exhibited greater volatility in the Southeast than in the Northeast, with a higher peak pre-crisis and lower trough during post-crisis, depending on the percentage of OZ properties located in the respective regions, this could skew the index generated by the 1HRS model.

To address this concern, the 1HRS model can easily be extended with an extra cluster of subtrends (λ^k) that control for regional differences in price dynamics. I use the 6 regions as defined by RCA; (1) Northeast, (2) Mid-Atlantic, (3) Midwest, (4) West, (5) Southwest and (6) Southeast. This regional subdivision is similar to NAREITs regional classification. The resulting two cluster hierarchical repeat sales model (2HRS) is given by;

$$y_{ist} = \beta_t - \beta_s + \sum_{j=1}^{J} d_i^j(\alpha_t^j - \alpha_s^j) + \sum_{k=1}^{K} d_i^k(\lambda_t^k - \lambda_s^k) + \omega_{ist} + \epsilon_{ist}, \quad (7)$$

$$\lambda_t = \lambda_{t-1} + \phi_{t-1}. \quad (8)$$

Note that I omit subscripts j and k mostly throughout Eq. (7) for reading easiness. Also note that in both (5) and (7) the common trend β_t still follows the random walk from Eq. (3). In order to calculate the log price trend for opportunity zones in the Northeast, one would again trivially add the common trends with the corresponding subtrends, or in this case; $\hat{\beta}_t + \hat{\alpha}_t^{\text{OZ}} + \hat{\lambda}_t^{\text{Northeast}}$.

5.4. Extended Model and Expectation Effect

As an extension of my core models, I then expanded the model to incorporate "runner-up" census tracts, or census tracts with a profile similar to that of the eligible and designated tracts in our original dataset. Note that our socioeconomic filters includes all qualifying properties with a poverty rate of below 40% and above 10%. The cutoff for eligibility to the OZ program is either a poverty rate of greater than 20% or median family income below 80% of the statewide or metro area median family income. Therefore, in the 10% to 20% poverty rate range, we capture properties which were eligible because they qualified on the basis of median family income and properties which almost qualified but remained "runner-ups."

I expanded the model in this manner in order to analyze the impact on price levels from the expectation of potential OZ benefits upon announcement of the program. I therefore decompose the total increase in value ω into ω^D, or the one-time price premium from designation, and ω^E, or the one-time price premium from eligibility. In the context of the DRS model, the specification becomes:

$$y_{ist} = \beta_t - \beta_s + \omega_{ist}^D + \omega_{ist}^E + \epsilon_{ist} \quad (9)$$

In the same straightforward manner, ω is decomposed into the same con-

stituent parts for both the 1HRS and 2HRS models. Note that while ω^D cannot assume a value of -1 as a census tract cannot be "undesignated," ω^E will assume a value of -1 if a property transacts in an eligible census tract and then transacts again in the same census tract after it was not selected for OZ designation. (This window occurred between the time the Tax Cuts and Jobs Act was passed in December 2017 and the final designation dates announced in April through July 2018.)

5.5. Estimation

For all specified models I apply full Bayesian inference to derive the posterior marginal distributions for our parameters of interest: the index levels, treatment dummy, and variance parameters. As mentioned above, I specify largely non-informative priors for all the (hyper)parameters (see Gelman, 2006, for a definition of "largely non-informative"). More specifically, the prior on β and ω is normally distributed with mean zero and a standard error of 1. For the variance parameters I use a half Cauchy distribution with mean zero and standard error 1. In all models I center the parameters, as shown in Van de Minne et al. (2019). This increases the sample size considerably (see Betancourt and Girolami (2015) as well).

In order to derive the marginal distributions of the parameters of interest I use Markov Chain Monte Carlo (MCMC) techniques. I employ the No-U-Turn-Sampler (NUTS) developed by Hoffman and Gelman (2014). NUTS is a generalization of the Hamiltonian Monte Carlo algorithm and converges very quickly. With the NUTS algorithm and the efficient re-parametrization of the model, I only needed a sample size of $1,500$ times three (parallel) chains. As is standard in the field, I use half the sample size as a warm-up and do not thin the series. The initial values are randomly (uniformly) selected with a value of -2 and +2, except for the variance parameters which have to be positive, and are thus initialized between 0 and +2.

MCMC sampling using the NUTS algorithm was carried out within the Stan modelling language, accessed from R. Data pre- and post-processing was conducted in R. I utilized the rgeos package within R for combining geospatial data on location of OZs with data provided by RCA on latitude and longitude for individual property sales.

6. Data and Descriptive Statistics

For my analysis, I utilized a (repeat sales) database provided by Real Capital Analytics, Inc. (RCA), covering over $10 trillion of commercial real estate transactions across the United States, accessed as of February 2019. RCA captures over 90% of all the commercial real estate transactions in the institutional investor space within the U.S., thereby giving us the best possible chance of capturing the effect from OZ designation on the limited subset of properties that have transacted in the short time frame since designation.

My base monthly data includes all transactions between January 2000 and February 2019 in eligible (designated and non-designated) OZs. As of February 2019, I observe a total 28,746 repeat sale transactions in these areas. Of these, 7,094 (or 25% of total sample) transactions are in tracts that would eventually become designated OZ. I then further restricted the data set to include only properties which were likely to be redeveloped.

As mentioned in Section 5, development sites are difficult to track in a repeat sale context given we do not have information on capital expenditures, and most development sites are sold with the explicit intent for subsequent redevelopment. Instead, I look only at properties over a threshold age of 30. I also remove residential rental properties, as these properties are less likely to be redeveloped given existing residents. Buechler and Van de Minne (2019) found corollary results in that apartment properties below a certain age are less likely to be redeveloped than other types of assets such as office and industrial properties of comparable age. I also remove hospitality and residential condo sales, as these might also suffer from similar issues related to existing residents, and in any case did not constitute a large portion of the data set. Finally, I restrict FAR to a minimum of 1.0 to identify properties in urban areas that were more likely to see redevelopment activity (as opposed to warehouses in rural or exurban locations that typically had FARs below 1.0).

The underlying assumption in the repeat sales framework is that we have controlled for unobserved heterogeneity, which is violated if the property changes characteristics between the buy and the sell. However, it would be imprudent in this case to filter against properties which underwent a rapid increase in value, as that is precisely the effect we are trying to identify. Luckily, RCA assigns a new property ID when a property undergoes a sig-

nificant rehabilitation, such as when a development site is converted into a new property. This provides some protection against significant changes in levels of property capitalization within the data.

In total, I end up with 1,887 transaction pairs across all eligible tracts. Of these, 544 (or 29%) transaction pairs were in OZ-designated tracts. 159 (or 8%) pairs formed after the OZs were designated. These transactions give us the identification of the ω parameter of interest when we compare relative values between trades after the designation date in designated versus eligible non-designated tracts. Within that subset, 49 of the pairs were formed in designated OZs and 110 were formed in non-designated eligible OZs.

Figure 1 provides a histogram of the annualized log price returns, for both the eligible and designated opportunity zones. Table 3 provides relevant descriptive statistics. Figure 2 provides the geographic distribution of the eligible and designated tracts in the data.

Table 3: Summary Statistics

	OZ	**non OZ**	**Total**
	log returns		
Mean	0.393	0.404	0.401
sd	0.701	0.580	0.619
Min.	-2.862	-3.219	-3.219
Max.	2.935	3.843	3.843
log returns/holding period (annual)			
Mean	0.156	0.158	0.157
sd	0.327	0.327	0.327
Min.	-2.808	-1.726	-2.808
Max.	2.304	4.917	4.917
regional distribution			
Southeast	62	150	212
Midwest	32	112	144
Southwest	21	79	100
West	202	473	675
Northeast	175	310	485
Mid-Atlantic	43	116	159
Total	535	1240	1775

On average prices went up by 1.3% per month for both eligible zones

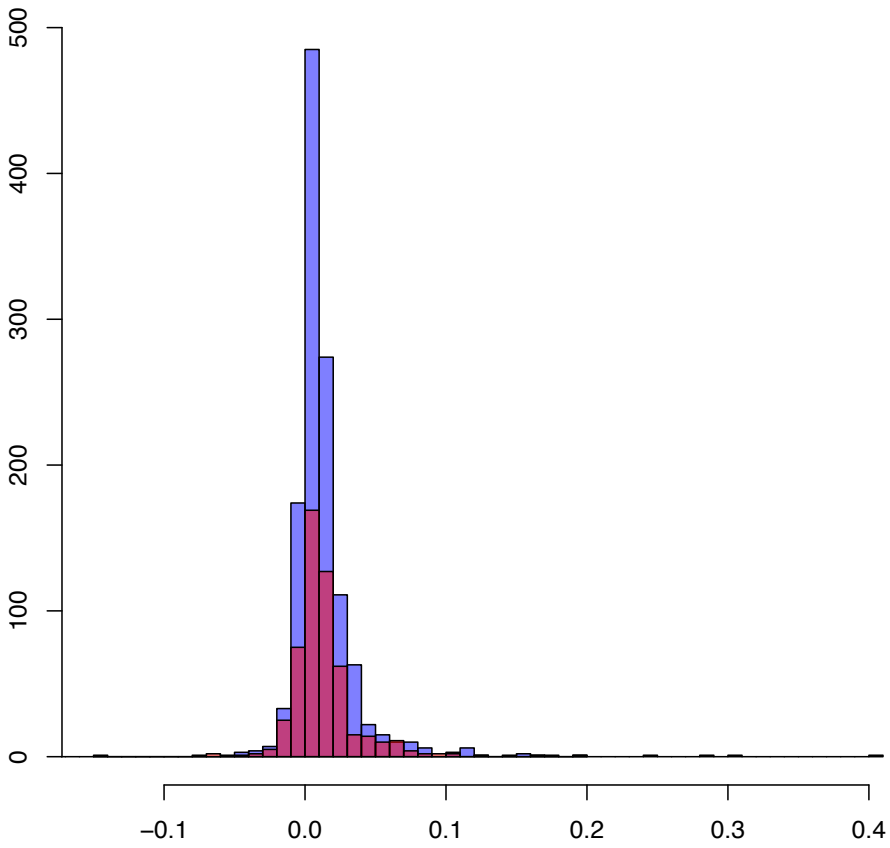


Figure 1: Geographic distribution of annualized log price returns. Blue indicates a property in a designated census tract, red indicates an eligible tract.

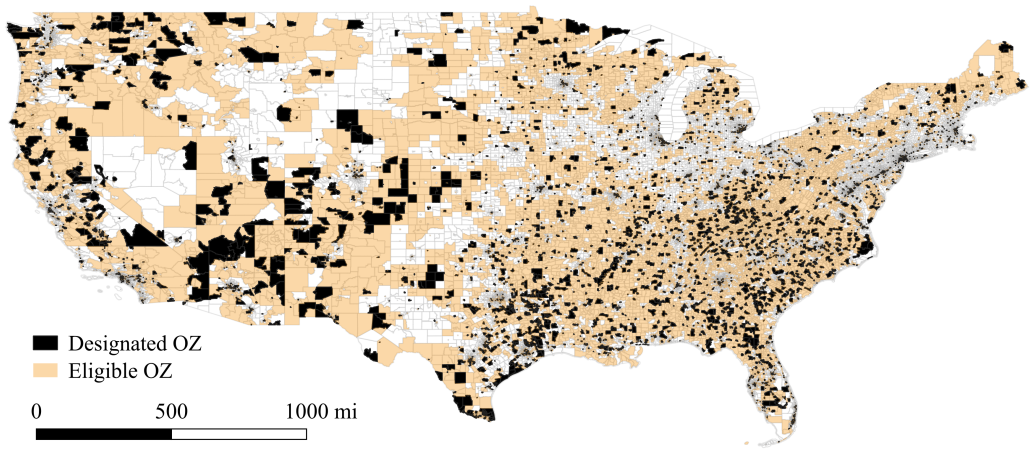


Figure 2: Geographic distribution of opportunity zones (mainland US). Black census tracts indicate opportunity zones

and the designated zones. Other metrics are also the same or similar. For example, log monthly return volatility is 0.027 for designated and eligible zones (annual results shown in Table 3). In addition, the total annual return was 0.39 for designated zones and 0.40 for eligible zones.

On average, 30% of the transactions are in a zone that would eventually be designated as an OZ. This percentage remains fairly constant across the various geographies considered, with the highest percentage of transactions in designated zones being observed in the Northeast (36% of the total). The lowest percentage of transactions in designated zones was observed in the Southwest (21% of the total) and Midwest (22%).

