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Effects of Gentrification on Homeowners: Evidence from a Natural Experiment

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Abstract

A major overhaul of the property tax system in the city of Philadelphia has generated significant variations in the amount of property taxes across properties. This exogenous policy shock provides a unique opportunity to identify the causal effects of gentrification, which is often accompanied by increased property values, on homeowners' tax payment behavior and residential mobility. The analysis, based on a difference-in-differences framework, suggests that gentrification leads to a higher risk of delinquency on homeowners' tax bills on average, but there has been no sign of a large-scale departure of elderly or financially disadvantaged homeowners in gentrifying neighborhoods. Tax delinquencies were somewhat inflated by appeals for reassessments, and programs designed to provide tax relief for long-term homeowners and new construction also help mitigate the risk of tax delinquencies and displacement. Findings from this study help researchers, policymakers, and practitioners better understand the mechanisms through which gentrification may impact long-term homeowners and the effectiveness of policies to mitigate their displacement.

Keywords: gentrification, property tax, tax delinquency, residential mobility
JEL classification: H20, H31, H71, R51

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1. Introduction

Gentrification — the influx of investment and higher-income households in previously low-income neighborhoods — has sparked debate among researchers and the general public about its consequences for preexisting residents. One mechanism through which gentrification is purported to influence residents is by increasing tax burdens for homeowners, which could lead to tax delinquencies, involuntary moves, and tax foreclosures. In particular, these concerns focus on how gentrification can drive long-term and elderly homeowners out of their homes; they cannot afford to pay skyrocketing tax bills owing to low or fixed incomes. Gentrification, on the other hand, may benefit homeowners by increasing their wealth from the increased value of their home, and this may also entice them to move so they can cash out on the increased home equity. A growing body of research has made notable progress on the relation between gentrification and residential mobility of renters, who hold more tenuous positions in the housing market than homeowners, but little is known about the effects of gentrification on homeowners and the potential mechanisms of such effects (Martin and Beck, 2018). Yet, the majority of housing units are still owner-occupied, and many homeowners are vulnerable to gentrification's negative consequences as well.

This study contributes to the literature by taking advantage of a sweeping property taxation system overhaul (actual value initiative, or AVI), which took place in 2013 and was implemented in 2014 in Philadelphia[2] to identify the effects of gentrification on homeowners' tax payment behavior and residential mobility. To our knowledge, this study is the first to isolate the causal relationship between gentrification and individual homeowners' tax payment behavior. Our identification strategy builds upon several features of the 2013 tax reform in Philadelphia. First, until 2013, Philadelphia had not conducted a comprehensive reassessment of market values for properties in the city since the 1980s, thereby keeping assessed values for most properties largely unchanged for several decades. For properties in gentrifying neighborhoods, gentrification increased homeowners' housing values but did not affect their tax burdens before 2013. By adopting the AVI, the city reassessed the market values of all properties in 2013, making tax assessed values closer to the properties' actual market values. Consequently, the effects of gentrification on property taxes become manifest through the changes in tax amounts and tax delinquencies after the AVI, allowing us to decouple the effects of gentrification on wealth building from tax burdens. Second, because the reform changed the way the city used individual assessments to calculate tax bills, and the tax reform was claimed to be "revenue neutral," the AVI should generate significant variations in property taxes instead of uniform increases across properties. Third, as part of the tax reform, the city implemented programs designed for gentrification relief. Our data provide information on tax abatements and exemptions at the property level that allows us to examine whether the programs mediate the effects of gentrification on homeowners' tax behavior.

Using a difference-in-differences (DID) framework, we compared changes in tax delinquencies and residential mobility before and after 2014 for homeowners in gentrifying neighborhoods with those changes for homeowners in nongentrifying neighborhoods. Empirical results suggest that gentrification, especially more intense levels of gentrification, leads to a significant increase

[2] Throughout this report, Philadelphia refers to the city of Philadelphia, rather than the metropolitan area.

in homeowners' risk of tax delinquency. On average, gentrification leads to an increase of 4.2 percentage points in the tax delinquency rate post-AVI, with the neighborhoods that underwent *intense gentrification* experiencing the largest increase of about 5.4 percentage points. As expected, homeowners receiving tax exemptions or abatements that provide greater relief for homeowners in gentrifying neighborhoods are much less likely to be delinquent on their tax payments than those who did not receive such tax relief. Results are consistent with the contention that as property taxes increase in gentrifying neighborhoods, gentrification increases the risk of tax delinquency, while gentrification relief programs help mitigate the delinquency risk for vulnerable homeowners. However, we have not observed either an increased volume of home sales or higher levels of outmigration among elderly and financially disadvantaged homeowners, as proxied by individuals with active residential mortgages, in gentrifying neighborhoods. Tax delinquencies were somewhat inflated by appeals for reassessment, and property tax relief programs help mitigate the risk of delinquencies and displacement. In addition, sharply increased property taxes appear to have reduced demand for owner-occupied housing in gentrifying neighborhoods, which helps explain the reduced outmigration rates as well.

This study helps inform understanding of the consequences of neighborhood changes affecting cities across the nation and the effectiveness of tax policy to intervene with these consequences. Our study builds on several strands of empirical research. First, it adds nuance to recent quantitative findings tracking individual residents that primarily focus on residential mobility and displacement of vulnerable residents, which generally do not find consistent evidence that gentrification leads vulnerable households to move more often relative to similar residents in nongentrifying neighborhoods (Ellen and O'Regan, 2011; Ding, Hwang, and Divringi, 2016; Freeman, 2005; McKinnish, Walsh, and White, 2010; Vigdor, 2002). These studies were either unable to distinguish between owners and renters in their analysis, or they have focused on renters and found mixed results. This study sheds light on gentrification's effects on the displacement of homeowners, who compose the majority of households in Philadelphia, and examines how a specific mechanism of displacement and the conditions under which it occurs can influence whether homeowners are displaced.

Second, this study's use of property-level data, local tax policy, and a natural experiment builds on research examining how the increase in property taxes affects gentrification and the mobility of incumbent residents. Cunningham (2014) finds that neighborhoods in states protected by property tax assessment caps actually gentrified faster than those in states without them, which does not appear to be consistent with the goal of this assessment process. Martin and Beck's (2018) study examines the effects of gentrification on the residential mobility of both homeowners and renters. They find some evidence that property tax pressure based on state-level policies can trigger involuntary moves by homeowners, but such displacement is no more common in gentrifying neighborhoods than elsewhere. Last, Shan (2010) suggests that higher property taxes raise mobility among elderly homeowners. A $100 increase in annual property taxes is associated with a 0.73 percentage point increase, or a relative increase of 8 percent, in the two-year mobility rate for elderly homeowners. However, Shan does not link gentrification to the mobility of elderly homeowners directly and instead uses variation in state property tax policy as an identification strategy.

More importantly, our study improves upon previous research by examining the causal effect of gentrification on property tax delinquencies and homeowners' residential mobility. The majority of existing research on the effects of gentrification suffers from serious identification challenges because gentrification is an ongoing, evolving process that often occurs simultaneously with increases in property taxes. Property taxes are also likely to be endogenous to individuals' moving decisions, because many local public services are financed through property taxes, and homeowners who pay high property taxes also tend to live in areas with good local public services (e.g., high-quality public schools, low crime rates, and new community centers). Thus, studies linking property taxes and residential mobility directly may suffer from selection bias, whereas our study can overcome these challenges by taking advantage of a natural experiment.

The structure of the paper is as follows: Section 2 describes the policy design and the cross-sectional variation that we exploit for identification. Section 3 presents the data and the empirical identification strategy. Section 4 presents the main results on the effects of gentrification on property tax delinquencies and mobility, together with the empirical results on the effectiveness of several tax relief programs. Section 5 concludes.

2. Background and Policy Design

This section first provides an overview of the old property tax system in Philadelphia and the specific context in which the AVI was introduced in 2013. This section then discusses the key features of the AVI and how the adoption of the AVI provides a unique opportunity to examine the effects of gentrification on homeowners' payment behavior and residential mobility.

2.1. Property Taxes in Philadelphia Before 2013

Before 2013, the property tax system in Philadelphia was characterized by low assessments of properties, extremely high rates of tax delinquency, and lesser reliance on property taxes compared with other jurisdictions (Pew Charitable Trusts, 2012 and 2013). Since the 1980s, Philadelphia had not conducted a comprehensive reassessment of the market value for properties in the city, and the assessed values for most properties had been substantially lower than their actual market values until 2013. The city only reassessed the value of very few homes during this time period, most of which were new construction. The main reason behind this low assessment was that, unlike most other states, Pennsylvania imposes no reassessment timetables or standard assessment methods on local governments (Pew Charitable Trusts, 2012).

