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# Preserving History or Property Values: Historic Preservation and Housing Prices in Washington, DC

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## Abstract

Neighborhood historic preservation has been highly controversial in Washington, DC, as proponents claim it preserves valuable architecture and critics claim in increases unaffordability. Using a dataset of all residential and condominium property sales in DC between 1992 and 2019, I find that the effect of historic designation on property values within historic districts is heterogeneous. While residential property values increase by 9%, condominium prices fall by 6.3% after designation. This paper also uniquely controls for endogeneity—which arises if in response to rising housing prices, neighborhood groups seek historic designation—by researching the party that nominated each historic district.



## Cover Page Footnote

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# 1 Introduction

Since 1950, the District of Columbia has designated 37 neighborhood historic districts with each recent decade bringing another 6 to 9 new designations. Now, 4.2% of all residential properties in DC reside in historic districts. The designation requires property owners to seek approval from the Historic Preservation Review Board (HPRB) before renovating or demolishing their properties. Since the HPRB often forces property owners to renovate in accordance to the historical character of the house, the DC government provides subsidies to low income families to pay for costly home repairs.

Neighborhood historic preservation has been highly controversial in Washington, DC. Proponents argue that historic architecture is a public good that needs protection from developers that do not internalize its external benefits. Increasing tourism, promoting the city's culture, and improving neighborhood cohesion are the main positive externalities claimed by preservation activists. They also fear that economically and politically powerful real estate developers threaten DC's architectural history and culture as demand for housing in the city booms.

Opponents of neighborhood historic preservation argue that restricting property-owners rights to redevelop their properties reduces the supply of housing, pushing housing costs upward and exacerbating a crisis of unaffordability. At the extreme, critics claim that preservation locks a city in its past, reducing its competitive advantage as new cities emerge in the United States and around the world (Glaeser, 2010). Critics also argue that preservation has regressive distributional effects by creating quaint, centrally located neighborhoods only available to wealthy property owners while pricing out low income groups.

Reflecting the public controversy over historic preservation, the policy has multiple offsetting effects on property values within historic districts. The loss from nearly eliminating the

option to redevelop restricts homeowners' ability to maximize the value of their properties, driving the value of properties inside historic districts down. On the other hand, the designation fixes the supply of housing at pre-designation levels, as well as preserves the positive externalities from historic properties—both effects push housing prices upward. Thus, the effect of historic designation on housing prices is theoretically ambiguous, and ultimately an empirical question.

This paper empirically tests the effect of historic preservation on property values and finds that the policy increases property values inside of designated districts: controlling for housing and neighborhood characteristics, historic designation increases property values inside of historic districts by 9%. The effect of historic designation differs by building type, however. While residential properties such as single-family homes and townhouses increase in value by 9%, condominium prices fall by 6.3% due to historic designation. The results also show that there are no statistically significant spillover effects of historic preservation; more specifically, properties within 250 feet of a historic district that are unaffected by policy's constraints on renovations but benefit from the positive externalities associated with neighborhood preservation saw no change in housing prices due to historic designation. The lack of spillover effects suggests that the externalities of historic preservation are small, at least to those living in the neighborhood. These results are robust to model specification, sample selection, and rigorous repeat-sales models. As policymakers continue to designate neighborhoods as historic districts in Washington, DC, they should take into account its unintended effects on housing prices.

## 2 Literature Review

Current literature produces mixed results of the impact of historic designation on housing prices, reflecting the theoretical ambiguity of the policy's net effects. Summarized in Table 1, the

existing literature covers a variety of US cities, indicating that the effects of historic preservation may differ considerably when interacted with specific local housing markets and government regulations. Previous literature tests the effect of historic designation on property values within historic districts (internal effect). Some studies test for spillover effects—that is the effect of historic designation on property values just outside of the historic district's boundary (external effect). My research supports the most robust finding in the literature: that historic designation increases property values within historic districts but has insignificant spillover effects.

Most studies seek to improve the methodology to mitigate the omitted variable bias and endogeneity that plague analyses on the effect of historic designation on property values. Traditional hedonic models—the standard for real estate economists—rely on deep datasets of housing characteristics (i.e. square footage, number of bedrooms) to isolate the determinants of housing prices. However, in determining the effect of historic designation, hedonic models cannot control for the difficult-to-quantify historic significance of a property, which is surely correlated with historic district designation.

Out of concern for omitted variable bias in hedonic models, more recent studies limit the sample to repeat sales to control for unobservable historical qualities of a property (Noonan, 2007; Noonan, 2011; Heintzelman & Altieri, 2013; Been, Ellen, Gedal, Glaeser, & McCabe, 2016; Oba & Noonan, 2017). Repeat sales models estimate the effect of historic designation on the change in property values sold twice—thus controlling for all the time-invariant characteristics of a property. Removing omitted variables comes at the cost of drastically reducing sample size. Repeat sales analyses can also introduce bias if properties that sell more frequently are not representative of the entire housing stock. Noonan (2007) and Been et al.

(2016) use both hedonic pricing models and repeat sales models for robustness, while Noonan (2011), Heintzelman and Altieri (2013), and Oba and Noonan (2017) rely solely on repeat sales.

Previous literature has employed a variety of approaches to control for endogeneity bias, which arises if rising housing prices lead neighborhood groups to seek historic designation. Noonan (2011) uses an instrumental variable approach with the interaction of historical quality and neighborhood demographics. Been et al. (2016) analyze the pre-designation pricing trends between historically designated districts and nearby neighborhoods and conclude that there is no evidence of diverging trends. Oba and Noonan (2017) conduct a deep dive into model specification and conclude that the model should control for neighborhood-specific price trends via an interaction term between a dummy variable for each neighborhood and a dummy variable for each sale year.