This similarity adds on to the baseline similarity along socioeconomic status between the two zones, given that all eligible and designated zones meet poverty rate or median family income thresholds by definition. We further restricted these variables by selecting only properties in census tracts with a poverty rate of between 10% and 40% and a median family income of below $80,000. A more restrictive definition may have been desirable, but in comparison to other studies of place-based incentives, my focus is on real estate transaction prices as opposed to employment or other socioeconomic outcomes, and so ensuring comparability between price behavior is more important than ensuring comparability between neighborhoods along

demographic dimensions.

In addition to comparing the repeat sale pairs between the two samples (OZ versus non-OZ, or treatment versus control), I also compare the actual properties that transacted on the basis of their hedonic characteristics. Although comparability in these dimensions is not as pivotal an assumption to our model, as we are focused primarily on understanding the relative similarity or difference between price return trends, nonetheless these descriptive statistics provide additional confirmation of the appropriateness of our selected control group. Again, these hedonic characteristics do not factor into our actual model as I have applied a repeat sales framework, and so any such differences have been differenced away.

In the RCA data I observe the transaction price (the level, not return), the size (in square footage), age and holding period. Table 4 compares these characteristics. Note that the sample size is different across the eligible and designated properties. I thus first take the average price, size, etc. of every property. The comparisons are made on those averages.

Table 4: Characteristics of Properties in Eligible and Designated OZs

	OZ		**non OZ**	
	mean	*sd*	*mean*	*sd*
Price Level	$16,988,587	$23,745,428	$28,974,016	$50,143,789
Price PSF	$181	$162	$283	$249
Size	138,244	168,523	127,158	177,230
Age	66.9	27.2	68.0	28.7
Holding Period	5.0	4.5	4.9	4.5

sd = standard deviation. OZ = opportunity zone. Holding period and age are in years. Size is in square feet.

Properties in eligible zones are 9% larger on average. The average price per square foot is also higher, by approximately 36%. The difference in price per square foot also, naturally, does not impact the repeat sales model. In addition, note that the standard deviations on all the variables are very high. In other words, these differences have no statistical impact.

When comparing age, size, and holding period through an Analysis of Variance (ANOVA) experiment, none of them showed a significant difference

between designated and eligible zone properties. The results were highly insignificant, with a p-value ranging from 0.22 to 0.83.

It is fortunate that the holding periods are very similar between the two samples. This is an important assumption of repeat sale models (Clapp and Giaccotto, 1999). Properties with longer (shorter) holding periods are by construction underrepresented (overrepresented) in repeat-sales samples, in particular when the sample period is short. Moreover, homeowners and investors tend to sell 'winners' – properties experiencing above-average price appreciation – more readily than 'losers', i.e. winners tend to have shorter holding periods, see Genesove and Mayer (2001); Bokhari and Geltner (2011).

A more direct comparison can be made by estimating a simple index on both subsets of markets. In order to make this comparison, I use the same repeat sale model described in Section 5 with a random walk as time structure, see Eq. (2) – (3). In this case, however, I estimate the models on both datasets separately, and as such through this specific experiment I cannot identify the OZ premium. (See Section 7 for the main findings regarding the OZ premium.) Nonetheless, this model is useful for understanding the parallel movement of trends prior to the OZ designation date. Figure 3 provides both log index levels. I denote this model as the Standard Repeat Sales model (SRS) for future reference.

The co-movement between the indexes is apparent from the beginning. The indexes slightly diverge at first, which creates a persistent difference in index levels. Still, the index levels are very highly correlated with 0.97. However, a more fair comparison is by looking at the index returns (Van de Minne et al., 2019; Guo et al., 2014). The correlation between the index returns is 0.41, which can be considered as high, given that we have monthly frequency. The return correlation increases to 0.78 if we examine the annual returns.

The volatility of the index returns are also comparable, with 0.018 and 0.019 for the OZ index versus the non OZ index respectively. It is also possible to make confidence bounds around the returns.[11]

[11] After estimating the index levels β_t and computing the log returns $(\beta_t - \beta_{t-1})$, one can compute the confidence bounds for the returns by; $\sqrt{\text{Var}(\beta_t) + \text{Var}(\beta_{t-1}) - 2 \times \text{Cov}(\beta_t, \beta_{t-1})}$.

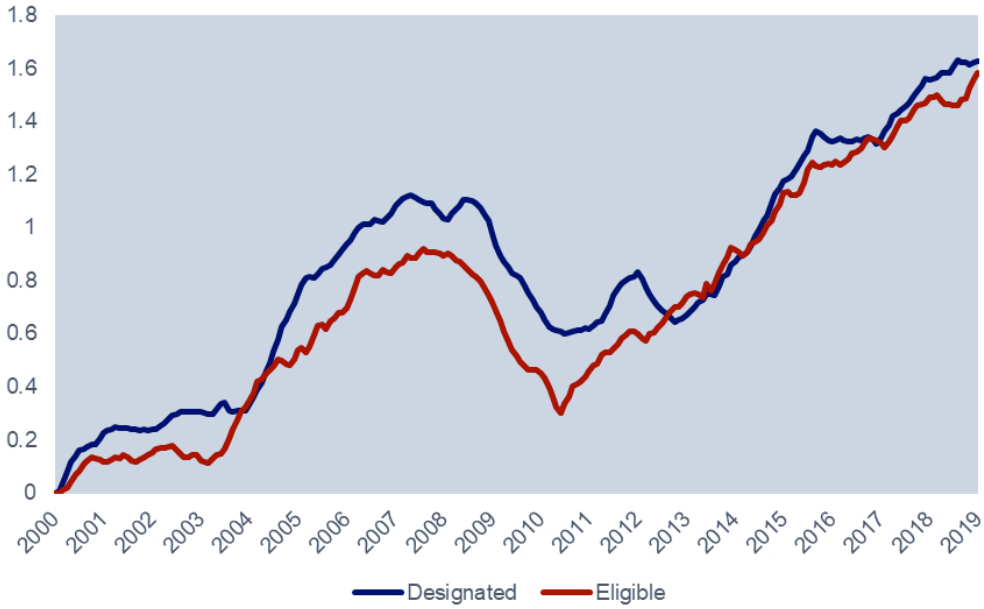


Figure 3: Price indexes for OZs (in blue) and non-OZs (in red).

After comparing the designated OZ log index returns with the 5% and 95% of the posterior of the eligible zone log index returns, I find that it falls within said range 100% of the times. If I perform the same exercise the other way around, again I find the returns are insignificantly different from each other 100% of the time. (This effect is also partly caused by high noise levels.)

Finally, note that the OZ index does seem to have a high run-up in the latest 9 months or so. This could indeed indicate that the designation increased property values in said census tracts. However, one must keep in mind that the designation of opportunity zones has been fuzzy, meaning we would indeed not expect a one-time "jump" in index levels, but rather a smooth increase over the course of several months (as the OZ regulation was being rolled-out). It's worth highlighting that the returns are not significantly different from each other in this specific period (or any prior period, per the earlier discussion.)

7. Results

7.1. Main Findings

In this Section I present the main findings of the DRS, 1HRS and 2HRS models. Table 5 provides the posteriors of the (hyper) parameters, including the parameter of interest ω, which shows the price premium resulting from OZ designation. Figure 4 gives the log time trend estimates of the different models and Table 6 provides selected statistics on the returns of the estimated indexes.

Table 5: Posteriors of (Hyper) Parameters and Goodness-of-Fit

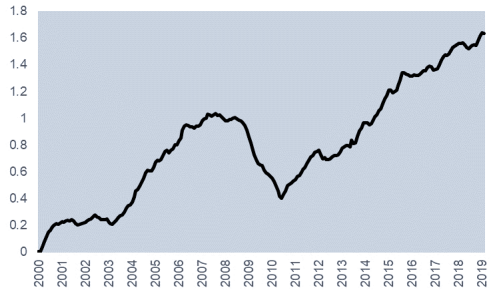
	mean	**se of mean**	**0.5%**	**2.50%**	**5%**	**95%**	**97.50%**	**99.5%**	$\bar{\mathbf{R}}$
					DRS				
ω	0.12	0.00	-0.11	-0.05	-0.03	0.27	0.30	0.36	1.00
σ_ϵ	0.56	0.00	0.54	0.55	0.55	0.58	0.58	0.59	1.00
σ_η	0.05	0.00	0.04	0.04	0.04	0.07	0.07	0.08	1.00
waic	3,036								
					1HRS				
ω	0.18	0.00	-0.13	-0.04	0.00	0.38	0.43	0.54	1.00
σ_ϵ	0.56	0.00	0.54	0.54	0.55	0.58	0.58	0.59	1.00
σ_η	0.05	0.00	0.03	0.04	0.04	0.07	0.07	0.08	1.00
σ_α	0.01	0.00	0.00	0.00	0.00	0.02	0.03	0.03	1.00
waic	3,031								
					2HRS				
ω	0.20	0.00	-0.10	-0.04	0.00	0.40	0.45	0.53	1.00
σ_ϵ	0.53	0.00	0.51	0.51	0.52	0.55	0.55	0.55	1.00
σ_η	0.05	0.00	0.03	0.03	0.03	0.06	0.06	0.07	1.00
σ_α	0.01	0.00	0.00	0.01	0.01	0.03	0.03	0.04	1.00
σ_λ	0.03	0.00	0.02	0.02	0.02	0.04	0.04	0.05	1.00
waic	2,881								

waic = Watanabe Akaike Information Criterium, see Watanabe (2010). DRS = difference in differences repeat sales, see Eqs. (3) – (4). 1HRS = 1 cluster hierarchical repeat sales model, see Eq. (3) and Eqs. (5) – (6). 2HRS = 2 cluster hierarchical repeat sales model, see Eq. (3) and Eqs.(7), (6) and (8). se of mean = the standard error of the mean during sampling. $\bar{\mathbf{R}}$ = if this value is less then 1.1, the parameter has converged; see Lunn et al. (2013) for more details.

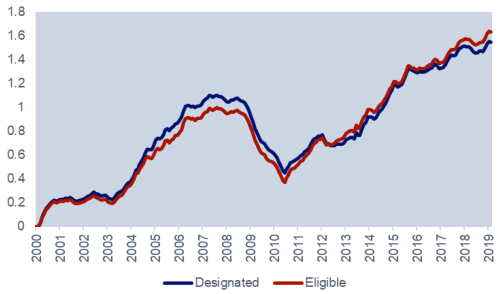
Table 6: Return Statistics of Indexes

	DRS	**1HRS**		**2HRS**		**SRS**	
	-	**OZ**	**non OZ**	**OZ**	**non OZ**	**OZ**	**non OZ**
Mean (monthly)	0.007	0.007	0.007	0.005	0.006	0.007	0.007
Std. Dev.	0.020	0.021	0.020	0.017	0.017	0.018	0.019
Min.	-0.055	-0.056	-0.055	-0.049	-0.046	-0.047	-0.040
Max.	0.059	0.056	0.057	0.050	0.050	0.055	0.050
Crisis (Levels)	-0.632	-0.652	-0.624	-0.585	-0.549	-0.521	-0.617
Correlations							
DRS		0.994	0.996	0.960	0.963	0.738	0.878
1HRS (OZ)			0.992	0.970	0.957	0.773	0.860
1HRS (non-OZ)				0.957	0.968	0.707	0.897
2HRS (OZ)					0.980	0.768	0.835
2HRS (non-OZ)						0.664	0.895
SRS (OZ)							0.407

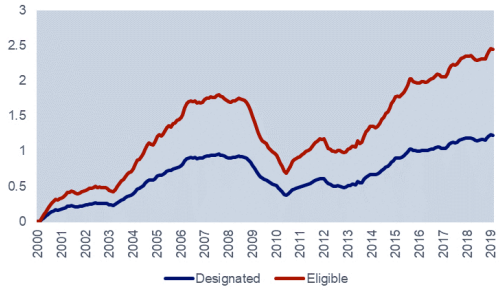
DRS = difference in differences repeat sales, see Eqs. (3) – (4). 1HRS = 1 cluster hierarchical repeat sales model, see Eq. (3) and Eqs. (5) – (6). 2HRS = 2 cluster hierarchical repeat sales model, see Eq. (3) and Eqs.(7), (6) and (8). SRS = the more standard repeat sale model estimated on two separate datasets, as laid out in Section 6, see Eqs. (2) – (3). Crisis = the log drop in prices during the GFC. More specifically we subtract the maximum (log) index level from the min (log) index level, between 2006 and 2012.



(a) DRS.