Philadelphia has also long been a community of homeowners (with a homeownership rate of 59 percent in 2000 and 54 percent in 2010), many of whom are of modest means. City officials have been reluctant to risk upsetting this large constituency by making any changes that could result in higher property tax bills for homeowners. Pew Charitable Trusts (2012) estimates that city property, on the whole, is taxed on only about 13 percent of its true market value, significantly lower than the city's official predetermined ratio of 32 percent. This means the assessed values listed on tax bills were, on average, about 60 percent lower than true market values. Growth in property taxes during these years was mainly attributable to small increases in the property tax rate, which rose from 8.264 percent in 2000 to 9.771 percent in 2013.

Philadelphia also has a long-standing problem with property tax collection. Over the years, about one-fifth of all parcels, or more than 100,000 properties, had outstanding tax bills, much higher than most other big cities in the United States (Pew Charitable Trusts, 2013). In April 2012, almost 18 percent of properties in Philadelphia were delinquent on their property tax payments. The relatively high concentration of people under poverty and the high homeownership rate help explain the high delinquency rates. In addition, the lack of a state-mandated time frame to start various enforcement actions and a lack of political will to impose strict enforcement measures against delinquent property owners have contributed to the serious tax collection issue that Philadelphia faces.

Philadelphia also relies less on property taxes (and more on wage and business taxes) than most other major cities. In 2011, Philadelphia's property tax per capita was only about one-quarter the amount generated in Washington, D.C., one-third of what is collected in Boston, and much lower than other big cities like Pittsburgh and Chicago — $729 per resident in Philadelphia, compared with $2,799 in Washington, D.C., $2,213 in Boston, $1,191 in Pittsburgh, and $1,181 in Chicago (Pew Charitable Trusts, 2012). As a result, far more attention had been directed at the income tax or other taxes, instead of property taxes.

2.2. The Actual Value Initiative

In 2013, after several years of public discussion and debate, Philadelphia adopted a comprehensive property tax reform known as the AVI, effective for tax bills due in early 2014. Under the AVI, Philadelphia conducted the first comprehensive reassessment of the market value of every property in Philadelphia since the 1980s. Consequently, the assessed values under the AVI generally reflect more accurately the properties' market values. After the comprehensive reassessment in 2013, the city had been busy dealing with a large number of appeals and adjusting valuations through targeted reassessments. As of spring 2015, owners of more than 10 percent of the properties in the city, almost 60,000 properties in all, had sought review and appealed for reassessments (Pew Charitable Trusts, 2015). Consequently, there were no new comprehensive, citywide revaluations until 2017.

Under the AVI, the city also changed the way individual assessments are used to calculate tax bills. Before 2013, the city levied taxes on only 32 percent (predetermined ratio) of a property's total assessed market value, and the tax rate was 9.771 percent as of 2013. Therefore, for a property assessed at $100,000 in 2013, the tax bill would be $3,130 ($100,000 × 0.32 × 0.09771), resulting in an effective tax rate of 3.13 percent of the assessed value. The AVI, however, changed this fractional assessment system so that 100 percent of a property's assessed market value is used to calculate tax bills. To keep this adjustment revenue-neutral, the city lowered the property tax rate from 9.771 percent in 2013 to 1.34 percent in 2014.[3] Using the previous example, a property assessed at $100,000 in 2014 would be taxed $1,340 ($100,000 × 0.0134). Thus, properties with no or smaller increases in assessed values may experience a decline in the amount of property tax, whereas those with larger increases in assessments would see significant increases in tax bills.

[3] The tax rate increased to 1.3998 percent in 2016.

In addition, the AVI transformed how property owners deal with any big tax increases that might result from the new system. The AVI introduced two major programs to mitigate tax increases for owner-occupied homeowners and long-term homeowners who are likely to face sharp increases in property tax bills after the reassessments. The homestead exemption, the biggest single mitigation program, is available for all owner-occupied primary residences in Philadelphia, regardless of homeowner's income or the length of tenure in their residences. The homestead exemption provides eligible homeowners an exemption of up to $30,000 of a property's value from taxation (about $400 in taxes in 2014). The other program, the Longtime Owner Occupants Program (LOOP), caps a property's taxable value for 10 years for eligible long-term homeowners (at least 10 years in their homes and below 150 percent of the area median).[4] The Pew Charitable Trusts (2015) estimated that about 18,000 homeowners received tax relief through LOOP by spring of 2015, and about 216,000 homeowners (about 37 percent of all properties) received homestead exemptions. Not all eligible homeowners, however, have enrolled in the homestead exemption program. One estimate suggests at least 68,000 qualified homeowners had not signed up, and low-income neighborhoods had even lower enrollment rates (Pew Charitable Trusts, 2015). Because of the changed method to calculate tax bills and the introduction of the new exemption programs, property taxes increased for certain properties and decreased for others, although the assessed values generally increased across properties.

2.3. The AVI and the Effects of Gentrification on Homeowners

Figure 1 illustrates some of the unique features of the property taxation system in Philadelphia by showing the trends in average assessed values, tax amounts, and tax delinquency rates in gentrifying neighborhoods and in their adjacent low-income neighborhoods that did not experience gentrification during 2000–2013. The average assessed values changed very little before the AVI, with an average increase of 42.9 percent during 2004–2013 in gentrifying neighborhoods and only 10.3 percent in nongentrifying neighborhoods. The concentrations of new construction, which are required to undergo reassessments, in gentrifying neighborhoods likely explain the observed differences. The assessed values, however, jumped sharply in 2014 when the city reassessed all properties under the AVI, with a much larger increase in gentrifying neighborhoods. Property taxes increased slightly before 2013, and the increase was mainly attributable to small increases in the property tax rate. After adopting the AVI, property taxes rose substantially in gentrifying neighborhoods, but there was almost no change in nongentrifying neighborhoods. These figures suggest that the adoption of the AVI allowed for the realization of the actual differences in assessed values and tax amounts between gentrifying and nongentrifying neighborhoods.

Homeowners benefit from the rising home values that often accompany gentrification, but they — especially long-term, lower-income homeowners — may become cost-burdened and, in extreme cases, could be displaced from their homes by higher property taxes. One pathway through which this can occur is through increased property value assessments and subsequent tax increases. This can make property taxes unaffordable for low-income homeowners, leading

[4] Homeowners who qualify for both LOOP and the homestead program may apply for whichever one results in the lower bill, but not both.

homeowners to become delinquent in their tax payments and possibly forcing them to sell their home or end up in tax foreclosures. Alternatively, homeowners may pay their increased tax bills on time but have to shift the financial burden onto other payments. While these homeowners are current on their property taxes, they are still at the risk of being forced to move from the neighborhood because of the increased financial burden. A third possibility that may lead to the outmigration of homeowners is through a process of cashing in on the increased value of their home. While Ellen and O'Regan (2011) do not find evidence of higher mobility rates among homeowners in gentrifying neighborhoods relative to nongentrifying neighborhoods, they find that those who exit gentrifying neighborhoods have relatively lower average incomes than the neighborhood itself and those exiting nongentrifying neighborhoods.

Empirical evidence on the consequences of gentrification on homeowners is rare, and the assumed causal sequence of the effects of gentrification on long-term homeowners has not been examined empirically (Martin and Beck, 2018). The endogenous nature of gentrification, property tax, and residential mobility makes it difficult for researchers to isolate the impact of gentrification on homeowners' tax payment behavior and displacement based on cross-sectional data. This study contributes to the literature by identifying their causal relationship based on an exogenous policy shock. Because of the unique design of Philadelphia's property tax system before 2013, gentrification and changes in assessments and property tax did not occur simultaneously. The adoption of the AVI helps reveal the true effects of gentrification on homeowners' tax payment behavior, as well as the specific mechanism of gentrification's effects on residential mobility through property taxes, instead of home equity.

3. Methodology and Data

3.1 Methodology

This study isolates the effects of gentrification by comparing the changes in the tax payment behavior of owner-occupied residential properties and vulnerable homeowners' outmigration rates in gentrifying tracts before and after the adoption of the AVI with those of the nongentrifying tracts in the control group. The two-way, property-level, DID model can be specified as:

$$Y_{it} = \beta_0 + \beta_1 * GENTRIFY_i + \beta_2 * AVI_t + \beta_3 * GENTRIFY_i * AVI_t + \gamma * X_i + \eta * N_i + \varepsilon_{it} \quad (1)$$

in which Y_{it} represents the outcome measure for property i in year t. $GENTRIFY_i$ is the dummy variable that represents whether property i is in a tract that had been gentrifying during 2000–2013. This variable is omitted in the estimation because we have controlled tract dummies. AVI_t is the time dummy and is assigned a value of one for the post-2014 period. $GENTRIFY_i*AVI_t$ is the two-way interaction of the time and treatment dummies. X_i represents a set of property characteristics that help predict property values, including square footage of living area, land size, year built, basement finish type, number of bedrooms, number of bathrooms, and building condition. N_i represents the neighborhood fixed effect, which helps control for tract-level unobserved heterogeneity. The coefficient of the two-way interaction term, β_3, is expected to capture the effect of gentrification on outcome measure Y. We also examine how homeowners

fare in neighborhoods with different levels of gentrification relative to those in nongentrifying neighborhoods. We achieve this by using interaction terms between the categorical gentrification variables and the *AVI* dummy.