Although historic preservation policies differ considerably by city, my results that historic designation increases property values by 9% with insignificant spillover effects compares well to existing literature. Employing a repeat sales model with neighborhood trend fixed effects, Oba and Noonan (2017) find historic designation increases property values by 12.1% in Atlanta. Been et al. (2016) use a hedonic pricing model with neighborhood trend fixed effects to find historic designation increases property values by 16.7% in New York City. Heintzelman and Altieri (2013) find that historic designation decreases property values in Boston by 11.6 to 15.5% using a yearly fixed effects model of repeat sales. Noonan and Krupka (2011), Heintzelman and Altieri (2013), and Oba and Noonan (2017) all find insignificant spillover effects. Only Been et al. (2016) find significant positive spillover effects using repeat sales or neighborhood trends models.

This study makes three substantial contributions to the existing literature. First, I propose a novel way to control for endogeneity by limiting the sample to historic districts that were nominated by activist organizations. In contrast to neighborhood groups and local government offices, non-profit architectural and historical organizations are significantly less likely to seek out neighborhood historic designation in response to rising housing prices. Research into the nomination process can help identify which districts are most likely exogenous. Second, I find that the effect of historic designation is heterogenous across housing type; specifically, while single-family homes and townhouses see a 9% increase in value after historic designation, condominiums fall by 6.3% in value. Thus, heterogeneity in housing characteristics explains some of the variation in the effects of historic designation on property values. This result complements recent research that finds that neighborhood heterogeneity explains some of the variation in the effect of historic designation (Been et al., 2016). Third, this study is the first to analyze the effect of historic designation on property values in Washington, DC.

# 3 Neighborhood Historic Designation in Washington, DC

Georgetown was designated as the first historic district in Washington, DC in 1950. At the time, the process of historic designation only required approval from the Council of the District of Columbia (Gale, 1991). In 1966, the National Historic Preservation Act required federal review of all historic designations by the Joint Committee on Landmarks until a local review board was established (Gale, 1991). Petitions requesting neighborhood designation increased after the Historic Preservation Review Board (HPRB) was created in 1983, which is comprised of 9 board members appointed by the mayor. Board members must have a strong background in one of the following disciplines: “history, prehistoric and historic archaeology, architectural history, and architecture” (Historic Landmark and Historic District Protection Act,

1978). Between 1950 and 2018, 37 neighborhood historic districts were designated, and 6 historic districts were expanded.

Table 2 shows that 84 percent of historic districts are located in the Northwest, but the HPRB has designated neighborhoods in all of DC's quadrants except for the Southwest, which is the smallest. Nine percent of historic districts are in the Northeast, while 7 percent are located in the Southeast. One historic district, Capitol Hill Historic District, spans across both the Northeast and the Southeast. The timing of historic districts has been fairly constant between 1970 and 2018, with each decade bringing 6 to 9 new historic districts or expansions. The location of historic districts designations has generally moved eastward, as all 4 historic districts in the Northeast were designated between 2010 and 2018. Figure 1 shows that even within the Northwest, newer historic districts are located further east.

Of all residential properties in DC, 4.2% are located within historic districts. Historic districts vary significantly in size and in number of residential properties. The average historic district is 0.183 square miles and contains 1310 residential properties. Capitol Hill historic district is the largest spanning 1.167 square miles and containing 7,797 residential units. The smallest historic district is Emerald Street, which is 0.004 square miles and contains 173 residential units. Neighborhood historic districts span a range of neighborhood types, from Massachusetts Avenue historic district, comprised of the major road and only 5 residential properties, to Anacostia historic district located in residential southeast DC.

## 3.1 The Designation Process

Property owners and neighborhood advisory councils are not the only parties eligible to nominate a neighborhood for historic designation. Government agencies (such as the HPRB and the Historic Preservation Office) and preservation activists can also nominate neighborhoods for

designation and are often heavily involved. The nominating party is not required to inform property owners of its application for historic designation. After the city receives a nomination for historic district designation, all development projects in the neighborhood are stalled, and no building permits are issued.

After nomination, the HPRB holds a public hearing to determine if the neighborhood should be designated as a historic district. By law, the HPRB's decision only depends on the historical significance of the neighborhood, but the public has an opportunity to comment. HPRB member, Brain Crane, made this point clear to the residents of Bloomingdale who spoke out against historic designation during the public hearing:

> I want to reflect that the way this board is constituted under the laws and regulations of the District is that our authority is very specifically limited, that we are, as I understand it, to consider the nomination that is before us according to the criteria for historic properties in the District of Columbia and the National Register of Historic Places. And that's pretty much it...We have no expertise in and have no authority to weigh concerns about the economic impact. I hear those concerns, I understand them, but this board was not created to hear those concerns; there are other venues where those concerns can be addressed.
> Likewise, while public comment is very important and it's good to hear the various arguments that the public have for and against the nomination, we are not empowered to count votes (Crane, 26 July 2018).

Thus, endogeneity only arises through the nomination process, not at the hearing itself. Establishing that the nomination for historic district was exogenous is a sufficient criterion to determine that the ultimate designation was also exogenous to housing price trends. At the end of the hearing, the HPRB votes to designate the neighborhood, and if approved, the designation becomes effective immediately.

## 3.2 The Restrictions Designation Imposes

After a neighborhood is designated as a historic district, all external renovations to a property require approval from the Historic Preservation Office (HPO). "Minor and routine

work" such as repairing fences or roofing can be approved within one or two days. More extensive work, including replacing the doorknob on the front door, require a full HPO review. The full HPO review process, in short, begins with an application for renovations complete with photos and diagrams of the proposed renovations filed by the property owner to the HPO. HPO staff then personally visit the property and write an official report on the renovation. At this point, the application can be permitted, denied or forwarded to the monthly HPRB meeting. If a renovation requires a full meeting, the applicant presents before the HPRB and the HPO staff summarize their report. The HPRB votes on the proposal, and if approved, the applicant can go forward to pursue a traditional building permit (Historic Landmark and Historic District Protection Act, 1978).