(b) 1HRS.



(c) 2HRS.

Figure 4: Log price trends of opportunity zones (OZ, red) versus eligible zones (non OZ, blue).

In all three specifications, parameter ω is positive, with a mean ranging from 0.12 to 0.20 depending on the specification. Under the 1HRS and 2HRS specifications, which showed a better model fit based on the WAIC score, ω was positive at the 5% confidence level and showed a mean value between 0.18

(1HRS) and 0.20 (2HRS). Under the DRS specification, ω was still strongly positive at 0.12, and was almost significant at the 5% confidence level. These results indicate that the OZ designation resulted in a one-time price increase ranging between 13% and 22%, with the highest increase being associated with the model with the most robust fit (calculated as e^{ω}).

To estimate the economic impact of this one-time increase on prices, I calculated a rough estimate of the total square footage of properties located in designated OZs. I then filtered again for only depreciated properties likely to be targeted for redevelopment under the program (age above 30, FAR above 1.0, and no residential or hospitality properties). For this calculation, I utilized not just data on sales, but data on all transactions gathered by RCA, including refinancings, as these transactions also capture information on property square footage useful for estimating the overall impact.

In order to understand the baseline levels in these areas, I then determined the average price per square foot in the designated census tracts in the year prior to designation. Subsequently, I multiplied this number with the square footage of the total population of properties in the designated census tracts which transacted after designation, using the same RCA data (but including properties that were not part of a repeat sale pair). The total resulting area was 55 million square feet. To calculate the weighted average price per square foot, I looked at transactions of the same property subset but in the year prior to designation, resulting in a value of $152 PSF. Thus, I estimate the total starting value of these properties at $8.4 billion. If we take 20% as the premium associated with this tax incentive, the total added value is approximately $1.7 billion.

In case of the DRS, only 1 common / parallel trend is assumed between all markets. With the other models, the OZ and non OZ tracts can diverge. However, this does not happen (not measured by statistical significance nor by economic significance) in the 1HRS model. Although the 2HRS model shows some divergence between the two trends, this is likely a product of the small sample size combined with the additional variables for each geographic subregion, leading to some potentially collinearity between the region index and OZ/non-OZ index. Note that any such collinearity is not an issue for the identification of ω as the program was rolled out over multiple months in different geographies and so does not experience a direct linear relationship with monthly index levels. While α shows a high magnitude for the non-OZ

(eligible) subtrend, it also has a large standard deviation, and in no period was the α subtrend significant at the 5% level. Hence, one can still conclude that the divergence was not statistically significant.

This is also indicated by the low estimated value for σ_α, the estimated deviation from the common trend, which is very close to zero in the 1HRS and 2HRS models. All indexes have roughly the same return and risk, and are highly correlated, see Table 6. The average monthly return is between 0.5% and 0.7% for all models. The standard deviation for the monthly returns is between 0.017 and 0.021 for all models. In order to understand how the trends differed during a financial crisis, I also looked at the drop from the maximum level to the minimum level between 2006 and 2012. Prices dropped between 52% and 65% during the GFC (see crisis variable in Table 6).

The correlations between the various indices are very high as well. The lowest correlations are typically with the SRS-model that I estimated in the Data Section, which is included here for completeness. Despite the apparent variations between the OZ and non-OZ trends in the 2HRS model, nonetheless the correlation between the index levels is high, at 0.98, on a monthly basis no less.

Figure 5 provides the estimated time trends for the various subregions, taken from the 2HRS model. In contrast to the OZ indexes, the subregion indexes (σ_λ) deviate more substantially. Also note that the estimate on σ_λ is comparatively large.

The highest returns and a relatively low crash magnitude are observed in the Northeast region. This is unsurprising, given that some major gateway cities (New York and Boston) are in this region. Interestingly, the runner-ups are the Southeast and Mid-Atlantic regions, which both exhibited dips of larger magnitude during the financial crisis, but have since recovered substantially and outpaced the Midwest, which previously showed stronger performance. The lowest performers in the index were the West and Southwest regions.

It is worth highlighting that we would expect some divergence from overall submarket performance for our specific asset class, which is older properties that are being targeted for redevelopment, and only those such properties which are located in designated or eligible OZs. While one would not tra-

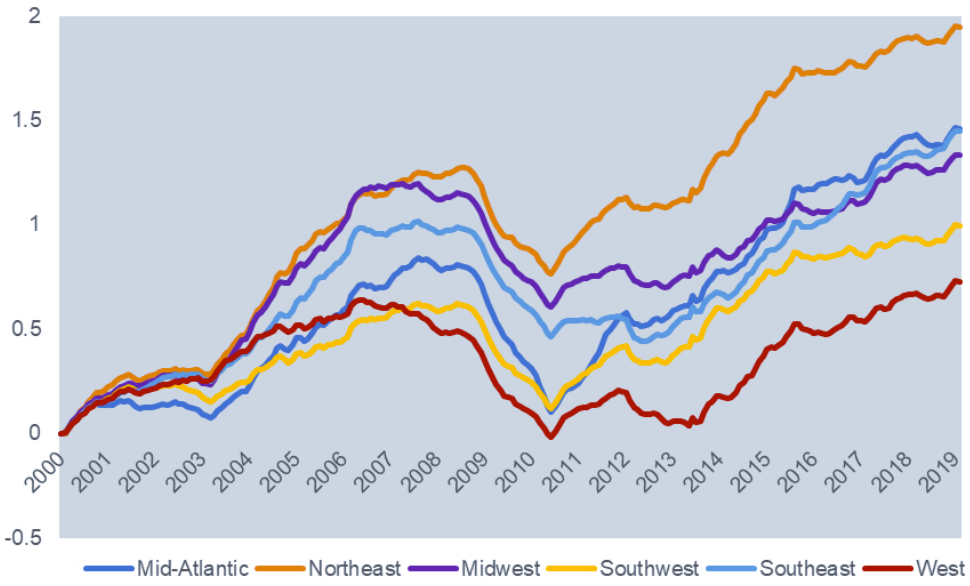


Figure 5: Regional subtrends ($\beta_t + \lambda_t$), estimated from the 2HRS model.

ditionally expect the Midwestern market to outpace the Southwest or West over recent periods, when one takes land constraints and impediments to new development into consideration, land for redevelopment becomes comparatively more attractive. (Hence, we still see robust performance in the Northeast market, where land constraints also play a large factor in development).

Finally, it is worth discussing the model fit as shown in Table 5. All of the parameters measured converged robustly, with $\bar{\text{R}}$ values substantially lower than the pre-defined threshold of 1.1 (Lunn et al., 2013). In addition, the standard error of the (sampling) mean is close to zero. These measures are used to provide indication of how well the No U-Turn Sampling (NUTS) algorithm estimated the actual mean, which is unfeasible to calculate using a formal representation of the Bayesian model structure.

Comparing the model-fit across the models, I find that the DRS and 1HRS model fit the data approximately equally (i.e. the WAIC is within a 10-point range, see Watanabe (2010).) The goodness-of-fit of the 2HRS model, on the other hand, is improved compared to the other models, with

a lower WAIC of 2,881.

7.2. Expectation Effect

In this section I explore the question of whether or not there was an expectation effect prior to actual designation of zones. Namely, census tracts were deemed eligible for the program a few months prior to the time the states picked the census tracts that would actually become designated OZs. See Section 4 for more details on the idiosyncrasies of the various state selection methodologies.

In Section 6 I found that 30% of the properties in eligible zones eventually became designated. By that logic, approximately 70% of the total value increase should happen after the designation of OZs. That assumes, of course, a perfectly efficient market; alternatively, one might imagine that many purchasers would simply delay their purchase of an asset until more clarity about the final designations was released, and so it is possible that transactions which occurred in the interim were not transactions where the buyer intended on utilizing the OZ tax incentives.

In order to conduct this experiment, I expanded the dataset to include properties in runner-up census tracts. To ensure comparability, I previously took advantage of the program's fuzzy designation properties, and limited tracts to those with a poverty rate of between 10 and 40% (which included some designated and eligible tracts that had a poverty rate of between 10 and 20%, below the required threshold, but a median family income within the qualifying threshold). Therefore, when applying the same filters on properties outside of eligible OZs, I end up with those properties which exhibited a census tract poverty rate of between 10% and 20%, right on the cusp of eligibility but unable to qualify. (Census tract data from the 2011-2015 American Community Survey was used to determine tract poverty rate.)

In total I observe 445 transaction pairs in these runner-up tracts. The characteristics of properties in these tracts are comparable to the OZ and eligible tracts. For example, the average price return is 0.39 and the volatility is 0.58, compared to 0.40 and 0.62 for the designated and eligible OZ properties, see Table 3.

After the addition of the properties in runner-up census tracts, I end up

with three categories; (1) properties in runner-up census tracts, (2) properties in eligible census tracts that did not get designated, and (3) properties in eligible census tracts that did get designated. I now also have two transformation dummies (ω). The first is after a property went from not being eligible to being eligible. This parameter should capture the expectation effect (ω^E). The second dummy is similar to the previous analysis, and captures the effect of going from eligible to designated OZ (ω^D). Dummy variable ω^E takes value 1 if the property went from not eligible to eligible, and is zero otherwise. Technically there is a third option, that did not occur in our dataset. If a property was purchased in an eligible zone, but sold in a zone that was non-eligible (i.e. after it was not selected during the designation process), the dummy variable could take up value -1. Note the value is also zero if the property was bought and sold as eligible.

Properties in census tract that were designated will also receive a value of 1 for ω^E, if the property was bought as non-eligible but got sold as either eligible or designated. In the latter case, the dummy for both ω^E and ω^D will have value 1. The total increase in value caused by the OZ program is therefore $\omega = \omega^D + \omega^E$. This way, we do not "double count" the designation premium by including a portion of the expectation premium within the variable.

Based on the expanded dataset, I re-estimate the same three models; DRS, 1HRS and 2HRS. Additionally, I add the time series for the SRS model in Figure 6a.

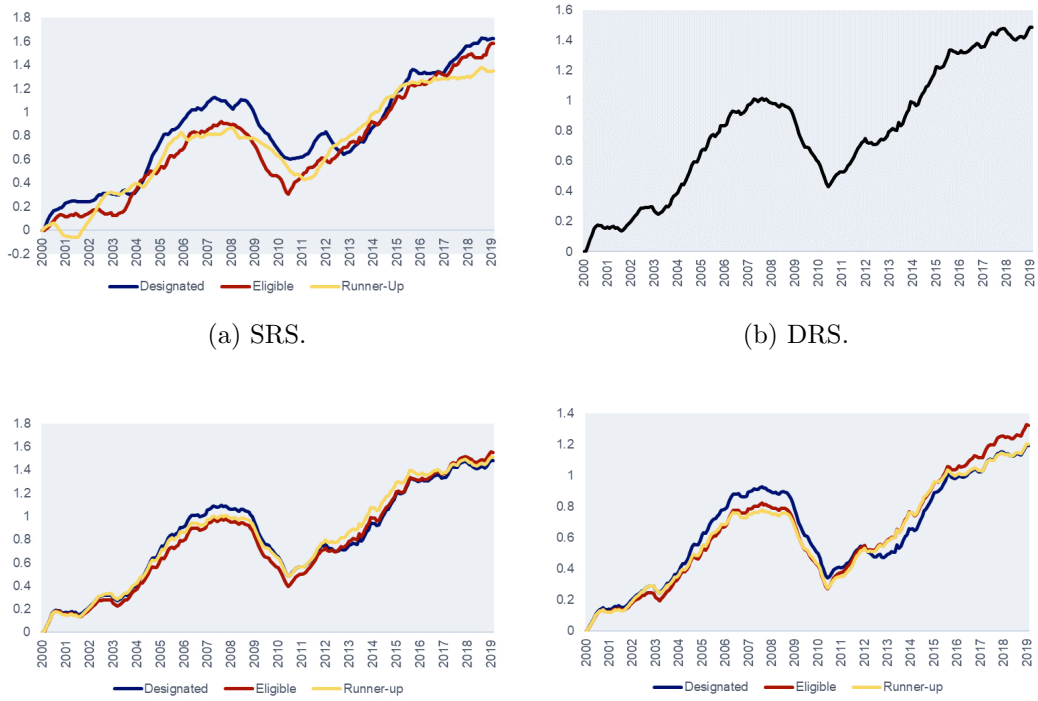
It is evident from Figure 6 that the indexes still co-move to a large extent. Even if estimated on separate datasets (SRS-model) the correlations remain high, see Figure 6a. In fact, with the larger sample size, we see more robust convergence of the indices in the 2HRS model, suggesting that with more information on performance across regions, the model is better able to discern between the regional fixed effect and the eligible / designated OZ effect. This provides additional confirmation of the robustness of the initial results.