We further employ a three-way DID regression and separately evaluate the effects of the homestead exemption program and other tax exemption and abatement programs, including LOOP. Because of confidentiality considerations, the city cannot share the data with information on specific abatements/exemption programs at the property level. Thus, we are unable to distinguish homeowners who receive LOOP exemptions or tax abatements for new construction or substantial property rehabilitation. The three-way DID model allows us to use several control groups to account for correlated trends associated with gentrification and the AVI. Our model compares the outcomes of owners receiving tax relief (a homestead exemption or other tax relief) in gentrifying neighborhoods after 2014: (1) with outcomes before the AVI, (2) with outcomes in adjacent low-income tracts not experiencing gentrification, and (3) with the outcomes of the properties in gentrifying neighborhoods but not receiving the corresponding tax relief. Thus, we observe the outcome for owners receiving tax relief post-AVI in gentrifying neighborhoods, whereas the other groups were either not exposed to the tax relief or not in the gentrifying neighborhoods. We use linear models for continuous outcome measures and linear probability models for binary outcomes to estimate the effect of gentrification. We rely on linear models partly for ease of interpretation of the coefficients.

The outcome measure (Y_{it}) includes the incidence of tax delinquencies and measures of residential mobility, in addition to the assessed values and tax amounts for individual residential properties. The property tax payment behavior of homeowners provides one indication of how they are faring financially in the face of higher taxes induced by gentrification.[5] We define two types of property tax delinquencies: any tax delinquencies at the end of the year and new tax delinquencies in the current year. Delinquent property taxes may indicate that a homeowner is cost-burdened as the owner fails to keep up on their tax payments because of financial hardship. Another possibility is that homeowners stop paying the full amount of property taxes while filing appeals for reassessments because they are unsatisfied with the significantly higher assessments when the AVI was initially adopted. We cannot observe this in our data, but we evaluate this possibility in more details later in the paper.

In addition to measures of tax delinquencies, we also examined outmigration of existing homeowners by examining sales of existing properties, residential mobility of elderly mortgage-holding homeowners (ages 55–84), and residential mobility of financially vulnerable homeowners based on having low Equifax Risk Scores (Risk Scores) and a mortgage.[6] We focus

[5] In Philadelphia, each year's property tax payments are mailed to property owners in November and are due in full by March 31 of the following calendar year. Property taxes are officially considered delinquent if they are not paid in full by the end of the calendar year in which the taxes were levied. Department of Revenue tax payment data provide information on the outstanding balance of principal, interest, and penalty at the end of the year. We consider the owner of a property to be delinquent on property tax for a particular year if the total outstanding balance of principal, interest, or penalty is greater than $1.

[6] Tax foreclosure could be another proxy, but it is still too early to identify tax foreclosures induced by the adoption of the AVI in 2014 because it usually takes several years to complete a tax foreclosure in Philadelphia (from two to

on elderly homeowners and low-score homeowners with outstanding mortgages for several considerations. First, elderly homeowners, especially those relying on fixed incomes and having insufficient liquid assets, are more vulnerable to rising property taxes. Because of liquidity constraints, they may be forced to liquidate their housing wealth and move, even if they have great psychological attachment to their houses and would prefer not to move. Second, individuals with low Risk Scores have either little or poor credit history and were often hit harder by the Great Recession, although low scores do not necessarily reflect low-income status. Thus, low-score homeowners are likely more vulnerable to financial challenges and, subsequently, displacement in the housing market. Finally, we focus on individuals with outstanding mortgages as our proxy for homeowners. Our data do not distinguish renters from owners directly, and while mortgage-holding individuals only serve as an imperfect proxy of homeowners, these homeowners are generally more "vulnerable" than typical homeowners to displacement since they have their mortgage to pay, while paying their property tax bills.

3.2 Gentrification Measures

Gentrification, put broadly, is the socioeconomic upgrading of a previously low-income neighborhood characterized by the influx of higher socioeconomic status residents and an increase in housing prices. Therefore, we measure gentrification by specifically concentrating on shifts in the socioeconomic status of residents and neighborhood housing prices. The gentrification measure that we use in this study employs the same methodology as in Ding et al. (2016) but is based on 2010 census tract boundaries.

By definition, for tracts to gentrify, they have to have been lower-income tracts at the beginning of the period. We consider tracts to be *gentrifiable* if their median household income was below the citywide median household income in the year 2000, using estimates from the 2000 U.S. census. We consider a tract to be *gentrifying* if it was gentrifiable in 2000 and experienced both a percentage increase above the citywide median increase in either its median gross rent or median home value *and* an increase above the citywide median increase in its share of college-educated residents from 2000 to 2013, based on data from the 2000 U.S. census and the American Community Survey (ACS) 5-year estimates from 2009 to 2013. We rely on housing values and rents because they reflect the demand for various amenities and investment in the neighborhood. We include changes in *either* rents or home values, because these changes do not necessarily occur in step with each other, but nonetheless indicate changing affordability in a previously low-income neighborhood. We additionally include criteria for demographic changes to deal with issues with past strategies, which misidentified gentrification in neighborhoods that only experienced housing price spillovers without demographic changes. We rely on above-median increases in the share of college-educated residents, rather than incomes, so we can capture young professionals who may have relatively lower incomes and so we can better distinguish an influx of new residents from incumbent upgrading (Clay, 1979; Freeman, 2005). Figure 2 provides a map of gentrifying neighborhoods based on our measure. Of Philadelphia's 366 tracts with population sizes over 50, we categorized 51 of its 182 gentrifiable tracts as gentrifying from

10 years or more). The vast majority of new tax delinquencies post-AVI have not been foreclosed (only about 1.4 percent of new delinquencies in 2014 and 2015 had been foreclosed as of July 2017).

2000 to 2013.[7] The remaining 131 tracts are *nongentrifying*; that is, they were gentrifiable in 2000 but did not meet the criteria listed previously.

Among tracts classified as gentrifying, we further categorize tracts to reflect different stages or paces of gentrification. Table 1 provides a summary of the gentrification measures. We use the following categories:

- *Weak/moderate gentrification:* Tract is not in the top quartile for either median rent or median home value in the 2009–2013 ACS estimates and was not gentrifying before 2000
- *Intense gentrification:* Tract is in the top quartile of gentrifying tracts for either median rent or median home value in the 2009–2013 ACS estimates and was not gentrifying before 2000
- *Continued gentrification:* Tract had been gentrifying in the 20 years prior to 2000 and continued gentrifying from 2000 to 2013

For the purposes of this analysis, we use a control group for the gentrifying tracts that consist of nongentrifying tracts within a half-mile radius of the boundary of a gentrifying tract. Nongentrifying neighborhoods that are farther away may have unobserved characteristics that make them less comparable with gentrifying neighborhoods. One tract that we identify as gentrifying is far away from all other gentrifying neighborhoods and is surrounded by several nongentrifying and nongentrifiable tracts with market conditions that are distinct from the other clusters of gentrifying tracts and those within a half-mile radius of them. We drop this gentrifying tract from the final sample to limit biasing estimates of the gentrification effect. The final analytic sample thus includes a total of 50 gentrifying tracts and 72 nongentrifying tracts in the control group (Figure 3). Tracts in the control groups are in the same submarket of gentrifying neighborhoods and with similar or slightly lower property values at the beginning of the century, but they did not experience the same level of neighborhood change as gentrifying neighborhoods from 2000 to 2013. Table 2 summarizes the neighborhood characteristics of gentrifying and adjacent nongentrifying neighborhoods used in the empirical analysis.

3.3 Tax Assessments and Tax Payment Data

This study primarily uses administrative panel data from the Department of Revenue (DOR) of the City of Philadelphia, which provide property-level information on tax assessments, tax amounts, whether properties have tax abatement and tax exemptions, and tax payment behavior for all properties in Philadelphia during 2012–2015. The DOR property tax data have an identifier for homestead exemptions and an identifier for tax abatements or LOOP exemptions. The DOR data are complemented by data from CoreLogic Solutions, which further provide information on property characteristics, the census tract in which the property is located, and deed transactions for residential properties in Philadelphia.[8] We rely on the DOR data on tax

[7] The data exclude 16 census tracts that had fewer than 50 residents or had zero housing units during the entire period of analysis.

[8] These data sets were linked by property parcel numbers, but all personally identifiable information was removed from the merged data for the empirical analysis.

assessments, tax amounts, and tax payment histories as of December 2016. Therefore, the data reflect the adjusted values by the end of 2016,[9] which might be different from the assessed values or property taxes in the initial tax bill after the AVI was implemented.