# 4 Descriptive Statistics

To estimate the effect of historic designation on property values, I combine a series of administrative datasets available at Open Data DC, a government data-sharing website. The Computer Assisted Mass Appraisal – Residential (CAMAR) dataset contains every residential property in DC, as well as the price and sale date for residential property transactions between 1992 and 2019. Additionally, CAMAR contains all the property characteristics used in the hedonic price regressions. The Computer Assisted Mass Appraisal – Condominium (CAMAC) contains the same information for all condominium sales between 1992 and 2018. The CAMAC data omits a few of the property characteristics available in the CAMAR data, such as the number of kitchens and the condition of the property. I merge the CAMAR and the CAMAC datasets with the Address Points dataset, which specifies the specific latitude, longitude, and full address for every Square Suffix Lot (SSL) in DC. SSL values are based on the land associated with a property, which uniquely defines every residential property in the CAMAR dataset. The

condominiums in the CAMAC dataset do not contain a corresponding lot value. Thus, I assign each condominium the lot at the center of its corresponding square, where a square is equivalent to a single city block. Since historic districts do not split blocks, this assumption does not affect the variable of interest: which condominiums are inside of historic districts.

For the location of historic districts, I obtain the Historic Districts dataset also from Open Data DC. I limit the Historic District data to neighborhood historic districts, omitting designated parks and government areas. However, the Historic Districts dataset contain only the 2018 boundaries, which have been expanded 6 times in varying years. To account for these expansions, I review the Boundary Increase Registration Forms available at the National Register of Historic Places. In 3 cases these forms include a map of the boundary extension, which I digitize onto the Historic Districts dataset. The other three cases only provide a verbal description of the extension, which I trace manually onto the Historic Districts dataset. I further match the nomination date for each historic district from the DC Inventory of Historic Sites database.

Using GIS methods, I identify properties within historic districts. For all properties outside of historic districts, I calculate the distance to the nearest historic district. I also calculate the distance to the nearest metro station entrance for every property in the dataset, accounting for when the metro station was constructed. As expected, properties sold in historic districts tend to be older than those outside of historic districts. Properties in historic districts also tend to be condominiums or townhouses as opposed to single-family homes which are more prevalent outside of historic districts. Table 4 shows the descriptive statistics for the full sample of property transactions *within* historic districts between 1992 and 2019. Table 5 shows the

descriptive statistics for the full sample of property transactions *outside* historic districts between 1992 and 2019.

### 4.1 Repeat Sales

While the CAMAR and CAMAC datasets only contain the most recent sale, I retrieve older versions of the CAMAR and CAMAC datasets to identify properties that sold repeatedly. The benefit of the repeat sales model is that by measuring price changes in the same property, the model controls for all time-invariant locational and property-specific characteristics of a property. The cost is a significant drop in the number of observations. After dropping all properties that were remodeled between the two sales and cleaning the data for outliers, I identify 3,653 repeat sales across the two datasets. I follow Oba and Noonan's (2017) methodology, who's repeat sales model contains only 2,451 observations, to identify properties that sold before and after historic designation. Table 6 shows that 1.8% repeat sales (65 properties) experienced a change in historic designation between sales.

The repeat sales model also controls for changes in the sale year, season, and historic designation of buffer areas (descriptive statistics shown in table 6). The older CAMAC and CAMAR datasets contain all property sales between 1992 and July 2018. As a result, most of the repeat sales are recent sales in the second half of 2018 and early 2019. However, the new data was also updated from previous years to include an additional 200 to 250 repeat sales per year between 1999 and 2017. The seasonal and yearly changes variables are measured as -1 for the initial sale, 0 for no sale, and 1 for final sale.

## 5 Methodology

Historical designation limits redevelopment and eliminates new construction in a neighborhood. Designation influences property values in many ways. First, the lost option to

redevelop a property decreases the land value that the property sits on. Owners value the option to redevelop, especially if the property is well below the initial zoning cap, and willingness to pay for a property decreases when this option is taken away. Second, there are positive externalities from living in aesthetically appealing neighborhoods. If a neighborhood is initially very aesthetically beautiful, as historic districts likely are, eliminating the neighbors' ability to tear down their old stone houses to build large, modern condominiums preserves the distinctive character of the neighborhood. Third, since housing is a durable good, maintenance costs factor into a consumer's willingness to buy property. Designation strictly regulates properties' structural repairs, increasing maintenance costs, which push housing prices downward. Fourth, DC has a local grant program to subsidize low-income families in historic districts that seek to improve or repair exterior features of historic homes. This subsidy may increase housing values in historic districts, similarly to how a local tax break would increase property values in a neighborhood. Fifth, designation eliminates the option to build new housing, making the supply of housing in the district perfectly inelastic. An exogenous increase in demand for housing in a designated neighborhood cannot be offset by equilibrium effects, as developers cannot enter the market and increase the supply of housing. Theoretically, perfectly inelastic supply only increases the severity of price shocks and has an ambiguous effect on housing prices depending on the direction of demand shocks. However, in DC demand for housing has steadily increased, creating a strong presumption that inelastic supply of housing causes higher housing prices in designated neighborhoods.