The estimated coefficients for the transfer of going from eligible to designated remains fairly robust as well. Specifically, ω^D is almost significant throughout all of the models, although just barely short of the 5% significance level. It is most significantly positive in the 2HRS model, which also has the best fit. In that case, the 5% estimate of ω^D is -0.007, again, right

Table 7: Posteriors of (Hyper) Parameters and Goodness-of-Fit, Extended Model

	mean	**se of mean**	**0.5%**	**2.50%**	**5%**	**95%**	**97.50%**	**99.5%**	$\bar{\mathbf{R}}$
					DRS				
ω^D	0.12	0.00	-0.12	-0.06	-0.03	0.27	0.30	0.35	1.00
ω^E	0.14	0.00	-0.06	-0.02	0.01	0.27	0.29	0.34	1.00
σ_ϵ	0.56	0.00	0.54	0.54	0.54	0.57	0.57	0.58	1.00
σ_η	0.05	0.00	0.03	0.04	0.04	0.06	0.07	0.07	1.00
waic	3,747								
					1HRS				
ω^D	0.18	0.00	-0.14	-0.06	-0.02	0.39	0.43	0.55	1.00
ω^E	0.07	0.00	-0.19	-0.13	-0.10	0.23	0.25	0.32	1.00
σ_ϵ	0.55	0.00	0.53	0.54	0.54	0.57	0.57	0.58	1.00
σ_η	0.05	0.00	0.03	0.03	0.04	0.06	0.06	0.07	1.00
σ_α	0.01	0.00	0.00	0.00	0.01	0.02	0.03	0.03	1.00
waic	3,740								
					2HRS				
ω^D	0.18	0.00	-0.12	-0.04	-0.01	0.36	0.41	0.48	1.00
ω^E	0.03	0.00	-0.22	-0.15	-0.12	0.18	0.21	0.26	1.00
σ_ϵ	0.53	0.00	0.51	0.51	0.51	0.54	0.54	0.55	1.00
σ_η	0.04	0.00	0.03	0.03	0.03	0.05	0.06	0.06	1.01
σ_α	0.01	0.00	0.00	0.01	0.01	0.02	0.02	0.03	1.00
σ_λ	0.03	0.00	0.02	0.02	0.02	0.03	0.03	0.04	1.00
waic	3,553								

waic = Watanabe Akaike Information Criterium, see Watanabe (2010). DRS = difference in differences repeat sales, see Eqs. (3) – (4). 1HRS = 1 cluster hierarchical repeat sales model, see Eq. (3) and Eqs. (5) – (6). 2HRS = 2 cluster hierarchical repeat sales model, see Eq. (3) and Eqs.(7), (6) and (8). se of mean = the standard error of the mean during sampling. $\bar{\mathbf{R}}$ = if this value is less then 1.1, the parameter has converged, see Lunn et al. (2013) for more details.



(a) SRS.

(b) DRS.

(c) 1HRS.

(d) 2HRS.

Figure 6: Log price trends of opportunity zones (OZ, red), eligible zones (non OZ, blue) and runner-up zones (yellow).

on the cusp of significance.

Other results are also similar, for example the coefficient σ_α remains low (hence the co-movenment) and parameter σ_λ is comparatively large. Once again, the 2HRS model produces the best fit as measured by the lower value of the WAIC score. The $\bar{\text{R}}$ scores are all approximately 1.0, indicating robust performance of the estimation protocol in terms of convergence.

On a regional level, one can once again observe similar patterns of divergence across the various regions, although we now see the strongest performance coming from the Midwest, followed by the Northeast. Again, the West is a lagard, although the Southwest now performs somewhat more favorably. Again, please keep in mind that these indices refer to a very small subset of the market with different dynamics than might be observed across a more

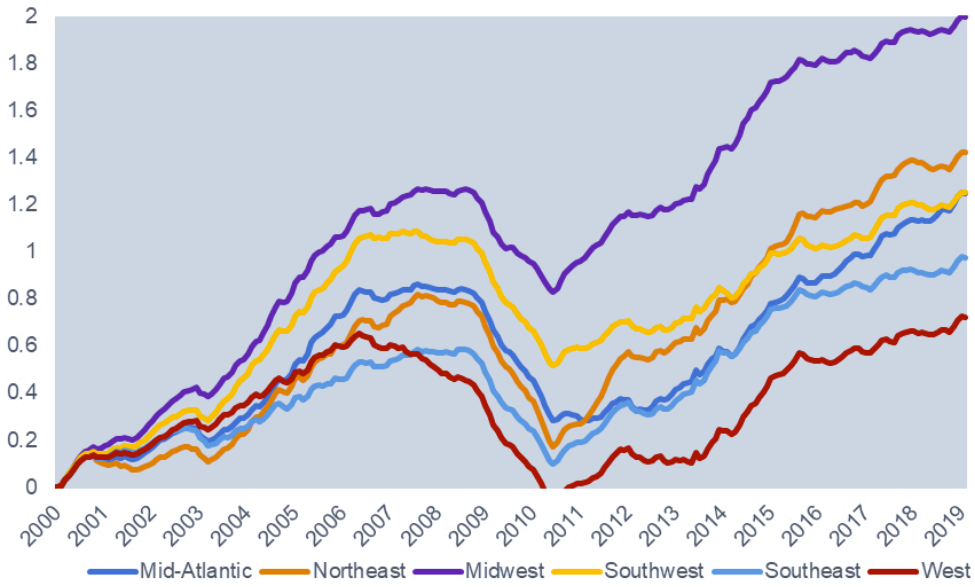


Figure 7: Regional subtrends ($\beta_t + \lambda_t$), estimated from the 2HRS extended model.

diversified set of asset classes. Other factors rather than broader regional real estate competitiveness may be at play when observing only depreciated properties that are likely to be targeted for redevelopment.

The new main parameter of interest in this Section is ω^E, as it captures the expectation effect after the tracts became eligible, prior to designation. In all cases we find a positive expectation effect. In the DRS model, the distribution of ω^E is significant, with a mean value of 0.14. In the 1HRS and 2HRS models, however, ω^E has a wide distribution and cannot be deemed to be significant. See Table 7.

Given the better fit of the latter models, and in particular the 2HRS model, it seems hard to conclusively say that there was a strong expectation effect associated with OZ eligibility prior to actual designation. One can posit numerous theories for why this might be the case, including the relatively short time frame that was expected between the time of program creation and census tract designation, which could have caused many buyers to hold off on consummating transactions until there was more certainty. Nonetheless, it is comforting to see that the effect is still positive, albeit insignificant, and

that there was a significant positive impact from eligibility within the DRS model framework.

7.3. Impact on Non-Depreciated Properties

One remaining concern is to better understand the behavior of property redevelopment activities relative to the broader market of assets in OZs. After all, while thus far I have discussed the impact observed on depreciated properties, I have yet to mention whether or not we can be sure that the price impact is attributable to redevelopment activities specifically. After all, the goal of a program like OZs is not to create a simple pass-through to owners of properties, but theoretically to generate agglomeration benefits which increase the productivity of land overall. One might posit that all properties in OZs may already have seen an increase in their values due to the expected higher NOI that will be generated in the neighborhoods over the coming years.

I considered a number of mechanisms to answer this question. RCA does track buyer intent as an observed variable, but it's not always immediately apparent (even to buyers themselves) if the plan will be to redevelop or to hold for investment. Some buyers may have purchased properties in OZs as a type of option until further clarity on the program was released by the IRS regarding the specifics of incentive eligibility.

I therefore instead began by analyzing the behavior of real estate assets in OZs overall, using the same equations previously specified (see Section 5), but with a more expansive filtering protocol. I now looked at all asset classes except development sites and all densities (as measured by FAR). In terms of age, I looked only at newer properties (under 30 years old) that would not be likely candidates for a "substantial redevelopment" project, as an investor must expend capital at least equal to the acquisition cost of a property in order to qualify for OZ benefits.

If these properties exhibited a price increase similar to that observed for properties targeted for redevelopment, then we can surmise that prices have risen largely due to expected growth in NOI and value in the designated zones, with less attention paid to the tax incentives specifically. In contrast, if we observe a partial price increase in these assets overall, we can conclude that a portion of the interest may have been due to value increase. Finally, if

there is no price increase in the model estimated on newer buildings unlikely to be targeted for redevelopment, one can surmise that the majority of the effect seen in the previous models is due to a direct pass-through of the tax incentives associated with redevelopment of a depreciated property. Indeed, I find that there is no positive impact on the prices of newer buildings, suggesting there is little evidence for exogenous value creation or agglomeration benefits.

The results of the analysis are presented in Table 8. In all of the models, ω was highly insignificant, with a mean very close to 0. Volatility remained in line with the previous results for the model estimated on depreciated properties. Fit statistics for Bayesian estimation were again robust and showed strong convergence.

An interesting divergence from the previous models is regional performance, which supports our previous suggestion that part of the reason why we see such robust performance in the Midwest is due to our focus on older, depreciated properties. In the new model on properties younger than 30 years old, we see the strongest performance in the Southeast, Southwest, and West. See Figure 8.

These results suggest that the majority of the price impact seen on depreciated properties stems from their likelihood to be redeveloped. There still remains the question, however, of whether or not these properties are being sold more frequently, or if prices are simply increasing for transactions that were already occurring or going to occur. An analysis of the implications of either of these effects is presented in greater detail in Section 9.

One possibility is that the properties sold after designation are mainly older/less valuable properties, which generally need some form of capital improvement, and have a higher propensity to be redeveloped. Therefore, one potential avenue for analyzing changes in market dynamics would be to construct a model to determine whether the age of properties transacted changed significantly after the announcement of the program. This could imply that more older properties (i.e. more properties likely to be redeveloped) are being traded.

Adding age to a repeat sales model is not straightforward. The issue is that age and time of sale are perfectly collinear, see Harding et al. (2007).

Table 8: Posteriors of (Hyper) Parameters and Goodness-of-Fit, New Properties Only

	mean	**se of mean**	**0.5%**	**2.50%**	**5%**	**95%**	**97.50%**	**99.5%**	$\bar{\mathbf{R}}$
					DRS				
ω	-0.01	0.00	-0.12	-0.10	-0.09	0.06	0.08	0.09	1.00
σ_ϵ	0.50	0.00	0.50	0.50	0.50	0.51	0.51	0.51	1.00
σ_η	0.03	0.00	0.02	0.02	0.02	0.03	0.04	0.04	1.00
waic	16,583								
					1HRS				
ω	-0.01	0.00	-0.13	-0.11	-0.09	0.07	0.08	0.11	1.00
σ_ϵ	0.50	0.00	0.49	0.50	0.50	0.51	0.51	0.51	1.00
σ_η	0.03	0.00	0.02	0.02	0.02	0.03	0.04	0.04	1.00
σ_α	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	1.00
waic	16,586								
					2HRS				
ω	0.00	0.00	-0.14	-0.10	-0.09	0.08	0.10	0.13	1.00
σ_ϵ	0.50	0.00	0.49	0.49	0.49	0.51	0.51	0.51	1.00
σ_η	0.03	0.00	0.02	0.02	0.02	0.03	0.03	0.04	1.00
σ_α	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	1.00
σ_λ	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.02	1.00
waic	16,442								

waic = Watanabe Akaike Information Criterium, see Watanabe (2010). DRS = difference in differences repeat sales, see Eqs. (3) – (4). 1HRS = 1 cluster hierarchical repeat sales model, see Eq. (3) and Eqs. (5) – (6). 2HRS = 2 cluster hierarchical repeat sales model, see Eq. (3) and Eqs.(7), (6) and (8). se of mean = the standard error of the mean during sampling. $\bar{\mathbf{R}}$ = if this value is less then 1.1, the parameter has converged; see Lunn et al. (2013) for more details.