We can use the panel data from 2012 to 2015 for the analysis of tax delinquencies and property sales. We use only the 2013 and 2014 data for the analysis of tax assessments and tax amounts, because there was no systematic variation in the value of the outcome variables during the years before or after 2014.[10]

We made a few additional decisions in creating the final study sample of residential properties used in our analysis. First, the analysis focuses on owner-occupied,[11] single-family residential properties, as identified in the CoreLogic Solutions data, in Philadelphia only. Second, properties with extremely low or extremely high values (those with assessed values below $10,000 and above $2,000,000 in 2014) were excluded from the analysis. Third, a few census tracts were excluded from the analysis, because there were too few owner-occupied housing units in the neighborhood (fewer than 10). Finally, a small number of properties that do not have data for the whole study period (2012–2015) were excluded. Consequently, we end up with a final sample of 89,421 properties in 122 census tracts in Philadelphia.

3.4 The Federal Reserve Bank of New York/Equifax Consumer Credit Panel

Following the methodology in Ding et al. (2016), we use the Federal Reserve Bank of New York/Equifax Consumer Credit Panel (CCP) data to evaluate the effect of gentrification on mobility patterns among vulnerable homeowners. The CCP data consist of an anonymized 5 percent random sample of U.S. consumers in a major credit bureau's total population of eligible individuals, as well as consumers in each sampled individual's household. This sample is constructed by selecting consumers with at least one public record or one credit account currently reported and with one of five numbers in the last two digits of their Social Security numbers (SSNs) (see details in Lee and van der Klaauw, 2010).[12] The CCP data report the credit characteristics for sample members quarterly beginning in 1999. The CCP data allow us to study residential mobility, because the CCP data include census geography identifiers based on census boundaries associated with each consumer's credit file. By identifying whether an individual has moved across neighborhoods, a "mover" is defined as an individual who lives in a census tract different from where he or she lived one year ago in this study. Consistent with early literature, we focus on the moving decisions of elderly homeowners, proxied by owners between 55 and 84

[9] Although there were no systematic changes in tax assessments and tax amounts after 2013, for a small share of properties, tax assessments and tax amounts could be adjusted as a result of appeals for reassessments or approval of new applications for tax exemptions (Pew Charitable Trusts, 2015).
[10] There was no new, comprehensive, citywide revaluation until 2017.
[11] Data from CoreLogic Solutions define owner occupancy based on the comparison of the mailing address of the property owner and the property address. If the mailing address and the property address do not match, the owner is considered an absentee owner; otherwise, the property is considered owner-occupied.
[12] The CCP data do not include actual SSNs. Equifax uses SSNs to assemble the data set, but the actual SSNs are not shared with researchers. In addition, the data set does not include any names, actual addresses, demographics (other than age), or other codes that could identify specific consumers or creditors.

years old and with outstanding residential mortgages, as well as homeowners with lower Risk Scores (below 580) and with outstanding residential mortgages.

3.5 Descriptive Statistics

Descriptive analysis confirms that the assessed value of single-family, owner-occupied properties in Philadelphia jumped sharply in 2014 when the city reassessed all properties under the AVI (Table 3). There was a larger increase in the assessed values for properties in gentrifying neighborhoods: The increase of $115,941 in the average assessed value, or a 307.0 percent increase, in gentrifying neighborhoods was larger than the increase of $44,284 in average assessed value, or 205.1 percent increase, in nongentrifying neighborhoods. Property taxes also rose more substantially in gentrifying neighborhoods after the AVI, with an increase of 57.4 percent from 2013 to 2014, compared with a slight decrease of 0.5 percent in nongentrifying neighborhoods. The biggest jumps in property taxes were concentrated in gentrifying neighborhoods where housing prices had soared in the past decade but had also been gentrifying in previous decades, with an average property tax increase of 76.8 percent in neighborhoods with continued gentrification. In neighborhoods undergoing intense gentrification, the increase in the tax amount ($1,047) was larger, but the percent change (43.5 percent) was smaller, because the average property tax amount was higher in these neighborhoods before the AVI, which is likely due to higher levels of new construction in these intensely gentrifying neighborhoods.

The average tax delinquency rate had been between 15 percent and 20 percent before 2013 in gentrifying neighborhoods. The tax delinquency rate was much higher, at about 30 percent, during the same period in nongentrifying neighborhoods. There was a substantial increase of 2.9 percentage points in the delinquency rate from 2013 to 2014 for owner-occupied properties in gentrifying neighborhoods (the 2013 mean was 12.4 percent). Those neighborhoods experiencing more intense levels of gentrification generally experienced larger increases in property tax delinquency rates — an increase of 4.8 percentage points (from 4.9 percent to 9.8 percent) in neighborhoods experiencing intense gentrification and an increase of 3.2 percentage points (from 10.4 percent to 13.6 percent) in neighborhoods undergoing continued gentrification. In contrast, tax delinquency rates in nongentrifying tracts declined slightly (an average decrease of 0.8 percentage points), although they were still at a relatively high level of 26.7 percent in 2014. However, the mobility of elderly and low-score homeowners in gentrifying neighborhoods declined significantly from 2013 to 2014 (e.g., a decrease from 4.3 percent to 2.3 percent for elderly homeowners), in contrast to an increase in the mobility rate of similar vulnerable homeowners in nongentrifying neighborhoods (an increase of 2.0 percentage points for elderly homeowners in nongentrifying tracts). Similar trends can also be found for sale transactions before and after the AVI, with a decrease in the volume of property sales in gentrifying neighborhoods and a small increase in nongentrifying neighborhoods.

About 53.4 percent of single-family, owner-occupied properties in gentrifying neighborhoods received homestead exemptions in 2014, and the share was similar (54.6 percent) in nongentrifying neighborhoods. However, the share of properties receiving other exemptions or abatements was much higher in gentrifying neighborhoods than in nongentrifying neighborhoods (22.7 percent in gentrifying versus 6.3 percent in nongentrifying). Because gentrifying neighborhoods had more new construction and experienced larger increases in property values in

general, it is not surprising that more homeowners in gentrifying neighborhoods qualify for gentrification protection programs.

4. Empirical Results

This section summarizes the regression results of the effects of gentrification and the effectiveness of tax relief programs. The gentrification effect is captured by the coefficient for the interaction variable (*GENTRIFY*AVI*), representing the change in the value of the corresponding outcome measure of being in a gentrifying neighborhood. As defined earlier, the control group generally refers to the properties in the nongentrifying tracts within a half-mile of any gentrifying neighborhoods.

4.1 Effects of Gentrification on Tax Delinquencies

Does gentrification lead to a higher risk of tax delinquency? Regression results suggest that gentrification does lead to an increase in the tax delinquency rate by an average of 4.2 percentage points — the mean was 12.3 percent in 2013 (see Table 4). Neighborhoods with intense gentrification have the largest increase in tax delinquency rates, with an increase of about 5.4 percentage points, compared with 4.4 percentage points for continued gentrification neighborhoods and 4.1 percentage points for weak/moderate gentrification neighborhoods. The results suggest that the more intense level of gentrification leads to a larger increase in the probability of tax delinquency. The effect of gentrification on the new delinquency rate is quite consistent, with a larger increase in the new delinquency rate for properties in neighborhoods with more intense levels of gentrification (an increase of 2.7 percentage points in tracts with intense gentrification, compared with 2.1 percentage points for continued gentrification neighborhoods and 1.5 percentage points for weak/moderate gentrification neighborhoods). It should be noted that the delinquency rates in neighborhoods undergoing intense gentrification are substantially lower than other neighborhoods, potentially because homeowners generally have higher income in these areas relative to other gentrifiable tracts. However, the sharp increase in delinquency rates accompanies the largest absolute changes in the assessed values and tax amounts, which may still impose greater financial burdens for homeowners in these neighborhoods.

4.2 Mechanisms of Gentrification's Effects on Tax Delinquencies

As mentioned earlier, liquidity-constrained homeowners may become tax delinquent because the increase in tax amount is significant enough that it is challenging for them to make timely payments on property taxes. We test this contention by examining the effects of gentrification on assessed values and tax amounts (Table 5). Regression results provide consistent evidence that gentrification leads to a significant increase in the assessed value and the tax amount of residential properties in Philadelphia. Gentrification leads to an average increase in assessed value of $71,657 (about 189.7 percent of the 2013 mean) and an increase of $542 in tax amount (about 57.8 percent of the 2013 mean), relative to the low-income tracts that did not experience gentrification. The increase of $542 is lower than expected (an increase of $71,657 in assessed value should lead to an increase of $960 in the tax amount, based on the 2014 tax rate of 1.34

percent), which could be explained by the existence of various tax relief programs that are not fully captured by the model. The results also show that both assessed values and tax amounts increase significantly in neighborhoods of any type of gentrification (weak/moderate gentrification, intense gentrification, and continued gentrification). However, the increase in assessed values and tax amounts is much larger in neighborhoods undergoing intense gentrification or continued gentrification. For example, gentrification leads to a tax amount increase of $1,050 on average in intense gentrification neighborhoods, compared with an increase of $798 in continued gentrification neighborhoods and an increase of $362 in neighborhoods with weak/moderate gentrification. The significant increase in property taxes for homeowners in gentrifying neighborhoods is consistent with our contention that the larger increase in property taxes in gentrifying neighborhoods leads to a higher risk of tax delinquencies.