Isolating the precise impact these effects have on housing prices is complicated because instead of being randomly selected, historic districts are meticulously chosen. Historic districts are designated precisely because of their unique historic character and significance. My hedonic

regression will be unable to pick up certain architectural characteristics that may make homes in historic districts more valuable regardless of official designation. This omitted variable is concerning, and I control for it in two ways. First, I use extensive longitudinal data with many observed home sales in historic districts *before* designation. By including a dummy variable that equals 1 if a home was sold in a neighborhood that ever became a historic district, I isolate the effect of the designation itself. I also conduct a repeat sales analysis that estimates the effect of historic designation on the change in price of the same property sold twice, thus automatically holding these time-invariant historic characteristics constant.

The historic district designation process may also be endogenous to housing price trends. If in response to rising housing prices, neighborhood organizations seek historic designation to ensure that developers cannot drastically change the character of their neighborhoods, the rising housing prices caused historic designation, not the other way around. Neighborhood organizations both actively nominate their neighborhoods for historic designation and likely lobby local government officials as well. Since the HPO is overseen by elected councilmembers, the local government's decision to nominate a neighborhood for historic designation reflects the views of their constituents. Thus, designation is largely endogenous to housing price trends.

I control for endogeneity by testing the effect of historic designation on housing prices for a subsample of historic districts nominated by activists. After reviewing applications to nominate neighborhoods as historic districts, I find that neighborhood groups authored only 7 of the 39 available nominations. Activist groups nominated 19 neighborhoods, government agencies nominated 13, and 2 designations did not provide nomination documentation. The activist groups are all nonprofit organizations that focus on architecture and history. The DC Preservation League nominated the most historic districts, closely followed by the Historic

Preservation Service of Colorado. Compared to neighborhood organizations and the DC local government, activists are significantly more likely to only consider the historic quality of a neighborhood in their nomination decisions. In fact, two historians affiliated with the George Washington University nominated Bloomingdale as a historic district in 2018. Activist-nominated historic districts are significantly more likely to be exogenous than government- or neighborhood-nominated historic districts are. As discussed in section 3.1, establishing that historic districts are exogenously nominated is sufficient to assume that the designation itself is also exogenous.

## 5.1 Hedonic Pricing Model

To determine the effect of historic designation on residential property values in DC, I estimate the following hedonic housing price model:

$$\ln P_{ijt} = \alpha + \beta X_i + \gamma CT_j + \delta I_{jt} + \tau HD_{it} + \varepsilon_{it} \quad (1)$$

Where the dependent variable is the natural log of the price of property i in census tract j in year t. $X_i$ is a vector of time-invariant property characteristics including the number of bedrooms, square footage, distance to nearest metro, etc. (full list in tables 4 and 5). $CT_j$ is a set of dummy variable fixed effects at the census tract level. $I_{jt}$ is a set of neighborhood specific time trends, with each census tract j interacted with each sale year t. $HD_{it}$ is a set of historic district variables. $\varepsilon_{it}$ is the mean zero random error term. The model controls for heteroskedasticity and clusters standard errors at the census tract level.

The $HD_{it}$ vector contains a variable $HD\ ever$ that equals 1 if a property sale is located within a historic district, before or after designation. By including $HD\ ever$, the model controls for the unobservable differences between homes within and outside of historic areas absent official designation. $HD\ post$ is a dummy variable that equals 1 if a property sale is located in a

historic distract after (post) designation. The coefficient on the $HD\ post$ variable estimates the effect of designation on property values. I interact the $HD\ post$ variable with each of the building types to determine if the effect of historic designation changes whether the property is a townhouse, single-family home, or condominium.

I also estimate spillover effects for homes that benefit from the positive externality of historic preservation, but do not face the policy's constraints on development. The $Buffer\ ever$ dummy variable in the $HD_{it}$ vector takes the value of 1 if a property sale is within 250 feet of a historic district, both before after designation. While $Buffer\ post$ is a dummy variable that equals 1 if a property is sold within 250 feet of a historic district after designation. I set the buffer distance to 250 feet because that is approximately the distance of one city block in Washington DC and is approximately equal to the buffer distances used by Been et al. (2016) and Oba and Noonan (2017).

## 5.2 Repeat Sales Model

To ensure robustness, I also estimate a series of repeat-sales models which control for all unobservable qualities in a property. Separating the effect of historic designation from a property's inherent historic qualities is essential for eliminating omitted variable bias in estimating the impact of historic designation on prices. The major downside of repeat sales models is that they drastically reduce sample size.

The repeat sales model takes the first difference of the simple hedonic pricing model between the two sale dates t and s (where t > s).

$$\ln P_{ijt} = \alpha + \beta X_i + \gamma_j CT_j + \delta I_t + \tau_t HD_{it} + \varepsilon_{it} \quad (2)$$

$$\ln P_{ijs} = \alpha + \beta X_i + \gamma_j CT_j + \delta I_t + \tau_s \delta HD_{is} + \varepsilon_{is} \quad (3)$$

$$\Delta \ln P_{it} = \delta \Delta I_t + \tau_t \Delta HD_{it} + \tau_s HD_{is} + \theta_{it} \quad (4)$$

Where $\theta_{it}$ is $\varepsilon_{it} - \varepsilon_{is}$. By first differencing equation 2 from equation 3, the repeat sales model in equation 4 removes all time-invariant variables. The dependent variable, $\Delta \ln P_{it}$, shows the difference in the log price of property i sold at times s and t. All property characteristics and time-invariant census tract fixed effects cancel out. The $\Delta I_t$ variable is the time elapsed between the initial sale and the final sale. Following Oba and Noonan (2017), I also include yearly and monthly dummy variables where the initial sale, no sale, and final sale take on the values of -1, 0, and 1, respectively. The $HD_{is}$ variable is a dummy variable if the property was in a historic district during the initial sale, and its coefficient $\tau_s$ allows properties in historic districts to appreciate at a different rate between the two sales. The $\Delta HD_{it}$ variable is a dummy variable that takes the value of 1 if a property was not located in a historic district during the initial sale but was located in a historic district during the final sale. Its coefficient $\tau_t$ shows the effect of historic district designation on home prices. Like the hedonic model in 5.1, I interact the $\Delta HD_{it}$ variable with each building type to allow the designation to affect building types differently.