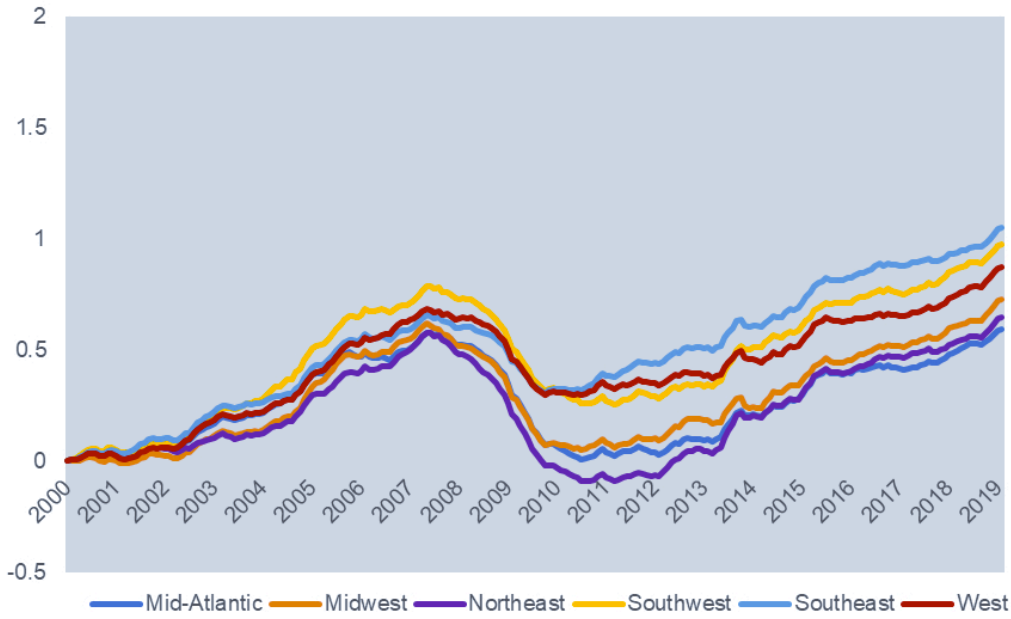


Figure 8: Regional subtrends ($\beta_t + \lambda_t$), estimated from the 2HRS extended model, new properties only.

For every year you progress in time, the property also becomes a year older. Arguably, the simplest way to include age in a repeat sale model is by means of transformation. I follow Harding et al. (2007) and log transform age, and only then take the difference between buy and sell. There is a beneficial interpretation to log transforming age, as it means that younger (older) properties, depreciate at a relative higher (lower) rate. Multiple papers found support for this overall depreciation scheme (Harding et al., 2007; Bokhari and Geltner, 2018).

Therefore, I swap out the left hand side variable in favor of age rather than price. I re-estimate the 1HRS model, but instead of using the transaction price as explained variable, I explain the ("differenced") log age, using the same method laid out in Section 5. The designation dummy (ω^D) should capture any significant change in age of properties being transacted after the OZ designation. The main results can be found in the lower panel of Table 9.

Table 9: Posteriors of (Hyper) Parameters and Goodness-of-Fit, Age as Function

	mean	**se of mean**	**0.5%**	**2.50%**	**5%**	**95%**	**97.50%**	**99.5%**	$\bar{\mathbf{R}}$
					DRS				
ω	-0.01	0.00	-0.10	-0.08	-0.07	0.05	0.06	0.08	1.00
σ_ϵ	0.42	0.00	0.41	0.42	0.42	0.43	0.43	0.43	1.00
σ_η	0.02	0.00	0.01	0.02	0.02	0.03	0.03	0.03	1.00
σ_α	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	1.00
waic	16,909								

waic = Watanabe Akaike Information Criterium, see Watanabe (2010). DRS = difference in differences repeat sales, see Eqs. (3) – (4). se of mean = the standard error of the mean during sampling. $\bar{\mathbf{R}}$ = if this value is less then 1.1, the parameter has converged; see Lunn et al. (2013) for more details.

The effect of the OZ designation on the age of properties is very little and insignificant. ω, which in this specific instance measures the potential one-time jump in age after OZ designation, has a mean of -0.01, but has a wide distribution that shows little evidence of significance. In other words, based on this specific analysis, I cannot find evidence that older, more depreciated properties are being bought in designated OZ census tracts with the purpose of renovation/redevelopment.

8. Case Study: New York City

As a way of furthering our understanding of the dynamics underlying the estimated price premium associated with OZ designation, I present a case study on New York City. Given the small amount of data available, it was necessary to choose a large market with significant transaction volume. While for the purposes of the econometric analysis presented in the earlier sections I utilized only repeat sales in order to minimize unobserved heterogeneity, for the purposes of this case study I limit analysis to descriptive statistics and qualitative commentary. The case study is intended primarily to elucidate market dynamics and provide additional detail on the types of properties factoring into our estimated results at the national level.

In New York City, we observe relatively minimal changes in spatial development patterns across the four core markets of New York City: the Bronx, Manhattan, Queens, and Brooklyn. The map presented in Figure 9 shows transactions in eligible, non-designated census tracts both prior and subsequent to the official designation of OZs. This map provides a reference for the natural variation in transaction activity across the different neighborhoods of New York City, which produces visually discernible clusters of activity in areas like Washington Heights, Lefferts Gardens southeast of Prospect Park, and the Lower East Side. At the same time, we do observe the degree of natural variation within neighborhoods, such as the widely dispersed pattern of sales across Bedford-Stuyvesant.

In comparison, the corollary map in Figure 9 shows the difference in the spatial patterns of transactions within designated zones before and after OZ designation. Again, we view some clusters of activity, but there is no immediately visible evidence of new centers for transaction activity appearing. From a policy standpoint, one might view this as the ostensible first-degree aim of the program, namely to catalyze the flow of capital into areas that currently exhibit a dearth. However, there are no locations where we see a newly-created outpouring of OZ activity.

Nonetheless, a few cases of transaction clustering on a localized level warrant attention. For example, we observe the sale of two development sites located in a designated OZ along the South Bronx waterfront. The designation of parts of the South Bronx as an OZ has received significant press attention given the gentrification and redevelopment processes already un-

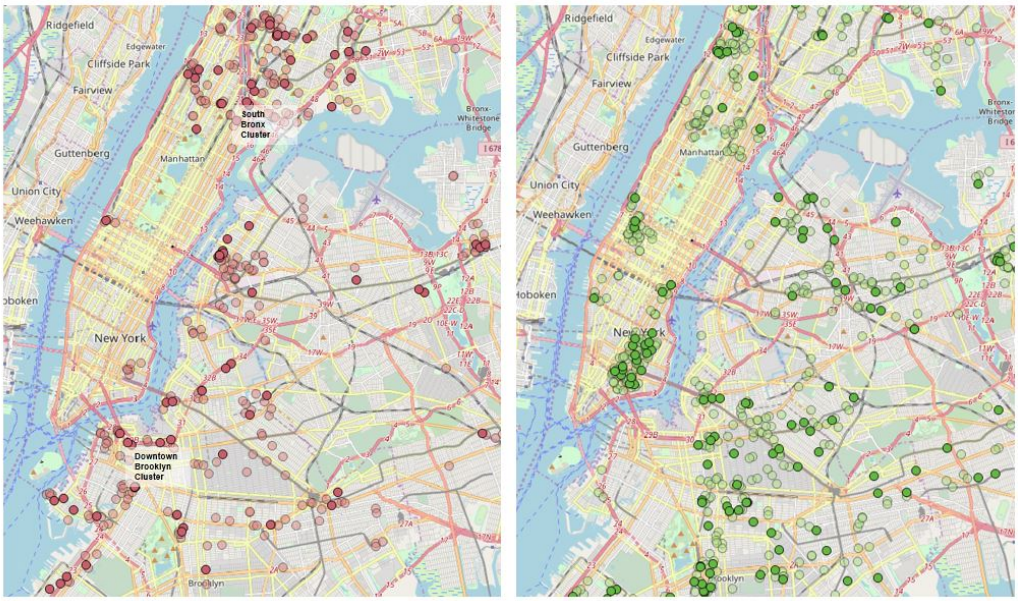


Figure 9: Geographic distribution of transactions in designated and eligible OZs, during the year prior to designation and the time period since. Dark red denotes a sale in a designated OZ after designation, and light red a sale in a designated OZ before designation. Dark green denotes a sale in an eligible OZ after designation, and light green a sale in an eligible OZ before designation.

derway, and the appearance of new OFs specifically targeting the geography. For example, developer Keith Rubenstein recently set up an OF through his firm, Somerset Partners, with a targeted total raise of $200 million, complementing work that his firm had already taken up towards a planned 1,300-unit new development located on the two sites shown in Figure 9. Those two sites were recently sold to Brookfield, raising some questions about the future of Rubenstein's fund.[12]

In the case of these types of projects, we can infer with a high degree of confidence that buyers have been factoring in the potential benefits of location in an OZ when determining their maximum potential purchase price. Indeed, a representative of a large brokerage firm working on sales in the neighborhood reported a premium of between 10-15% above market. [13] Especially given the size of the sales (in the case of the two South Bronx sites, over $150 million in aggregate), it seems implausible that an institutional investor would fail to conduct a full underwriting of the post-tax benefits and/or potential increased land productivity that would be achieved from location in an OZ. This narrative coincides with our econometric findings in that investors and developers may be willing to pay a premium for sites and buildings that they were already considering purchasing, or for projects that were already in pre-development, even if we haven't yet observed the emergence of increased transaction volume in new areas.

We can identify other transactions in OZs occurring after designation that we can clearly identify as involving sophisticated investors that would factor the tax benefits into their willingness to pay. In Downtown Brooklyn, two nearby sites along Tillary Street were sold in the third quarter of 2018, both with a confirmed buyer's intention to pursue redevelopment. The combined transaction volume for these two sites, one currently a vacant development site and the other a storage facility, was over $90 million, which again provides some indication of the institutional nature of the buyers. Nearby, a hotel at 90 Sands Street was purchased for $170 million.

Overall, the OZ designation appears to have built upon a existing increase in Downtown Brooklyn's transaction activity over the prior years leading up

[12] `https://ny.curbed.com/2018/4/4/17197246`
[13] `https://www.bisnow.com/new-york`

to designation. Large recently completed projects in the vicinity include The Ashland (nearly 600 mixed-income apartments) and CityPoint (nearly 2 million square feet of mixed-use space). For investors who were already planning to undertake redevelopments in the area, the OZ designation might reasonably increase their willingness to pay given the as-of-right tax benefits, as well as the potential for the incentive to create agglomeration benefits in an area already exhibiting robust real estate fundamentals. Ofer Cohen, the head of a leading brokerage firm in NYC, TerraCRG, noted that "some of the areas designated as opportunity zones are already attracting attention and significant amounts of capital," highlighting Gowanus, Downtown Brooklyn, Greenpoint, Sunset Park, and the Brooklyn Navy Yard [14]. According to Cohen, the firm expected over $1 billion of capital to flow into OZs in Brooklyn in 2019.

While we might view transactions in these areas of Brooklyn, where qualifying redevelopment projects were already attracting institutional capital, as emblematic of the type of OZ transaction driving a price change in the market, in other areas we can attempt to characterize transactions where it appears relatively more unlikely that the investors changed their underwriting based on the OZ benefit. In such cases it is possible the buyer either did not fully capitalize the potential tax benefits into the property purchase, or may have been willing to pay some smaller premium attributed solely the aforementioned potential upside from cluster agglomeration effects. For example, we observe a cluster of four stabilized / core residential buildings which transacted along Sheridan Avenue in the Bronx, with a buyer's intent to hold for investment rather than redevelop or renovate. The total transaction size for the cluster was just short of $15 million. While it is possible that an investor or developer would acquire these types of buildings as an option, with the potential to later redevelop and gain eligibility for OZ benefits, it seems contextually unlikely that smaller, less-sophisticated investors would pursue this avenue. More likely, these trades represent "business as usual" activity. For this reason, I elected to filter out residential properties, even if they were above a certain age, from the data set of potentially redevelopment properties used to estimate the impact of the OZ designation premium in the base models.

[14] `https://commercialobserver.com`

It's also worth noting the existing breakdown and zoning of property types in OZ areas within NYC. The vast majority of tax lots (81%) are located in residential areas, while only 12% are located in areas zoned for manufacturing, and 4% are in commercial areas. [15] In addition, 76% of the total lots currently host a residential or mixed-use residential structure of some sort. Only 9% of the properties are vacant lots or parking and only 6% of the properties host industrial facilities. These types of asset classes often constitute the ideal candidates for redevelopment projects in NYC, so it's worth considering how small a portion they make up of the designated OZ lots.