Tax delinquencies, however, may also be inflated by an unusual number of high-value property assessment appeals in Philadelphia: When a homeowner is unsatisfied with the significantly higher assessments, they may stop paying the full amount of property tax and file an appeal for reassessments, which could have driven up delinquency figures, at least in the short term. We identified a sample of more than 4,000 likely appeals by comparing assessed values of the properties in 2015 and 2016 with the corresponding 2014 values. If the assessed value of the property was adjusted downward after 2014, we assume the homeowner had appealed for reassessment and successfully adjusted the assessed value downward. Although this is an imperfect measure, it should capture the portion of the homeowners who are more likely to enter delinquency owing only to inaccurate or unfair assessments, instead of liquidity constraints. These residents are more likely to become current on tax payments after the assessed values are adjusted, as confirmed by the data: These homeowners' tax delinquency rate dropped from 30.2 percent in 2014, which was higher than the average of 15.1 percent of all properties in gentrifying neighborhoods, to 10.7 percent in 2015, likely because their appeals had been approved and the assessed values had been reduced. When we exclude these likely appeals from the sample, the estimated gentrification effect on tax delinquencies is slightly smaller (an increase of 4.0 percentage points instead of 4.2 percentage points at the aggregate level, and an increase of 4.7 percentage points for intense gentrification neighborhoods instead of 5.4 percentage points). Therefore, the results suggest the large number of property assessment appeals contributes to the increased tax delinquency rate in gentrifying neighborhoods, but we are unable to determine the extent of their contribution to the observed delinquency rates because we cannot identify all appeals more reliably. The magnitude of the gentrification effects becomes smaller, but the major conclusions nonetheless hold when we exclude these likely appeals.

4.3 Effects of Gentrification on Residential Mobility and Home Sales

The results on tax delinquencies are informative but do not allow us to draw conclusions on the relationship between gentrification and residential displacement directly, partly because tax delinquencies were somewhat inflated by appeals for reassessments and partly because delinquencies do not necessarily mean that the resident moves away. Property taxes may affect the moving decisions of vulnerable homeowners, such as those elderly homeowners relying on fixed incomes and having insufficient liquid assets, through liquidity constraints. We also suspect, however, that increased property taxes could reduce the demand for properties in

gentrifying neighborhoods, thus suppressing the number of transactions and reducing the moving rates of homeowners in these neighborhoods.

The regression results suggest that the probability of moving for elderly homeowners (ages 55–84) in gentrifying neighborhoods actually decreased (by 3.3 percentage points) after the adoption of the AVI (Table 4). The decline is larger in neighborhoods with intense gentrification or continued gentrification (4.3 percentage points and 4.5 percentage points, respectively). In other words, the sharp increase in property assessments in gentrifying neighborhoods has not led to an increased mobility rate at the aggregate level among elderly homeowners. This finding seems to be contradictory to what Shan (2010) found that elderly homeowners respond to increased property taxes by moving to more affordable housing or housing with lower property taxes. One possible explanation is that many elderly long-term homeowners in Philadelphia can afford to stay because of the tax relief provided by LOOP and other programs, which we evaluate in the next subsection. It is also possible, as mentioned earlier, that the sharply increased property taxes for properties in gentrifying neighborhoods have suppressed both demand for housing and the volume of transactions in these neighborhoods, making it more difficult for vulnerable homeowners to sell their properties, even when they want to do so, after the AVI. The regression results on property sales confirm that the probability of sale of existing properties decreases in gentrifying neighborhoods after the adoption of the AVI (about 0.8 percentage points lower on average, with an even larger decrease in neighborhoods with intense gentrification or continued gentrification).

The results on residential mobility, as well as on property sales, although somewhat counterintuitive, are not surprising. Several other studies find that outmigration rates of homeowners from gentrifying neighborhoods are not significantly higher than those in nongentrifying neighborhoods (Ding et al., 2016; Martin and Beck, 2018). Higher tax delinquency rates may just signal homeowners' unwillingness to pay increased property taxes, given the historical lack of a strict enforcement system in place for delinquent properties in Philadelphia. Further research, however, is still needed to examine whether the higher delinquency rates in gentrifying neighborhoods will eventually result in higher outmigration of vulnerable homeowners in the long term.

4.4 Effects of Tax Exemptions and Abatements

The AVI introduced the homestead exemption program and froze property tax assessments for longtime homeowners in neighborhoods with larger increases in property values to prevent sharply increased tax burdens that would impel vulnerable homeowners to move out of their homes. We ran a set of three-way DID regressions to evaluate whether the homestead exemptions and other types of exemptions are more effective in preventing tax delinquencies for homeowners in gentrifying neighborhoods. Because we are unable to link the DOR tax abatements and exemptions data to the CCP data, our discussion here focuses only on gentrification's effects on tax delinquencies, property sales, and property taxes (see Table 6).

Properties receiving homestead exemptions generally experience a slightly larger increase in tax amount ($265) and tax delinquency rate (4.2 percentage points) in gentrifying neighborhoods, relative to those in nongentrifying neighborhoods. In other words, homestead exemptions are less

effective in reducing the risk of tax delinquencies and tax amounts in gentrifying neighborhoods than in nongentrifying neighborhoods. There are at least two possible explanations. First, homestead exemptions provide almost the same level of relief (up to $400) for all homeowners, regardless of the assessed values of the properties. A largely fixed amount of tax relief, thus, provides relatively greater relief for owners of lower-value properties, which are more likely to be located in nongentrifying neighborhoods. Therefore, homestead exemptions are expected to be more effective for homeowners in nongentrifying neighborhoods. Second, the application and eventually enrolling in the homestead exemption program may signal the homeowners' financial skills and awareness of various tax relief programs, and thus homestead exemptions may correlate to the incidence of filing appeals for property reassessments. In other words, homeowners receiving homestead exemptions may also be more likely to file appeals for reassessments and stop paying their full tax payments when they experience significant increases in property taxes post-AVI. This does not necessarily reflect their financial difficulty in making those tax payments; instead, it may reflect their dissatisfaction with sharply increased tax bills.

Regression results suggest that LOOP or the ten-year tax abatement programs are effective in reducing the tax delinquency rate for properties in gentrifying neighborhoods (about 2.1 percentage points lower in aggregate delinquency rate and 1.5 percentage points lower in the new delinquency rate) relative to those in nongentrifying neighborhoods. Different from the homestead exemption, these exemption and abatement programs provide greater tax relief on average for properties in gentrifying neighborhoods. The regression results suggest that these programs reduce a larger amount of property tax — about $587 — for homeowners in gentrifying neighborhoods, relative to the property tax reduction in nongentrifying neighborhoods. Therefore, these programs are more effective in preventing tax delinquencies for homeowners in gentrifying neighborhoods. In addition, properties already enrolled in these tax relief programs are less likely to enter appeal-induced tax delinquencies because their property taxes are largely unchanged post-AVI, and the homeowners thus have no incentive to file appeals for property reassessments. These findings help explain why we do not observe higher rates of outmigration among elderly and low-score mortgage-holding homeowners, many of whom are more likely to be protected by these tax relief programs.

Although the DOR data do not distinguish LOOP from the property tax abatement program, we try to isolate the effects of LOOP. According to the AVI, properties that had received ten-year tax abatements are ineligible for LOOP, which was adopted in 2014. Those properties that did not benefit from any exemptions or abatements until after 2014 could serve as a better proxy of LOOP properties, since the exemption programs in which they enrolled are more likely to be LOOP (except those newly receiving ten-year abatements after 2014). The regression results on tax delinquencies using this proxy as the variable of interest are quite consistent, while the effect on tax amounts has a slightly smaller magnitude ($475, instead of the $587 in the original model). Thus, we are more confident that the conclusion we draw based on several tax relief programs should also hold for LOOP.

Overall, because the city has adopted various abatement and exemption programs, rising assessed values do not necessarily lead to tax delinquencies or displacement. The new addition of LOOP and the existing tax abatement programs help reduce the risk of tax delinquencies in gentrifying neighborhoods. The results suggest that well-targeted policies could significantly

mitigate the negative consequences of gentrification for homeowners. Based on our findings, it is reasonable to assume that, without these programs, the tax delinquency rate could be higher in gentrifying neighborhoods, although a comprehensive cost-benefit analysis is still needed before any conclusions can be drawn about the cost-effectiveness of these programs.

4.5 Robustness Check

We conduct additional analyses using different control groups, data aggregated at the neighborhood level instead of the property level, and other subsamples to discern how sensitive the results are to some of our analytical decisions. For the sake of brevity, we only discuss general patterns here. When we expand the control group to owner-occupied properties in all nongentrifying neighborhoods, instead of those in adjacent neighborhoods, gentrification's effects on tax delinquencies is still significant, but the magnitude becomes slightly smaller. Gentrification's effects on the mobility of elderly homeowners and low-score homeowners are quite consistent as well (Table 7). When the unit of analysis is census tract instead of properties, the results are quite consistent, both in terms of the sign and magnitude of the coefficients (Table 8).