# 6 Results

My preferred model—the fixed-effects, repeat-sales model that includes only activist-nominated historic districts—shows that historic designation increases property values by 9%. The effect is heterogenous across building types; in fact, condominiums fall in value after historic designation by 6.3%. There is no evidence of statistically significant spillover effects of historic designation. These results are robust to model specification and sample selection.

## 6.1 Hedonic Pricing Model

Table 7 shows the regression results for the hedonic pricing model. To identify the effect of historic designation, all models include an HD post variable to measure the effect of historic designation on property values. Following Been et at. (2016), all models control for

neighborhood trends, which interact each sale year with each census tract, controlling for a host of locational, time-variant omitted variables associated with housing prices. Activist-nominated HD models only include historic districts nominated by activists, controlling for endogeneity. Residential only models include additional property characteristics not available in the condominium data, such as the number of stories, kitchens, and the property's condition, which further control for possible omitted variables. Additionally, residential only models may better isolate the effect of historic designation if the relationship between other control variables depends on if a property is a condominium or a residential home. For example, the marginal effect of adding a bathroom to a condominium, which are typically smaller and have fewer bathrooms, is larger than the marginal effect for a bigger, single-family home. The results reflect these diminishing marginal returns on bathrooms as the coefficient falls 4 to 5 percentage points in residential only models.

In all models the HD post variable is positive and statistically significant at the 95% level, suggesting that historic designation increases property values between 10.7 and 14.5%. The effect of historic designation falls by 1.4 to 3.8% in the activist-nominated HD models, indicating that endogeneity biases the estimates upward but cannot explain the entire the increase in property values from historic district designation. Surprisingly, the HD ever variable is neither consistently positive nor statistically significant. However, the consistently positive sign on the HD ever variables in activist-nominated HD models, compared with their consistently negative signs for the all HD models, may suggest that properties in historic districts nominated by activists have more historical qualities than those in neighborhood- or government-nominated districts, leading to a price premium even before designation.

The interaction terms between the HD post variable and each building type show that the effect of historic designation affects condominium prices significantly less than other building types. The interaction terms should be interpreted as the marginal effect of the building type on the HD post variable. Thus, model 2 shows that condominium prices fell by 1.9% after historic designation, and this difference is statistically significant at the 99% level. None of the other interaction terms are significant in any of the models, suggesting that condominiums are uniquely affected by historic designation, while all other building types increase in value.

The coefficients on the buffer ever and buffer post variables are also neither consistently positive nor statistically significant across models. Historic designation appears to have insignificant spillover effects. This result is robust to interacting the Buffer post 250f variable with each building type. The coefficients of the control variables have the expected signs and are consistent with the literature. A 1% increase in the square footage of a property increases the property value between 2.37 and 4.6%. Been et al. (2016) find a similar effect, with a 1% increase in the square footage leading to a 3.7% increase in property value. Increasing the number of bedrooms or bathrooms or adding a hardwood floor all increase the value of the property. A property in excellent condition sells for 6% more than properties in good condition (the omitted category), and properties in poor condition sell for 35% less. All models explain over 83% of the variation in the log price of a property.

## 6.2 Repeat Sales Model

Table 8 shows the results of the repeat sales models, which better control for property-specific omitted variable bias. The coefficient on the $\Delta HD$ variable shows the marginal effect of historic designation, holding the historic quality of a property constant. Following Heintzelman and Altieri (2013), the fixed effects models controls for the $\Delta saledate$, $\Delta saleyear$ and census

tract fixed effects. The neighborhood trends models interact the $\Delta saledate$ variable with each census tract (Oba and Noonan, 2017). The neighborhood trends specification better controls for time-variant neighborhood characteristics at the cost of drastically reducing the degrees of freedom. Due to limited observations in the repeat sales dataset, I prefer the more parsimonious fixed effects models.

The coefficient on the $\Delta HD$ variable is positive in all four models, but only retains statistical significance in the first three. Across the repeat sales models, historic designation increases property values between 3.9 and 10.6%. As expected, the coefficients on the $\Delta HD$ variable are slightly lower in the repeat sales models than they are in the hedonic models, likely reflecting the omitted variable bias associated with a property's unquantifiable historic quality. Also, both the coefficient on the $\Delta HD$ variable and its statistical significance fall when limiting sample to historic districts nominated by activist groups, further supporting the conclusion that including neighborhood- and government-nominated historic districts overstates the effect of historic designation due to endogeneity. Model 2 best controls for both omitted variable bias (through the repeat sales model specification) and endogeneity associated with the nomination process (through limiting the sample to historic districts nominated by activist groups) while preserving degrees of freedom. Therefore, my best estimate is that historic designation increases property values by 9%.

This effect is not uniform across building type. The $\Delta HD * Condo$ interaction term is negative and statistically significant across all four models, suggesting that condominium prices fall between 6.3 and 9.7% from historic designation. Similar to the hedonic models, I also test interaction terms between the $\Delta HD$ variable and the other building types. I find highly insignificant effects for every other building type and remove the interaction terms from the

model to preserve degrees of freedom. The result that historic designation causes condominium prices to fall is robust across model specification and subsamples.

The repeat sales models also support the conclusion that historic designation has insignificant spillover effects. The coefficients on the $\Delta Buffer\ 250f$ variable for both model specifications are insignificant and change signs. Interaction terms between the $\Delta Buffer\ 250f$ variable and each building type are all insignificant and were removed from the model. The coefficient on the HD always variable shows that properties in historic districts appreciate faster than properties outside of historic districts, but the coefficient is only significant in the fixed effects model with all HDs.