One other nuanced point worth highlighting in research by the Citizens Housing Planning Council (CHPC) is the significant overlap between properties owned between the New York City Housing Authority (NYCHA) and designated OZ areas. In fact, over 40% of the agency's properties are located in designated OZs. This was likely designed in order to allow for NYCHA to benefit from increased Low Income Housing Tax Credit pricing (LIHTC) given the impact the OZ benefit would have on tax credit yields. This would be important as NYCHA continues to execute on privatization of existing buildings through HUD's Rental Assistance Demonstration program under the NextGen NYCHA plan (NYC, 2015). In these cases, given the low rent levels at NYCHA buildings, it would be possible to agree upon a nominal acquisition price in order to still qualify for OZ benefits through even a moderate rehabilitation scope.

As one would expect given the relatively robust public sector community, economic and housing development agencies existing in NYC, there is likely to be a significant degree of partnership between the agencies and private entities on the development of projects achieving "social goods" in the City. At the 2018 Development Finance Conference hosted by the New York City Economic Development Corporation (NYCEDC), a non-profit corporation created during the Bloomberg era to manage and make strategic dispositions of the City's land, officials described how the City is planning to develop a funding program to complement OZ benefits. Eric Clement, who heads the NYCEDC's Strategic Investment Group, was quoted as suggesting below

[15] http://chpcny.org/research/opportunity-zone-analysis/

market rate loans of 3% for qualifying OZ fund managers [16].

On a quantitative basis, it is misleading to provide a descriptive comparison of prices in NYC before and after OZ designation, given the high degree of heterogeneity that led us to adopt a repeat sales framework for the core of our study. Nonetheless, I provide descriptive statistics of changes in purchase intent in Table 10 and of changes in buyer type in Table 11. Overall, we see relatively minimal changes in the types of activity taking place and buyer profile, providing some anecdotal indication that at least in some geographies the OZ program has not fundamentally changed the way developers and investors interact with the urban environment, but led primarily to a higher capitalization of value in existing properties as a pass-through of tax benefits.

Table 10: Percentage Breakdown of Purchase Intent in Designated OZs, New York City

	Before Designation	**After Designation**
Investment	73.0%	73.7%
Occupancy	2.4%	0.0%
Redevelopment	18.9%	21.2%
Renovation	5.8%	5.1%
Number of Transactions	381	99

OZ = opportunity zone.

Table 11: Percentage Breakdown of Buyer Types in Designated OZs, New York City

	Before Designation	**After Designation**
Developer, Owner, Operators	89.5%	90.9%
Corporate	3.2%	0.0%
REIT, REOC	0.3%	3.0%
Investment Manager or Fund	4.5%	2.0%
Government	0.8%	1.0%
Other	1.8%	3.0%

OZ = opportunity zone. REIT = real estate investment trust. REOC = real estate operating company.

[16] `https://impactalpha.com`

9. Policy Framework

The topic of investing in distressed or low-income areas has always been complex, as one quickly runs into the issue of whether new investments will change the quality of the area for residents who are already living there, or rather will create an improved area for a new set of residents (or some outcome in between). A wide body of literature has focused on this topic; while generally outside the scope of my current study, it's nonetheless worth mentioning a few highlights on key findings. For example, a number of authors have devoted attention to understanding the impacts on real estate property values resulting from the announcement and subsequent construction of new infrastructure assets. Studies have addressed positive and negative impacts resulting from airports (see Jud and Winkler, 2006, among others); stadiums (see Dehring et al., 2007, among others); and transit stations (see Zuk et al., 2018; Zhong and Li, 2016, among others). Some studies have specifically focused on the expectation effect associated with new transit lines (see Paul and Spurr, 2016, among others). These studies have often had an explicit policy intent of determining the feasibility of real estate value capture as a mechanism for financing large infrastructure projects that do not in and of themselves necessarily generate a market rate of return.

These studies have, similarly to my current work, run into questions of how to understand the neighborhood change that results from transformative policy and infrastructure change. Zuk et al. (2018) speaks specifically to this question and highlights the need for planners to develop a cohesive framework for understanding ways to mitigate the effects of gentrification in the context of transportation infrastructure projects. The authors also note the need to distinguish between gentrification and displacement, as there can be positive social, economic, and health benefits resulting to current residents due to the gentrification that accompanies a new transit line opening. (In contrast, displacement refers specifically to the housing insecurity inflicted upon current residents as a result of such demographic changes).

A parallel set of literature has looked more specifically at redevelopment projects related to public housing and commented, again, on the normative quandaries that arise when trying to determine why we improve the built environment of distressed neighborhoods if those very improvements will then, within a market economy, result in value increases that displace the very

residents who (ostensibly) were the target of the program. For example, Goetz (2012) writes about the goal of dispersing concentrated poverty at the heart of public housing revitalization in the United States, and the fact that displacement was not an unintended consequence but rather a fundamental tenet of redevelopment programs like HOPE VI, a now-defunct large scale program primarily aimed at converting public housing into mixed-income privately owned housing. The author argues that the results of these programs, which were aimed to create more mixed-income communities, have generally been disappointing, as displaced residents have moved to similar high-poverty neighborhoods. Similarly, Keating (2000) describes the Centennial Place HOPE VI public housing redevelopment project in Atlanta, noting that only 79 out of 1,115 households originally residing at Centennial Place returned after redevelopment had been completed. The authors call for a robust examination of what the impacts of living in mixed-income communities have been on low-income individuals and families.

Thus, before assessing whether the OZ program has succeeded at achieving its goals based on our econometric results, we should first pause to ask what the meaning of different econometric outcomes implies for the various stakeholders involved, including private sector real estate firms, current residents, and different levels of government. In Table 12, I describe the likely cause of different types of value increases or decreases that we might observe in redevelopment candidate sites within OZs. In Table 13, I then describe the likely impact that each such scenario would pose for the aforementioned key stakeholders.

I divide the scenarios based on the level of increase or decrease we observe in prices of (re)development sites. If we were to observe a decrease, this would likely be due to a stigma effect whereby any potential tax incentive is outweighed by a negative outlook of the designated OZs' future economic performance. If we were to observe no significant impact on the prices of (re)development sites in OZs, this would likely be because the incentives were insufficient to generate any meaningful impact (many argue this was the result of the federal EZ programs that offered very shallow wage tax credit benefits).

On the contrary, if we see a positive increase in values, there can be numerous interpretations for the underlying causes, which we can parse to some extent based on how the increase compares to the value of the proposed

Table 12: Mapping of Potential Outcomes for OZs and Causes

Stakeholder	**Change in Development Site Value**				
	Decrease	**None**	**Increase** $< i_t$	**Increase** $= i_t$	**Increase** $> i_t$
Likely Cause	The tax incentive had little to no effect, and was outweighed by a stigma effect resulting from designation.	The tax incentive was insufficient to meaningfully impact expected returns. New development is not being stimulated, and therefore no one is assuming any increase in land productivity.	Properties that previously had a negative NPV for development are now positive. A portion of tax incentive value is being captured by landowners and a portion by developers.	Development was previously feasible, and the entire tax incentive value is being captured by existing landowners. Developers' return is held neutral.	Developers foresee long-term NOI growth in the area and willing to pay more for properties. Either the landowner is capturing all of the additional value in the sale, or it's being split between the developer and the landowner.
Effects on Transaction Volume	Multiple Possible Outcomes	No Effect on Volume	Increase in Number of Land Transactions	No Effect on Volume	Either stays constant or increases

i_t = value of tax incentive

Table 13: Mapping of Potential Outcomes for OZs and Stakeholders

Stakeholder	**Change in Development Site Value**				
	Decrease	**None**	**Increase** $< i_t$	**Increase** $= i_t$	**Increase** $> i_t$
Homeowners	Negative; home values go down as due to stigma effect	No effect	Positive; increased feasibility of development increases values	No effect; development activity does not change	Positive; NOI growth increases land values
Renters	Positive; lower values result in lower rents, holding cap rates constant	No effect	Negative; as development increases, land values and rents increase	No effect	Negative; growth results from higher NOIs, higher rents
Landowners (Sellers of Development Sites)	Negative; landowners will realize value declines	No effect	Positive; landowners with assets previously worth $0 will realize gains	Positive; landowners will capture additional value as a pass-through	Positive; landowners will capture additional value as a pass-through
Developers (Buyers of Development Sites)	No effect	No effect	Positive; more transaction opportunities for developers	No effect	No effect (if all captured by landowner)
Federal Government	Negative; capital gains tax base goes down without social good	Negative; capital gains tax base goes down without any meaningful benefits	Positive; potential for gains of efficiency	Negative; loss of capital gains tax base without gains in efficiency	Positive; potential for gains of efficiency
Local Government	Negative; property tax base goes down without social good	No effect	Positive; property tax base increases	Positive; property tax base increases	Positive; property tax base increases

i_t = value of tax incentive

tax benefit. If the increase in value is less than the value of the tax benefit, it is plausible that previously the sites in these areas exhibited a negative NPV for development. As a result, once the tax incentive is introduced, the first portion of the incentive is captured by the developer in order to reach an NPV of $0 based on the appropriate discount rate. After that point, one can presume the remaining value of the tax incentive would be capitalized by the existing land owner, assuming the seller has perfect information into the developer's finances and economics.

Other explanations are reasonable if we see an increase either equal to the tax incentive or greater than the tax incentive. If the value is exactly equal, one might surmise that the entire tax incentive is being captured by the existing landowner, and the IRR is effectively being held constant for the developer. If the value increase is above that of the tax incentive, then there is likely some type of land productivity increase that is being underwritten, which permits the developer to pay a portion of price increase associated directly with the pass-through of the tax incentive and a portion associated with expected NOI growth in the future.

I should note that this is a bit of an oversimplification, as given imperfect information, as well as potential impacts on demand for construction labor resulting from an increase in new building starts, it is likely the landowner would not capture the 'full' value of the tax benefit or potential future NOI growth resulting from increased land productivity. For example, it is theoretically possible that the re(development) site price increase we observe is approximately equal to the tax benefit, but that a portion of this increase is driven by NOI growth, yet we only observe the net effect after a portion has been incorporated by the developer entity into its return (as opposed to the previous landowner).

In Table 13, I go into more detail on the implications for specific stakeholders. While the popular media might present the program as a windfall for developers, with the exception of projects that were already underway, it is more likely that existing landowners will be the ones to benefit most significantly under a variety of circumstances. Unless we assume off-market transactions with imperfect information, in fact, developers are likely to benefit only in the sense that they would find a larger market of potential development sites. In an efficient market, it's difficult to imagine a circumstance where a future purchaser of a (re)development site in an OZ realizes a wind-

fall due to the program.

Among homeowners and renters, the expected dynamics are somewhat unsurprising. Under most circumstances, we would expect existing homeowners to benefit as a result of NOI growth and increased land productivity, as they will realize value increases. Similarly, renters will likely have to pay higher rents if values increase. This framework does assume that we observe effects primarily on a neighborhood scale; it's worth noting that if the OZ program significantly increases housing stock overall by opening up more areas for development in a given metro area, it's possible that overall renters' utility could increase due to higher supply and more competition for tenants.

The dynamics among government entities are also interesting and worth considering in light of the fact that while OZs have generally been considered a bipartisan policy, the program was passed as part of the signature tax legislation of the Trump administration. Perhaps somewhat unsurprisingly, therefore, in most scenarios we see a transfer of the tax base from the federal government to state and local governments. As the effective capital gains tax rate goes down due to OZ incentives, additional value is capitalized into land values which are taxed at the local level. Depending on the eventual scale of the program, as well as whether the program is eventually extended, the OZ program will cause a not-insignificant shift in the tax base and an increased ability for state governments to implement more localized policies.

Which outcomes do we observe as normatively desirable? By looking at the potential stakeholder outcomes, the scenario which appears to benefit the most parties is the situation where the value of land in OZs increases by an amount less than that of the tax incentive. This makes intuitive sense, as this is the only scenario where we see new development activity that would not have occurred but for the OZ incentive. Renters still likely suffer from increases in rent burden, but this impact could potentially be offset by policy tools offered in concert with the OZ program. In contrast, the scenarios where we see a negative impact due to a stigma effect or no impact on prices can be understood as policy failures, as there is little potential for any social benefit.

In contrast, if prices increase above the level of the tax increase, there is some potential for value gain. At a minimum, if more value is generated through more productive land, the tax base of the municipality will increase, which can be used to generate more social goods for residents, whether home-

owners or renters. In this way, Table 13 is simplistic, as it looks only at the first-order impact on residents and firms based on the program, when the changes to the tax base will themselves generate second order effects depending on the policy objectives and capacity of local governance entities.