We also test the relationship between changes in property tax assessments and tax delinquencies and various demographic variables often associated with gentrification to assess our gentrification measures. As Table 9 shows, the changes in property assessment values, tax amounts, and delinquency rates are highly correlated with the various demographic variables often associated with gentrification. The Spearman correlations suggest that changes in property assessments, tax amounts, and tax delinquencies from 2013 to 2014 are positively correlated with changes in home values, rents, percent share of whites, percent of college educated, and median incomes from 2000 to 2013, and they are negatively correlated with changes in poverty rates. While there is no clear consensus in the research on how to best operationalize gentrification for assessing a large number of neighborhoods, these relationships suggest that our findings should hold even if alternative measures of gentrification that rely on other neighborhood indicators are used.

5. Conclusion

The contention that gentrification displaces long-term homeowners by increasing their property taxes has received renewed attention from policymakers and scholars in recent years. Although the hypothesized causal relationship and mechanism between gentrification, property taxes, and displacement is straightforward, researchers have provided little empirical evidence of such a link. This study sheds light on this assumed causal sequence: whether and how gentrification leads to increased risk of tax delinquencies and displacement of vulnerable homeowners by increasing homeowners' property tax liability. This study also evaluates the effectiveness of several gentrification protection programs in mitigating the negative effects of gentrification.

Empirical results of this study confirm that gentrification increases the risk of delinquency on property tax payments under a tax system in which property assessments more accurately reflect the market price of the property. Gentrification, often accompanied by increased property values, leads to increased property taxes, causing more homeowners to become delinquent on their tax

payments on average. By freezing or lowering tax amounts, programs that provide greater relief for long-term residents lower the delinquency risk for homeowners.

Tax delinquencies, however, have been inflated to a certain degree by a large number of property assessment appeals, which have driven up delinquency figures, at least in the short term. There is no sign so far that homeowners in gentrifying neighborhoods are more likely to experience residential displacement, one of the worst consequences that gentrification could generate. Elderly homeowners as well as homeowners with lower credit scores are no more likely to move out of gentrifying neighborhoods. This is likely because of the well-targeted gentrification relief program reducing the likelihood of a larger-scale departure of less advantaged homeowners in these neighborhoods. Fewer sale transactions in the gentrifying neighborhoods as a result of increased property taxes may also help explain observed lower mobility rates. More studies, however, are still needed to track whether the higher tax delinquency rates in gentrifying neighborhoods will force more disadvantaged homeowners to move out in the long term. Nonetheless, while many homeowners manage to stay in their homes, they may sacrifice other basic needs to make property tax payments or pay tax payments later in order to stay in their home. Thus, in the longer term, they may still face the risk of having to sell their home or ending up in tax foreclosure, so well-targeted tax relief programs and efforts to increase take-up rates can help mitigate such negative outcomes.

Overall, this empirical study contributes to debates on gentrification and residential displacement by shedding new light on the effects of gentrification on homeowners and the effectiveness of several innovative gentrification relief programs. The results help researchers and policymakers understand the complicated relationship between gentrification, property taxes, and residential displacement when designing programs to prevent negative consequences from gentrification.

References

Clay, Phillip L. 1979. *Neighborhood Renewal*. Lexington, MA: Lexington Books.

Cunningham, Chris. 2014. Limiting Property Tax Assessments to Slow Gentrification. *Atlanta Federal Reserve Bank Real Estate Research blog.* Available at http://realestateresearch.frbatlanta.org/rer/2014/03/limiting-property-tax-assessments-to-slow-gentrification.html.

Ding, Lei, Jackelyn Hwang, and Eileen Divringi. 2016. "Gentrification and Residential Mobility in Philadelphia," *Regional Science and Urban Economics*, 61: 38–51.

Ellen, Ingrid Gould, and Katherine M. O'Regan. 2011. "How Low Income Neighborhoods Change: Entry, Exit, and Enhancement," *Regional Science and Urban Economics*, 41(2): 89–97.

Freeman, Lance. 2005. "Displacement or Succession? Residential Mobility in Gentrifying Neighborhoods," *Urban Affairs Review*, 40(4): 463–491.

Gillen, Kevin C., and John A. Westrum. 2014. "Fiscal Analysis of Philadelphia's Ten-Year Property Tax Abatement: A Case Study." Philadelphia, PA: Fels Institute of Government, University of Pennsylvania. Available at http://www.fels.upenn.edu/sites/www.fels.upenn.edu/files/abatement_fiscal_analysis.pdf.

Lee, Donghoon, and Wilbert van der Klaauw. 2010. "An Introduction to the FRBNY Consumer Credit Panel," Staff Reports 479, Federal Reserve Bank of New York. Available at http://www.newyorkfed.org/research/staff_reports/sr479.html.

McKinnish, Terra, Randall Walsh, and T. Kirk White. 2010. "Who Gentrifies Low-Income Neighborhoods?" *Journal of Urban Economics*, 67(2):180–193.

Martin, Isaac William and Kevin Beck. 2018. "Gentrification, Property Tax Limitation, and Displacement," *Urban Affairs Review,* 54(1):33–73.

Pew Charitable Trusts. November 2012. "The Actual Value Initiative: Overhauling Property Taxes in Philadelphia." Available at http://www.pewtrusts.org/~/media/legacy/uploadedfiles/wwwpewtrustsorg/reports/philadelphia_research_initiative/philadelphiapropertytaxespdf.pdf.

Pew Charitable Trusts. June 2013. "Delinquent Property Tax in Philadelphia." Available at http://www.pewtrusts.org/~/media/legacy/uploadedfiles/wwwpewtrustsorg/reports/philadelphia_research_initiative/philadelphiapropertytaxdelinquencyreportpdf.pdf.

Pew Charitable Trusts. September 2015. "The Actual Value Initiative: Philadelphia's Progress on Its property Tax Overhaul." Available at http://www.pewtrusts.org/~/media/assets/2015/09/philadelphia-avi-update-brief.pdf.

Schiller, Timothy. 2011. “What's it Worth? Property Taxes and Assessment Practices,” *Business Review* Q3, 21–30.

Shan, Hui. 2010. “Property Taxes and Elderly Mobility,” *Journal of Urban Economics*, 67: 194–205.

Vigdor, Jacob L. 2002. “Does Gentrification Harm the Poor?” *Brookings–Wharton Papers on Urban Affairs*, 133–173.

Figure 1. Change in Average Assessments, Property Taxes, and Tax Delinquency Rates of Owner-Occupied, Single-Family Homes in Philadelphia by Neighborhood Gentrification Status

Notes: Properties in gentrifying and nongentrifying neighborhoods are within a half-mile radius of the boundary of a gentrifying tract. Properties are single-family, owner-occupied homes with assessed values between $10,000 and $2,000,000. Sample size may vary slightly across different years.

Source: Authors' calculations using data from the City of Philadelphia and CoreLogic Solutions.