## 6.3 Discussion

The findings in sections 6.1 and 6.2 offer a broad view of the many dimensions of historic district policy in DC. The immediate and most robust result is that historic designation increases housing prices by 9%, and that this effect is severely mitigated for condominiums. One possible explanation for the divergence in residential and condominium prices because of historic designation is that individuals' preferences to live in a historic neighborhood strongly correlate with their preferences to live in a historic house. Since condominiums tend to be newer and less historically significant than townhouses and single-family homes in historic districts,[1] individuals that buy condominiums may systematically derive less utility from historic architecture than those who buy townhouses or single-family homes. If individuals that prefer to live in a historic district also have strong preferences to own a historic home, then the value historic properties should increase more than all other properties after historic designation. Individuals that care little about historic value may simultaneously prefer to buy condominiums

[1] The median residential property is 28 years older than the median condominium.

and find the higher maintenance costs associated with historic districts outweigh the benefits of historic preservation. This analysis suggests that differences in individuals' preferences for historic architecture explain the divergence in residential and condominium property values after historic designation. One alternative mechanism is that condominiums simply require more maintenance than residential homes, making the added regulatory requirement costlier. Future theoretical and empirical research should explore the determinants of the heterogeneous effects of historic designation on residential property values.

A second surprising result is that there appear to be no statistically significant spillover effects of historic designation. It is very intuitive that properties right outside of historic districts gain from the positive externalities associated with preservation, but face none of the constraints on renovations, and thus should see property values increase. This null result is consistent with the literature and warrants further investigation. It could suggest that there are fewer externalities from living in historic districts than previously thought, and individuals care more about consuming historically significant property than living near it. Alternatively, the boundaries for historic districts may stretch beyond the area of historical significance; thus, the spillover areas are too far from the properties that provide the largest positive externalities.

Taken together, the results show that intentional sample selection is critical for determining the effect of historic designation. The repeat-sales models show smaller effects of historic designation than traditional hedonic models, likely suggesting the presence of omitted variables associated with time-invariant, property-specific historic characteristics. On the other hand, repeat sales models can introduce bias if properties that sell more frequently are not representative of the entire housing stock. The models that only include activist-nominated historic districts also show smaller effects for every model specification and subsample,

suggesting the presence of endogeneity in the full sample of historic districts. Future researchers should carefully choose which historic districts to include in the sample by paying close attention to the designation process and incentives of those nominating historic districts.

## 6.4 Caveats

There are two limitations to my analysis: (1) the effect of historic designation may be heterogenous across districts; and (2) the prevalence of spatial autocorrelation. Been et al. (2016) first identified that the effects of historic preservation are heterogenous and depend on a neighborhood's initial level of development and aesthetic value. Testing the possibility of heterogenous effects of historic preservation in Washington DC would be a worthy area of future research. The problem with incorporating heterogeneity into the current model is the unavailability of data. Been et al. (2016) quantify each neighborhood's initial level of development using FAR, which is the legal maximum size for each building in a neighborhood—clearly an imperfect measure of pre-designation level of development. This metric would not work for analyzing heterogeneity in Washington, DC, where residential zoning laws restrict height by the number of stories each property can have, not FAR. In conjunction with the city-wide building height limit, the maximum number of stories for a residential property has very little variation between neighborhoods and cannot be interpreted as the pre-designation level of neighborhood development. The second independent variable to test for heterogenous effects is the pre-designation aesthetic value of a neighborhood, an even more challenging variable to quantify. An in-depth survey of neighborhood aesthetic valuations is beyond the scope of this paper.

In real estate, the importance of location cannot be overstated. Spatial autocorrelation, the phenomenon that properties that are closer to each other are more alike and affect each other, can

bias the results of repeat sales and hedonic pricing models (Oba & Noonan 2017). My spatial controls, clustering standard errors at the census tract level and controlling for neighborhood trends, are unable to fully control for biases associated with spatial autocorrelation. A more robust model would include a spatial weights matrix, where a property's value depends on recent sales nearby as a function of distance to the initial property. However, a spatial weights matrix cannot account for differences in the time elapsed between nearby sales, which is why I prefer neighborhood-specific time trends.

# 7 Conclusion

This paper sheds new light on the local housing market effects of neighborhood historic districts in Washington DC. The main finding that historic district designation increases property values by 9% supports critics concerns that the policy increases the cost of housing, exacerbating a crisis of unaffordability. However, the effect of historic designation differs by building type. While residential properties such as single-family homes and townhouses increase in value by 9%, condominium prices fall by 6.3% due to historic designation. These findings are robust to sample selection to account for endogeneity and repeat sales that drastically reduce omitted variables. I cannot fully control for spatial autocorrelation, but I am comforted that the results are robust to standard errors clustered at the census tract level.

Admittedly, I do not offer a complete economic analysis of neighborhood historic preservation policy. Future research should quantify the positive externalities from neighborhood preservation for a more complete cost benefit policy analysis. Still, policymakers should take into consideration the upward pressure that neighborhood historic designation has on residential property values, which is not currently factored into the HPRB's decision making. As more

neighborhoods are nominated for historic preservation, my analysis underscores the importance of taking housing costs into account.