In order to relate these findings back to my econometric results, I ask the question of how the increase in prices compares to the potential value of the tax incentives. In Section 4, I performed an analysis of the cash flows that would be received for an illustrative real estate investment in an OZ-designated area versus a comparable building outside of an OZ. There, I found that the increase in NPV on a post-tax basis was in the range of 19%. In contrast, I find that the increase in value resulting from OZ designation ranges from 20% to 22% across the models with the best fit scores.

These results suggest that the OZ program's realized value increases are approximately equal to or slightly greater than the value of the tax impact. It is plausible that in some cases, the OZ program is resulting in its normatively optimal outcome of encouraging new development that would otherwise not have occurred, as opposed to applying tax incentives to the benefit of landowners who were already in the process of selling sites for transactions that would have occurred anyway. However, given the small spread between the two values, it seems likely that for the most part the OZ program is resulting in a pass-through of benefits without creating additional value. (This result is also further supported by the fact that the additional realized value we calculate for the program's first year of existence is approximately equal to the budgeted annual cost of the lost capital gains taxes).

Again, we must make some oversimplifications to draw conclusions, as it is also possible that the only reason we don't always see a value increase equal to the tax incentive value is because of imperfect information. In other words, perhaps developers were already planning to consummate the transactions we observe, but were able to sufficiently negotiate with landowners so as to capture some of the tax incentive for their own benefit.

Even if we were to see results that OZs were fulfilling their intended purpose and spurring new development activity in distressed areas, this would not assuage the fears of many OZ critics who argue that the tool will encourage gentrification. While value increases should have a beneficial impact on homeowners, indeed, we run into the same quandary whereby an increase in

the productivity of the land can be considered a negative attribute from the perspective of encouraging low-income residents to remain in the area. To better understand these dynamics, I proceed with a set of policy recommendations to alleviate potential negative impacts 10 and present a theoretical framework relating OZs to financialization in Section 11.

10. Policy Recommendations

In the following section, I present a number of proposed policy solutions derived from my econometric results and policy framework in order to encourage responsible investing in OZs.

1. **Official Limits on Qualifying IRR**: A significant issue associated with the OZ program is the notion that the subsidy could be misused for projects that do not satisfy an implicit but-for requirement (i.e. that a project would not have occurred without the subsidy). The issue is one that affects other subsidies as well; Abravanel et al. (2013) note that among projects that qualify for NMTC, a significant portion would likely have proceeded without the subsidy provided by the credit.

   In the case of the OZ, the subsidy has been designed to be nimble with minimal regulation in order to foster appeal to a larger subset of investors. This is a real benefit of the program; there has been massive attention received by OZs during the months since the program was announced, with billions of new fund capitalization made available specifically for investments in the designated zones.

   In contrast, the LIHTC and NMTC programs suffer from significant complexity that can make it difficult to attract the same level of interest from investors. As a result, both programs rely heavily on intermediary organization, such as tax credit syndicators [17]. While these organizations fulfill an important role of transmitting information on programs to investors without the same level of expertise on tax credits and regulations, they are not costless. GAO (2017) notes that syndicators typically charge fees ranging from 2 to 5% of the total tax credit investment, which is directly passed onto the public sector as an additional project cost, given that many tax credit projects derive their economics almost entirely from subsidies.

   Therefore, I do not propose that OZ activity should be subject to the same degree of project review as these current tax credit programs, which could impede transformative impacts from being realized by requiring the emergence of new intermediary organizations that divert

[17] `https://www.novoco.com/notes-from-novogradac`

public funds from end users. Instead, an automated threshold of qualification should be derived for determination of whether an OZ project qualifies based on the potential IRR from redevelopment. A standard formula could be utilized based on the acquisition cost expended on a project, which is already tracked for the "substantial rehab" test as part of the OZ program. The formula would then utilize median construction values and rents based on a particular regional scale, and determine a rough estimate for the project IRR. Projects would be evaluated in comparison to a regional and asset-specific hurdle rate. If properties fall above the hurdle rate prior to OZ benefits, they would not be eligible for OZ benefits, thereby helping to exclude activities that do not satisfy a "but for" requirement.

Such a system would not be difficult to implement, and could even be accompanied by a mapping tool to facilitate investors' decision-making process. For example, a similar tool was created by this paper's author to assist the municipal government of Guadalajara, Mexico determine subsidy and tax incentive levels for projects in distressed sections of the city's downtown core based on projected IRRs for redevelopment [18].

Ideally, to avoid a cliff effect, there would be a graduation of benefits depending on what portion of tax incentive is required in order to push the development above the hurdle rate. However, in practice this could cause confusion among investors that would defeat the purpose of simplifying regulation in the first place. Instead, there might be one or two levels of benefits, similar to the existing tiering structure that applies to prior capital gains reductions depending on the number of years that an investment in a designated OZ is held (10% or 15% depending on hold period).

2. **Increase supply of affordable housing in designated OZs**: The most immediate concern from my econometric results, combined with the analysis of potential stakeholders impacted by the OZ program, is that if an increase in land value is achieved as a result of the program, this will result in rent growth that will price out existing residents of the designated zones. Overall, it is a social benefit that depreciated

[18] `https://guad.shinyapps.io/GDLMapper/`

and vacant properties are being rehabilitated, if there is value being created beyond a simple pass-through of the tax benefit. Therefore, an auxiliary measure should be taken to permit this redevelopment to happen while limiting the negative impacts on equity and inclusion that occur as a consequence.

The most straightforward policy to implement in concert with existing subsidies and programs would be a concentrated effort to increase the supply of affordable housing in designated OZs. The additional supply, ideally at a wide range of income tiers, would offset the growing demand that would put pressure on rents which prior to OZ designation may have been "naturally affordable" [19].

One potential route for enacting this would be through inclusionary zoning to require a portion of any new units built in specific designated OZs to include an affordable component. Governments would need to strike a delicate balance in encouraging activity in more distressed OZs to take off without limiting economics that might already be on the border of feasibility. Another route would be more efforts to couple OZs with existing housing subsidies like the LIHTC. This could easily be accomplished by including additional points for locating a project in an OZ within a State Qualified Allocation Plan (QAP), which guides how LIHTCs are awarded across different projects based on a set of pre-determined criteria. QAPs are frequently used by a state as a means of achieving specific policy objectives related to affordable housing, such as the inclusion of "green" elements or targeting units to formerly homeless individuals.

A number of policymakers have already expended significant effort in attempting to align state housing policies with OZs. For example, the Maryland state housing agency has discussed providing targeted loans and grants to support affordable housing in designated OZs. Widespread inclusion of a criteria related to presence within an OZ in state QAPs across the country could help further that effort.

3. **Evaluate change in redevelopment site transaction volume over time**: As noted in Section 9, we can differentiate amongst different types of price impacts depending on how they compare to tax

[19] `https://www.novoco.com/notes-from-novogradac`

incentive levels. In addition, these impacts are likely to have varying secondary effects on transaction volume. Note that if we observe an increase exactly equal to the tax incentive, we would likely not expect to observe a change in volume, as it would represent a pass-through to the landowner. In contrast, if we observe an increase slightly below the tax incentive, we might expect to see an increase in transaction volume due to the increase in the number of economically feasible (re)development projects.

Therefore, while perhaps a trivial recommendation, the IRS should continue to monitor levels of transaction activity for redevelopment in OZs as a fairly straightforward measure of how the program is impacting neighborhoods. If transaction volumes do not significantly increase, a recalibration or retargeting of the subsidy should be reconsidered. State governments might also implement monitoring of their own, and can at minimum reduce other subsidy levels for projects if they observe that redevelopment site prices are increasing without a commensurate increase in redevelopment volume.

11. Theoretical Framework

I proceed in the current section by placing OZs and my econometric results within the theoretical framework of financialization and urban entrepreneurialism. To recapitulate, in the early sections of this paper I found econometric results that suggested the OZ program has resulted in a pass-through of tax benefits to existing landowners with limited potential to benefit current residents of surrounding neighborhoods. In the immediately preceding two sections, I asked the second-order question of what the intended effects were of the program by laying out the potential likely outcomes of the program. In this section, I now ask the third-order question of why the program was designed in such a manner.

To this end, I begin by considering OZs as a means of bringing regions previously inaccessible to financial markets into the fold of global trade. As part of the larger concept of financialization, OZs have helped to open the door for increased financial activity involving assets located in the target areas. I then proceed by describing how within an era of urban entrepreneurialism, we no longer equate "big" government with redistributive aims. I consider arguments that OZs represent an expansion of state power in a post-Keynesian fashion at the same time that specific private interests are empowered. I conclude by returning to my econometric results and discuss how a price increase which benefits existing landowners naturally results from the twin trends of increased financialization and urban entrepreneurialism.

11.1. OZs and Financialization

Mavroudeas and Papadatos (2018) describe financialization as an argument that, through innovation, the financial services sector has conquered and transformed capitalism. In review, they offer key facts employed by proponents of financialization, including the increased share of financial services in GDP and profit and the increased indebtedness of working- and middle-class households. Financialization is also often linked to globalization given the interconnectedness of financial services on a cross-border scale.

In many ways, the OZ program is consistent with a broader characterization of financialization as a means of making the world "smaller" from the standpoint of how capital flows. Geo (2006) describes how in an era

of financial globalization, "financial markets are now including the excluded with a vengeance." The authors go on to note that a low-income borrower who might previously have been considered underbanked "now participates at a distance in all machinations of Wall Street's cash-flow-bundling and risk-redistribution apparatus." While in this context the authors appear to intend more to reference workers in informal sectors across the Global South, nonetheless the same motif applies to the underbanked in low-income communities across the United States. The OZ program represents the latest extension of the global financial apparatus into areas which previously, perhaps as a historical aftereffect of redlining as well as increased conservatism among lenders following the GFC, had seen comparatively lower flows of capital.

What has driven investors into a geographic class of real estate assets that was previously considered too risky to justify the returns for new development? French et al. (2011) helps us understand to some extent the reason why programs like OZs have helped to attract the flow of financial capital into areas that might once have been considered too risky for investment. Specifically, the authors, drawing on the work of Froud et al. (2000), note the challenges faced by investment firms in trying to meet the double-digit return expectations of their shareholders. Paraphrasing Froud et al. (2000), French et al. (2011) writes that "there exists a fundamental discrepancy between the expectations of capital marks for double-digit asset growth and the single-digit growth achievable in most real product markets." Therefore, OZs have naturally been attractive to investors seeking such levels of returns for their shareholders and/or clients, as they represent a rare opportunity to attain potentially above-market returns until the market has become flooded by more investors, once the investment thesis of development in OZs has been proven out. As mentioned previously, the simultaneous expansion of profit driven by financial services and the financial disempowerment of the lower- and middle-classes remains one of the core facts cited by proponents of the financialization hypothesis. This coincides with our observation of capital accumulation through OZs that fails to benefit existing residents.

Another core aspect of the financialization hypothesis is the adoption of shareholder value maximization as a core guiding principle (Mavroudeas and Papadatos, 2018). In many ways, the mechanism by which OZs have attracted capital to areas outside what, in the popular imagination, is consid-

ered the traditional purview of Wall Street, is not in and of itself a new phenomenon. Wainwright (2012) describes how "regional spaces are integrated into international finance networks," considering "financialization of financial services themselves" whereby localized lenders and other local providers of financial services have themselves been consumed through this global process (and have begun to pursue shareholder maximization above any social aims that may have previously existed). This financialization of finance processes has separated lending and related institutions at the local level from their prior social functions as part of the necessary homogenization required to operate branches at the global scale. We can understand OZs within the same framework, as a mechanism for homogenizing financial functions in regional spaces in order to better integrate them into the global economy. Before OZs, how would one finance a revitalization of a similar distressed, depreciated commercial property? One might cobble together a variety of subsidies, or perhaps benefit from the generosity of a socially-minded sponsor seeking a below-market rate of return. All of these strategies are not easily homogenized at the global scale and thus not easily integrated into the global economy.

Dymski (2005) also writes on the mechanisms by which global financialization has homogenized formerly differential systems. The author writes that the "financial homogenization/stratification process is eating away idiosyncratic features of many national financial systems from the inside out." Again, while the author's focus is primarily on global processes, we can understand the same phenomenon occurring on a domestic scale within OZs. Financing projects in low-income areas across the U.S. has often been a deeply idiosyncratic process, and the appearance of commoditized funds targeting the areas as a new type of asset class represents a move towards greater homogenization. OZs have now become a risky asset class that can be quantified and partially de-risked by adjusting the effective rate of return to investors, creating a sufficient return spread so as to theoretically protect against above-market losses.