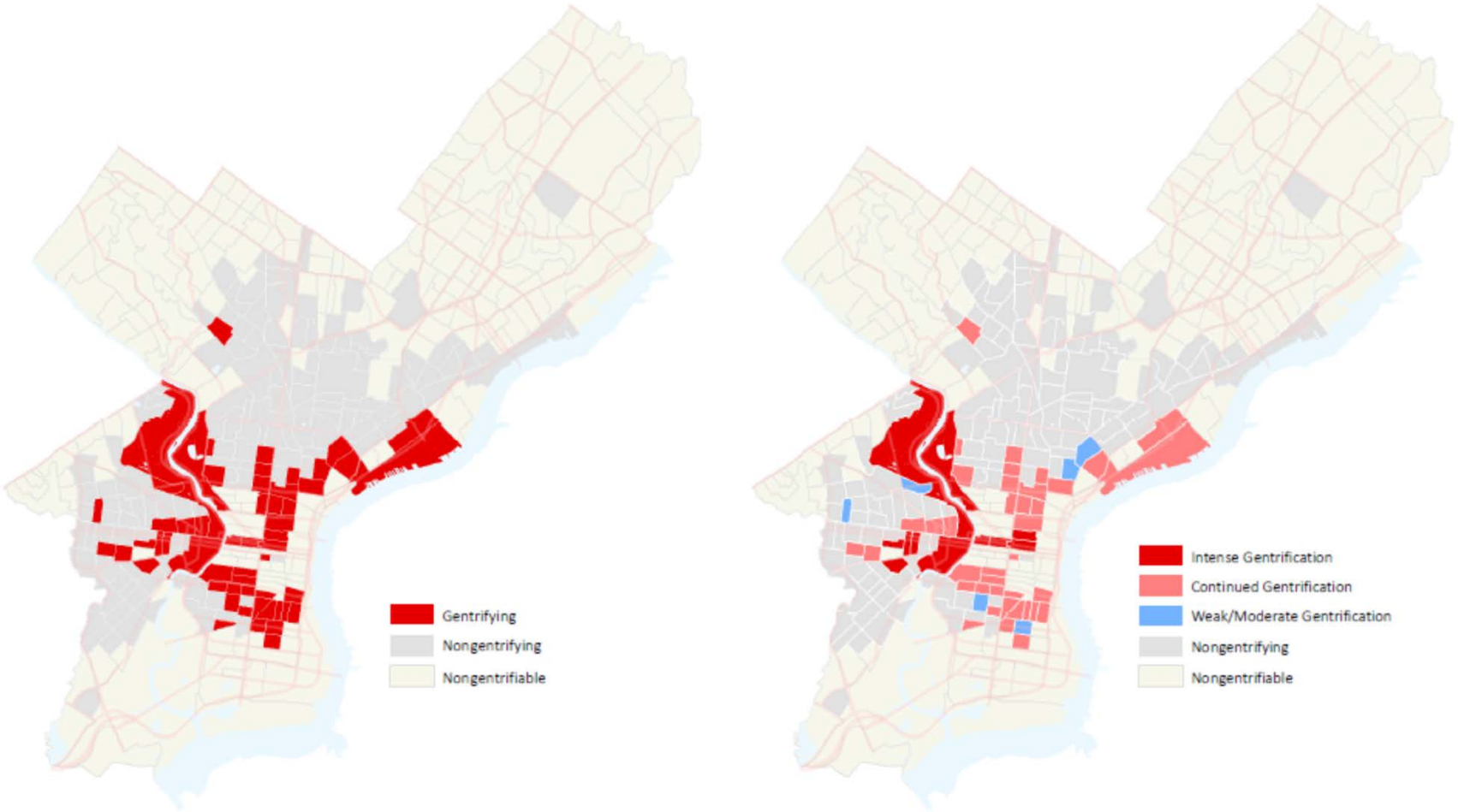

Figure 2. Gentrifying Neighborhoods in the City of Philadelphia (Left, Binary Measure; Right, Categorical Measure)
Sources: Authors' definition based on the 2000 census and 2009–2013 American Community Survey data; U.S. Census TIGER/Line Shapefiles.

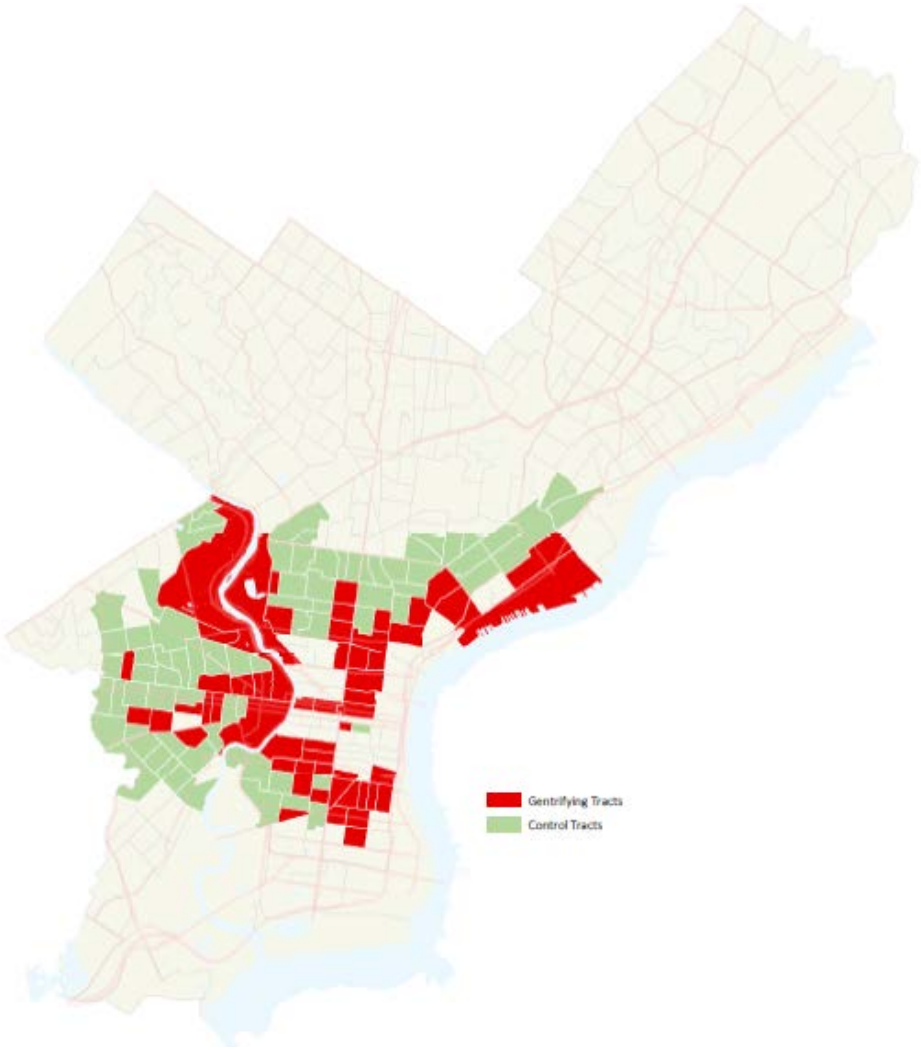

Figure 3. Gentrifying Neighborhoods in the City of Philadelphia and Adjacent Nongentrifying Neighborhoods (within a half-mile).
Note: One gentrifying tract ("*42101024000*") was dropped from the final analysis.
Sources: Authors' definition based on the 2000 census and 2009–2013 American Community Survey data; U.S. Census TIGER/Line Shapefiles.

Table 1. Description of Categorical Gentrification Measure

	Categories	Tracts (n)	Explanation
Nongentrifiable		184	Has median income above citywide median income in 2000
Nongentrifying		131	Has median income below the citywide median income in 2000 and does not meet criteria for gentrifying either pre-2000 or from 2000-–2013
Gentrifying		51	Has median income below the citywide median income in 2000; percent increase in rent or value above citywide median increase; increase in percent of college-educated residents above citywide median increase
	Weak/Moderate gentrification	25	Gentrifying but not in the top quartile for rent or value in 2009–2013, not gentrifying pre-2000
	Intense gentrification	6	Gentrifying and in the top quartile for rent or value in 2009–2013, not gentrifying pre-2000
	Continued gentrification	20	Pre-2000 gentrification and gentrifying 2000–2013

Sources: Authors' calculations using data from the 1980, 1990, and 2000 censuses and the 2009–2013 American Community Survey.

Table 2. Neighborhood Characteristics by Gentrification Category

	Gentrifying	Nongentrifying
Initial Neighborhood Condition, 2000		
Total population (n)	175,368	307,409
Non-Hispanic white (%)	35.5	13.6
Non-Hispanic black (%)	48.3	72.7
Renters (%)	50.6	44.2
College educated (%)	14.8	8.7
Below poverty (%)	32.8	36.8
Median household income (2000 $)	21,406	20,091
Median rent (2000 $)	400	384
Median value (2000 $)	57,488	38,861
Change in Neighborhood Indicators, 2000–2013		
Change in total population (%)	3.8	–3.7
Change in non-Hispanic white (%)	22.4	–13.7
Change in non-Hispanic black (%)	–28.2	–9.7
Average percent change in median household income (%)	23.5	–11.1
Average percent change in renters (%)	–3.4	–8.7
Average percent change in college educated (%)	17.5	1.5
Average percent change in poverty rate (%)	–3.8	4.1
Average percent change in median rent (%)	39.3	14.2
Average percent change in median home value (%)	171.7	69.1
Tracts (n)	50	72

Note: Gentrifying and nongentrifying neighborhoods are within a half-mile radius of the boundary of a gentrifying tract only; tracts that have an extremely small population or no population were excluded.
Sources: Authors' calculations using data from 2000 census and the 2009–2013 American Community Survey.

Table 3. Descriptive Statistics of the Study Sample

Variables	2013	2014	Absolute Change	Change (%)	Difference in Changes[a] (%)
Assessment ($)					
Gentrifying	37,765	153,706	115,941	307.0	101.9
Weak/moderate	27,856	116,051	88,196	316.6	111.5
Intense	77,997	298,205	220,208	282.3	77.2
Continued	50,956	204,463	153,507	301.3	96.1
Nongentrifying	21,587	65,871	44,284	205.1	
Property Tax ($)					
Gentrifying	938	1,476	538	57.4	57.9
Weak/moderate	812	1,170	358	44.1	44.6
Intense	2,405	3,451	1,047	43.5	44.1
Continued	1,034	1,828	794	76.8	77.4
Nongentrifying	647	644	–3	–0.5	
Tax delinquencies (%)					
Gentrifying	12.35	15.22	2.87		3.68
Weak/moderate	13.89	16.45	2.56		3.36
Intense	4.94	9.76	4.83		5.63
Continued	10.40	13.63	3.24		4.04
Nongentrifying	27.45	26.65	–0.81		
New tax delinquencies (%)					
Gentrifying	2.71	5.79	3.08		1.48
Weak/moderate	3.06	5.82	2.77		1.16
Intense	1.07	5.79	4.72		3.12
Continued	2.25	5.73	3.48		1.87
Nongentrifying	4.81	6.42	1.61		
Sales of existing properties (%)					
Gentrifying	4.44	3.73	–0.71		–0.99
Weak/moderate	3.39	3.29	–0.10		–0.38
Intense	3.97	3.11	–0.86		–1.14
Continued	6.20	4.50	–1.70		–1.98
Nongentrifying	1.58	1.86	0.28		
Outmigration of elderly homeowners (%)					
Gentrifying	4.27	2.30	–1.97		–3.94
Nongentrifying	1.88	3.85	1.97		
Outmigration of low-score homeowners (%)					
Gentrifying	6.23	5.71	–0.52		–2.31
Nongentrifying	4.12	5.91	1.79		
Homestead exemptions (%)					
Gentrifying	—	53.43			
Nongentrifying	—	54.62			
Other exemptions/abatements (%)					
Gentrifying	4.89	22.69	17.81		12.74
Nongentrifying	1.23	6.30	5.06		

[a] Difference in changes represents the difference between the change of the corresponding group and the nongentrifying tracts.