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*Figure 1: Washington DC Historic Districts*

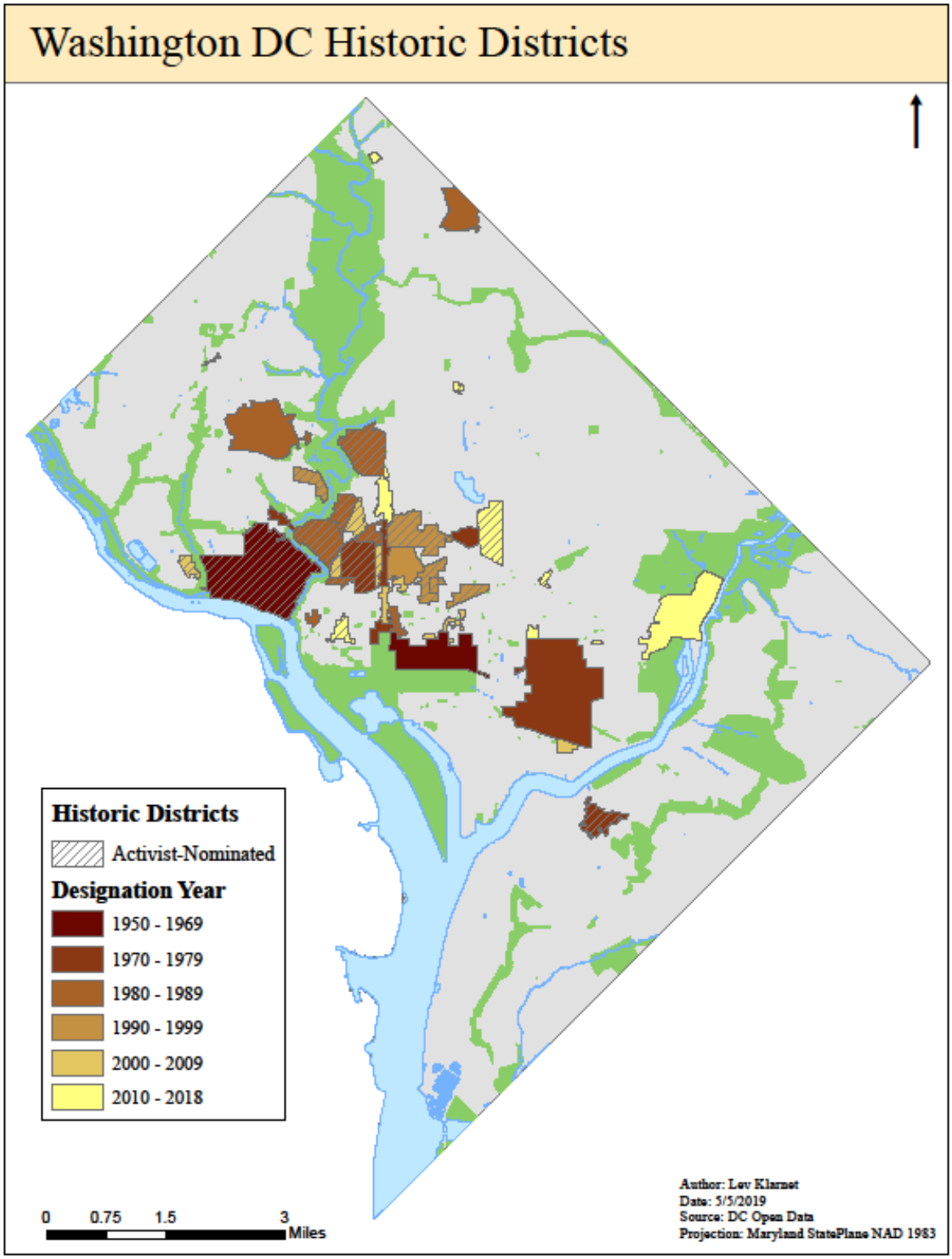

*Table 1: Literature Review*

| Study | Location | Model Type | Internal (% change) | External (% change) |
|---|---|---|---|---|
| Coffin (1989) | Chicago | Hedonic | +6 to +7 | — |
| Asabere et al. (1994) | Philadelphia | Hedonic | -24 | — |
| Clark and Herrin (1997) | Sacramento | Hedonic | +17 | -20 |
| Noonan (2007) | Chicago | Hedonic using Instruments | -37 | Insignificant |
| Heintzelman and Altieri (2013) | Boston | Repeat Sales | -11.6 to -15.5 | Insignificant |
| Been et al. (2016) | New York | Hedonic and Repeat Sales | +16.7 | +11.9 |
| Oba and Noonan (2017) | Atlanta | Repeat Sales | +12.1 | Insignificant |
| Klarnet (2019) | Washington DC | Hedonic and Repeat Sales | +9 | Insignificant |

Note: the selected relevant literature is limited to studies that analyze the effect of local historic districts on observed property sales in the United States. This excludes studies on historic landmarks or individual properties, federal historic designation, studies that rely on appraisal data or analyze non-US cities.

*Table 2: Historic Districts Descriptive Statistics*

| | Total Number of Districts | Percentage of Districts | By Time period and Designation | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1950-1960s | 1970s | 1980s | 1990s | 2000s | 2010-2018 |
| Northwest | 36 | 84 | 2 | 6 | 9 | 6 | 8 | 5 |
| Northeast | 4 | 9 | 0 | 0 | 0 | 0 | 0 | 4 |
| Southwest | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Southeast | 3 | 7 | 0 | 2 | 0 | 0 | 1 | 0 |
| Total | 43 | 100 | 2 | 8 | 9 | 6 | 9 | 9 |
| % of total | | | 5 | 19 | 21 | 14 | 21 | 21 |

Note: these statistics group all 37 neighborhood historic designations and 6 expansions in Washington DC between 1950 and 2018.