Thus, in many ways the OZ program fits within the broader trend of financialization. The program exhibits attributes of enhancing capital accumulation among the financial services industry at the same time that it disempowers lower- and middle-income current residents of the neighborhoods. The program also operates through a mechanism that allows for homoge-

nization of assets in OZs that permits greater integration with the global financial system.

As a counterargument to this hypothesis, one might argue that the profile of investors interested in OZ benefits differs from the global firms and individuals traditionally associated with financialization. Put simply, we can ask whether the investors are part of the "1%," or petty cash investors seeking to avoid taxes. In particular, global investors will likely be less interested in a fund specifically geared to reducing U.S. capital gains taxes.

I offer two responses. First, while not the entirety of the pool, some investors interested in OZs are corporate investors with large tax capacities, making investments directly from their balance sheets. These investors fall squarely within the typology of financialization. Secondly, financialization as a theory has never posited that all value capture occurs at the hands of powerful financial services firm. Tracing back to the end user, capital employed by large asset managers frequently includes pension funds geared to middle-income earners. These users do benefit from the activities undertaken by financial firms, but their benefit does not contradict the outsize accumulation by asset managers, as well as the influence gained by those directing capital flows. Thus, even if some investors providing capital for institution funds are themselves petty cash investors, when their capital is managed by firms associated with financialization, then this type of activity still fits within the same framework.

11.2. OZs and Neoliberal Urban Entrepreneurialism

In addition to financialization, I also understand the OZ program as an outgrowth of a trend towards urban entrepreneurialism. I therefore examine the replacement of traditional Keynesian governmental intervention in OZs with a neoliberal mode of urban regeneration.

What do I mean by neoliberalism in the urban context? While constructing a singular definition of neoliberalism represents a Sisyphean task, as a working definition I refer to neoliberalism as "the resurgence of laissez-faire ideas in what is still called, in most quarters, conservative economic thought" (Rodgers, 2018). Within urban policy, this "market-oriented direction" results in unique contradictions, as "planning is a prerequisite for neoliberal urban development," despite the fact that neoliberalism is by definition an

embrace of laissez-faire ideas (Tasan-Kok, 2012). We observe these same contradictions within the context of OZs.

As a foundational text in the space, Harvey (1989) describes the shift from "managerialism" to "entrepreneurialism" in urban governance. The author describes how the traditional urban boosterism of the U.S. witnessed a revival in the 1970s in response to a reduction in federal taxes and benefits. Harvey writes that the new urban entrepreneurialism which emerged "has, as its centerpiece, the notion of public-private partnership." Cities became competitors for corporate relocations and jobs, and were often pitted against each other in attempts to attract the new gentry. To this end, massive ill-advised urban regeneration projects were often envisioned as a necessary use of taxpayer funds in order to maintain and grow regional competitiveness. At its core, urban neoliberalism and entrepreneurialism rely on an active state role in encouraging private sector activity.

To an observer familiar only with a Keynesian mode of governance that relies on a large state geared towards redistribution, at the heart of urban entrepreneurialism lies a contradiction. Given the normative goals of the public sector, why would a large, high-capacity state pursue goals contradictory to redistribution? This same fundamental question permeates our analysis of OZs. On one hand the reduction of the federal tax base represents an undeniable rolling back of the state, and a transfer of wealth to private companies who are expected to pursue transformative projects that will enhance the competitiveness of designated OZs on a national scale. On the other hand, OZs are nonetheless redistributive in that they will divert a specific portion of tax revenue to private entities working in specific low-income areas, whereas such capital gains tax funds may otherwise have been used for policies with broader appeal. Harvey (1989) is acutely aware of this type of contradiction in his formulation of entrepreneurialism, which frames the urban government as at once both an actor of increasing power to influence the built environment as well as one with a diminished role next to the might of the private sector.

Konings (2009) critiques the majority of the literature on neoliberalism and argues that there has been a fundamental misappraisal of what neoliberalism means. The author argues that state power has actually been enhanced during the neoliberal era through a reconfiguration of power relationships. He argues that both the state and financial institutions gained significantly

more leverage through the new power relationships of neoliberalism, with banks freer to "innovate like never before," whereas a more strict "economic discipline" was imposed "on the lower strata of the American population." Indeed, we might posit that OZs offer a perfect example of an instance where the government has exerted a greater power to enact a policy that permits a previously unseen level of innovation within the private sector to invest capital within distressed areas of the country. As long as we free ourselves of the tenet that state power necessarily means the state pursues redistributive goals, then we can view actions that favor wealth accumulation as part of a powerful state apparatus.

Other writers comment on the mechanisms by which state-led urban redevelopment initiatives have often reinforced processes of gentrification and accumulation of power and capital by private actors.Hackworth and Smith (2001) characterize the notion of third-wave gentrification: after the "second wave" of gentrification in the 1970s, when individual homeowners and urban "pioneers" contributed to a demographic shift in selected inner-city neighborhoods, local governments began to play a more proactive role in encouraging demographic shifts through large state-led interventions. These typically took the form of massive urban regeneration sites, intended to result in spillover effects for the larger community (not to mention an increase in the tax base). Immergluck (2009) describes an example in the context of the Atlanta Beltline, characterizing the increase in home values surrounding a new system of parks after its announcement as an example of state-led gentrification.

We thus, again, need to separate the question of whether OZs were redistributive from the question of whether OZs were emblematic of massive state power. It is plausible that OZs are, as a program, emblematic of massive state power capable of changing neighborhoods, but at the same time not a redistributive process. Indeed, the neoliberal era has shifted the role of the state in relation to the private sector, and even if the state has coalesced power rather than losing it (per some authors' interpretation), nonetheless we would be mistaken to assume that policymakers continue to pursue aims of redistribution in line with a Keynesian approach. We can instead interpret OZs as a mechanism towards a state-led process of gentrification at the national scale.

Of course, one may make a counterargument that OZs indeed hold promise

for effectuating redistributive aims. As described in Section 9, individual (low- or middle-income) homeowners could certainly stand to benefit from an increase in the development activity within a designated OZ if it results in overall value increases for the neighborhood. Through the process of increased commodification accompanying the arrival of new OZ funds and related vehicles, OZs have the potential to reach a much greater scale of impact within distressed areas than many of the more niche existing community development institutions. Katz (2018), in offering thoughts on policy measures to foster equitable outcomes for the OZ program, notes that the program offers an opportunity "to reimagine the community development finance system from the bottom up." We can also note specific elements of the program that are helpful towards these aims. For example, French et al. (2011) critiques the short-term hold periods of firms seeking to constantly maximize share value and meet the unrealistic return expectations of their shareholders. In contrast, the OZ program rewards long-term capital, with certain key benefits available only after a minimum 10-year hold period.

11.3. Econometric Results within the Framework

Finally, we can tie back the theoretical framework we have constructed with the results of the econometric portion of the study. Given we observe a price increase that is approximately equal to the size of the tax benefit, suggesting OZs have primarily resulted in a pass-through of the tax benefit to landowners, how does that influence the conclusions we can draw about state-led gentrification?

If land values are increasing, we can indeed surmise that the program is having an impact. A process of financialization is now underway in OZs that will fundamentally tie these areas more closely into global (or at minimum the national) financial systems, in a way that perhaps has not been seen since the expansion of subprime lending during the GFC. In addition, we can also observe the increased power of the state to enact a large transfer of wealth, although to whom remains an open question. The state fits within our framework of reimagined power relationships following the neoliberal era that have not reduced its power, but merely reshaped its relationships and ends. The OZ program appears to be successful at achieving its goal of increasing values within designated areas, consistent with this imagining of the urban entrepreneurial state.

A logical question is how the program would have differed within the context of a welfare state. For one, there may have been a more concerted focus on generating new construction of projects with significant spillover effects for the designated areas. While Table 13 offers a menu of fairly pessimistic direct effects for renters in designated areas, nonetheless such renters do stand to benefit if the amenities of a neighborhood improve with new development. However, if this outcome had been higher on the list of priorities, there likely would have been more restrictive guidelines on job creation goals and what types of assets are eligible for OZ incentives. We might also have seen some of the explicit affordability requirements mentioned in Section 10 included as part of the fundamental federal backbone of the program.

To conclude, the evidence we see on the impact of OZs reflects the types of outcomes we would expect the state to pursue in the era of urban entrepreneurialism, with a bent towards empowering private players without any explicit redistributive goals. The program also reflects trends towards financialization, with an increase in the influence of the financial services sector at the expense of low- to middle-income households. The commodification of assets in OZs also reflects the necessity of homogenization in order to incorporate heterogeneous assets within global financial trade.

12. Conclusion

I began this study by presenting the background of the OZ program in light of its potentially transformative impact on neighborhoods: a new subsidy with the potential to dramatically impact the amount of capital available to low-income communities on a national basis. For historical background, I provided a review of literature on previous similar place-based incentive programs, giving a sense of some of the methodological issues that have previously arisen and the uncertainty regarding whether these types of programs can actually have a significant impact on socioeconomic outcomes and real estate prices in target areas.

Acknowledging that few prior studies have focused on the topic of commercial real estate, largely due to estimation difficulties that I have tried to alleviate through our introduction of a Bayesian repeat sale estimation protocol, I went on to place the current study as a novel approach to interpreting the efficacy of place-based incentives generally, in addition to being at both the forefront of research on OZs specifically. With that in mind, I provided a description of the structural time series approach I adopted in Section 5 and then went on to summarize pertinent attributes of the data in Section 6. In Section 6, I paid particular attention to the importance of the parallel trends assumption in a difference-in-differences framework, and described how I used the repeat sales methodology as well as a series of supplementary checks and filters to control for heterogeneity between the treatment and the control group (as well as within each group).

In Section 7, I describe the results of the main model to test for the impact of OZ designation on real estate prices, finding a large premium ω in the range of 20% that was significant at the 5% level in two of the model specifications (1HRS and 2HRS). In the DRS model specification, the premium ω was almost significant, and in any case the DRS model showed the weakest fit of all the models on a WAIC basis. I went on to create an expanded model that decomposed the designation and expectation effect (ω^D and ω^E, respectively). Unfortunately, on a decomposed basis, the results were not significant, except for ω^E in the DRS specification. ω_D remained close to significance at the 5% level in all specifications, especially in the 2HRS model which showed the strongest fit score (in that model, the value of ω^D at the 5% significance level was -0.007).

Based on the econometric results, I went on in Sections 9, 10, and 11 to provide a framework for understanding the sociopolitical implications of these findings. First, I summarized how we might interpret the causation of various observed effects, and which stakeholders stand to benefit in each scenario. Given the empirically observed increased in land values was approximately equal to the expected NPV increased from the tax incentive, and perhaps more importantly given that we do not see an increase in the values of newer properties unlikely to be redeveloped, I concluded that the OZ program has likely thus far represented primarily a pass-through of benefits to existing landowners. Note that as previously mentioned, we do not know a priori the split of tax incentive value capture between capital expenditures and land value. It is possible that more of the benefit should in theory be capitalized into the land, and that the observed empirical results are lower than what we might expect if all of the new value indeed went exclusively to the land. If this were true, the OZ program might have increased the NPV of development projects that would have otherwise exhibited an NPV of below $0.

Finally, I acknowledged that the OZ program has expanded the reach of financialization into areas that may previously have been cut off from global financial systems after the GFC, and that the program is emblematic of a reinforced state power that nonetheless does not necessarily pursue Keynesian aims of social equity.

12.1. Limitations and Future Work

There are some limitations to the current research worth highlighting. First, the sample size of transactions is necessarily low given the limited time that has elapsed since the program was inaugurated, combined with our restrictive filters that required us to identify depreciated properties likely to be targeted for redevelopment, with at least 2 historical sales since 2000. While our significance tests control for the low sample size, and our hierarchical time series approach is specifically designed to aid us in this type of situation, it is nonetheless possible that a few data observations could skew our results. Therefore, it would be advisable to rerun the model in later years and determine if there is any decay in the premium parameter ω, or if it continues to remain robust with more observations.

An application of the methodologies applied here to other place-based

subsidy programs presents itself as a natural future avenue of study. It would be interesting to determine if we observe more significant results when looking at the impact of the NMTC or federal and state EZ/ECs after applying Bayesian smoothing strategies, compared to some of the prior studies that have often found negligible impacts.

By the same token, as the OZ program continues to involve, we will need to better track the secondary socioeconomic impacts on the residents of the areas. The first-order impact on commercial real estate is likely the first effect we would observe and therefore represents an ideal choice of study for understanding early indicators of program success, but cannot provide a holistic picture of whether or not the program has achieved its ostensible economic development objectives.

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