Note: The number of observations may vary for different variables.

Sources: Authors' calculations using data on property assessments and tax payment history from the Department of Revenue of the City of Philadelphia, CoreLogic Solutions data, and data from the FRBNY/Equifax Consumer Credit Panel.

Table 4. Summary of the Gentrification Effects on Tax Delinquency and Residential Mobility (Coefficients of the Interaction, *GENTRIFY∗AVI,* from Different Linear Probability Regressions)

	Coefficient	Standard Error
Tax delinquencies		
Gentrifying	0.042***	0.003
Categorical gentrification variables		
Weak/moderate	0.041***	0.003
Intense	0.054***	0.014
Continued	0.044***	0.004
New delinquencies		
Gentrifying	0.017***	0.002
Categorical gentrification variables		
Weak/moderate	0.015***	0.002
Intense	0.027***	0.007
Continued	0.021***	0.002
Outmigration of elderly homeowners (ages 55–84)		
Gentrifying	–0.033**	0.014
Categorical gentrification variables		
Weak/moderate	–0.015	0.018
Intense	–0.043†	0.025
Continued	–0.045**	0.018
Outmigration of low-score homeowners (<580)		
Gentrifying	–0.003	0.026
Categorical gentrification variables		
Weak/moderate	–0.031	0.031
Intense	–0.094	0.092
Continued	0.057	0.038
Sales of existing properties		
Gentrifying	–0.008***	0.001
Categorical gentrification variables		
Weak/moderate	–0.002†	0.001
Intense	–0.012*	0.005
Continued	–0.017***	0.002

Notes: ***, **, and * represent significance at the 0.001, 0.01, and 0.05 level respectively; † = p<0.10. Based on the 2012–2015 data; N = 340,200 and 357,684 property years for regressions on tax delinquency and property sales, respectively (properties that were sold during the study period were dropped from the tax delinquency regressions); N = 2,406 and 1,293 individual years for regressions on mobility of elderly homeowners and low-score homeowners, respectively.

Sources: Authors' calculations using data on property assessments and tax payment history from the Department of Revenue of the City of Philadelphia and CoreLogic Solutions, and data from the FRBNY/Equifax Consumer Credit Panel.

Table 5. Summary of Gentrification's Effects on Property Assessments and Tax Amounts (Coefficients of the Interaction, *GENTRIFY∗AVI*, from Different Linear Regressions)

	Coefficient	Standard Error
Assessed value ($)		
Gentrification dummy	71,657***	333.89
Categorical gentrification variables		
Weak/moderate	43,912***	375.43
Intense	175,924***	1,512.29
Continued	109,223***	454.72
Tax amount ($)		
Gentrification dummy	542***	4.38
Categorical gentrification variables		
Weak/moderate	362***	5.14
Intense	1,050***	20.71
Continued	798***	6.23

Notes: ***, **, and * represent significance at the 0.001, 0.01, and 0.05 level, respectively. Based on the 2013 and 2014 data only; N = 178,842 property years.
Sources: Authors' calculations using data on property assessments and tax payment history from the Department of Revenue of the City of Philadelphia and CoreLogic Solutions.

Table 6. Effectiveness of Tax Exemption/Abatement: Summary of Gentrification's Effects from Property-Level DID Regressions (Coefficients of the Three-Way Interaction, *GENTRIFY*EXEMPTION*AVI*, from Different Linear Regressions)

	Homestead Exemption		Other Exemption/Abatement		Likely LOOP Exemption	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Assessment ($)	–3,048***	669.51	13,698***	1,031.04	5,132***	1,093.40
Tax amount ($)	265***	8.68	–587***	13.45	-475***	14.52
Tax delinquencies	0.042***	0.006	–0.021*	0.009	-0.019*	0.009
New tax delinquencies	–0.001	0.003	–0.015***	0.005	-0.016***	0.005
Sales of existing properties	–0.011***	0.002	0.005	0.004	0.005	0.004

Notes: ***, **, and * represent significance at the 0.001, 0.01, and 0.05 level, respectively. N = 178,842 property years for regressions on assessment and tax amount; N = 340,200 and 357,684 property years for regressions on tax delinquency and property sales, respectively.

Sources: Authors' calculations using data on property assessments and tax payment history from the Department of Revenue of the City of Philadelphia and CoreLogic Solutions.

Table 7. Robustness Check: Summary of Gentrification's Effects on Tax Delinquencies Using All Nongentrifying Neighborhoods as Control

	Coefficient	Standard Error
Tax delinquencies		
Gentrifying	0.031***	0.003
Categorical gentrification variables		
Weak/moderate	0.030***	0.003
Intense	0.043***	0.013
Continued	0.033***	0.004
New delinquencies		
Gentrifying	0.015***	0.001
Categorical gentrification variables		
Weak/moderate	0.013***	0.002
Intense	0.025***	0.007
Continued	0.019***	0.002
Outmigration of elderly homeowners (ages 55–84)		
Gentrifying	–0.022†	0.012
Categorical gentrification variables		
Weak/moderate	–0.004	0.017
Intense	–0.033	0.024
Continued	–0.035**	0.017
Outmigration of low-score homeowners (<580)		
Gentrifying	–0.004	0.022
Categorical gentrification variables		
Weak/moderate	–0.034	0.027
Intense	–0.092	0.087
Continued	0.057†	0.034
Sales of existing properties		
Gentrifying	–0.006***	0.001
Categorical gentrification variables		
Weak/moderate	–0.001	0.001
Intense	–0.010†	0.005
Continued	–0.015***	0.001

Notes: ***, **, and * represent significance at the 0.001, 0.01, and 0.05 level respectively; † = p<0.10. N = 531,564 and 555,568 property years for regressions on tax delinquency and property sales. N = 3,619 and 2,263 individual years for regressions on mobility of elderly homeowners and low-score homeowners, respectively.
Sources: Authors' calculations using data on property assessments and tax payment history from the Department of Revenue of the City of Philadelphia and CoreLogic Solutions, and data from the FRBNY/Equifax Consumer Credit Panel.

Table 8. Robustness Check: Summary of Gentrification's Effects Using Tract-Level Aggregated Data

	Coefficient	Standard Error
Tax delinquencies		
Gentrifying	0.037***	0.005
Categorical gentrification variables		
Weak/moderate	0.030***	0.007
Intense	0.058***	0.012
Continued	0.040***	0.007
New delinquencies		
Gentrifying	0.016***	0.004
Categorical gentrification variables		
Weak/moderate	0.009*	0.005
Intense	0.030***	0.008
Continued	0.020***	0.005
Sales of existing properties		
Gentrifying	–0.008***	0.002
Categorical gentrification variables		
Weak/moderate	0.001	0.003
Intense	–0.011*	0.005
Continued	–0.017***	0.003

Notes: ***, **, and * represent significance at the 0.001, 0.01, and 0.05 level, respectively; † = p<0.10. N = 488 tract years for tract-level regressions.
Sources: Authors' calculations using data on property assessment and tax payment history from the Department of Revenue of the City of Philadelphia and CoreLogic Solutions.

Table 9. Spearman Correlations Between Changes in Tax Assessments, Property Taxes, Tax Delinquencies from 2013 to 2014, and Measures of Neighborhood Change from 2000 to 2013

	Change in Property Value (%)	Change in Median Rent (%)	Change in Percent White (%)	Change in College Educated (%)	Change in Median Household Income (%)	Change in Poverty Rate (%)
Change in property assessments, 2013–2014 (%)	0.569***	0.192*	0.224*	0.311***	0.102	–0.131
Change in property tax, 2013–2014 (%)	0.679***	0.234**	0.300***	0.400***	0.193*	–0.207*
Change in tax delinquency rate, 2013–2014 (%)	0.541***	0.243**	0.225*	0.440***	0.258**	–0.215**

Notes: ***, **, and * represent significance at the 0.001, 0.01, and 0.05 level, respectively. N = 122 tracts.
Sources: Authors' calculations using data on property assessment and tax payment history from the Department of Revenue of the City of Philadelphia and CoreLogic Solutions.