*Table 3: Historic Districts by Size and Parcels*

| | Mean | Sd | p10 | p25 | Median | p75 | p90 |
|---|---|---|---|---|---|---|---|
| Size HD (sq miles) | 0.183 | 0.257 | 0.013 | 0.045 | 0.085 | 0.199 | 0.487 |
| Number of parcels | 1310.759 | 1673.317 | 140 | 321 | 633 | 1653 | 3774 |

*Table 4: Descriptive Statistics – All Residential Sales within Historic Districts 1992 – 2019*

| | Mean | Sd | Median | Min | Max |
|---|---|---|---|---|---|
| Price | 630,104.70 | 418,753.10 | 525,000.00 | 9,000.00 | 3,300,000.00 |
| Number of bedrooms | 2.44 | 1.35 | 2 | 1 | 10 |
| Number of bathrooms | 1.85 | 0.93 | 2 | 1 | 9 |
| Number of half bathrooms | 0.42 | 0.54 | 0 | 0 | 5 |
| Square footage | 1,351.49 | 703.52 | 1,200.00 | 360.00 | 4,267.00 |
| Lot size | 1,077.60 | 1,108.46 | 782.00 | 11.00 | 11,600.00 |
| Age | 50.12 | 33.61 | 43 | 0 | 195 |
| Year built | 1930.78 | 41.03 | 1914 | 1765 | 2018 |
| Number of fireplaces | 0.67 | 0.91 | 0 | 0 | 7 |
| Hardwood floor | 0.46 | 0.50 | | | |
| Metro within 250 meters | 0.03 | 0.17 | | | |
| AC | 0.87 | 0.34 | | | |
| Building type | | | | | |
| Townhouse inside | 0.32 | 0.47 | | | |
| Townhouse corner | 0.08 | 0.27 | | | |
| Single-family home | 0.03 | 0.17 | | | |
| Multi-family home | 0.01 | 0.11 | | | |
| Semi-detached home | 0.03 | 0.17 | | | |
| Condo | 0.53 | 0.50 | | | |
| Heating type | | | | | |
| Forced air | 0.35 | 0.48 | | | |
| Hot water radiator | 0.22 | 0.42 | | | |
| Heat pump | 0.25 | 0.43 | | | |
| Warm cool | 0.16 | 0.37 | | | |
| Residential only | | | | | |
| Number of stories | 2.30 | 0.48 | 2 | 1 | 5 |
| Number of kitchens | 1.42 | 0.65 | 1 | 0 | 4 |
| Condition | | | | | |
| Excellent | 0.00 | 0.06 | | | |
| Average | 0.35 | 0.48 | | | |
| Good | 0.54 | 0.50 | | | |
| Fair | 0.01 | 0.09 | | | |
| Poor | 0.00 | 0.03 | | | |

Note: Median, min, and max not shown for dummy variables. The mean represents the portion of dummy variables equal to one. N = 22,007.

*Table 5: Descriptive Statistics – All Residential Sales outside Historic Districts 1992 – 2019*

| | Mean | Sd | Median | Min | Max |
|---|---|---|---|---|---|
| Price | 450,504.10 | 328,229.10 | 376,582.50 | 4,850.00 | 8,243,685.00 |
| Number of bedrooms | 2.76 | 1.23 | 3 | 1 | 10 |
| Number of bathrooms | 1.86 | 0.91 | 2 | 1 | 8 |
| Number of half bathrooms | 0.46 | 0.58 | 0 | 0 | 11 |
| Square footage | 1,371.43 | 636.88 | 1,260.00 | 359.00 | 4,272.00 |
| Lot size | 2,290.19 | 2,096.88 | 1,651.00 | 11.00 | 11,626.00 |
| Age | 42.34 | 24.52 | 45 | 0 | 118 |
| Year built | 1948.12 | 33.07 | 1940 | 1780 | 2018 |
| Number of fireplaces | 0.46 | 17.40 | 0 | 0 | 4068 |
| Hardwood floor | 0.63 | 0.48 | | | |
| Metro within 250 meters | 0.01 | 0.11 | | | |
| AC | 0.78 | 0.41 | | | |
| Building type | | | | | |
| Townhouse inside | 0.24 | 0.42 | | | |
| Townhouse corner | 0.07 | 0.26 | | | |
| Single-family home | 0.21 | 0.40 | | | |
| Multi-family home | 0.04 | 0.19 | | | |
| Semi-detached home | 0.11 | 0.31 | | | |
| Condo | 0.34 | 0.47 | | | |
| Heating type | | | | | |
| Forced air | 0.42 | 0.49 | | | |
| Hot water radiator | 0.25 | 0.43 | | | |
| Heat pump | 0.14 | 0.35 | | | |
| Warm cool | 0.18 | 0.38 | | | |
| Residential only | | | | | |
| Number of stories | 2.03 | 0.35 | 2 | 1 | 4 |
| Number of kitchens | 1.21 | 0.63 | 1 | 0 | 6 |
| Condition | | | | | |
| Excellent | 0.01 | 0.12 | | | |
| Average | 0.44 | 0.50 | | | |
| Good | 0.42 | 0.49 | | | |
| Fair | 0.01 | 0.09 | | | |
| Poor | 0.00 | 0.04 | | | |

Note: Median, min, and max not shown for dummy variables. The mean represents the portion of dummy variables equal to one. N = 66,636.

*Table 6: Descriptive Statistics – Repeat Sales 1992 – 2019*

| | Mean | Std. dev. | Min | Max | Median |
|---|---|---|---|---|---|
| Δprice (log) | 0.40 | 0.54 | -2.84 | 5.14 | 0.27 |
| Δsaledate (days) | 2,742.09 | 2,187.25 | 30 | 9,875 | 2,198 |
| HD always | 0.23 | 0.42 | | | |
| ΔHD | 0.02 | 0.14 | | | |
| Buffer 250feet always | 0.04 | 0.19 | | | |
| ΔBuffer 250f | 0.01 | 0.11 | | | |
| Δspring | -0.24 | 0.49 | | | |
| Δfall | 0.05 | 0.62 | | | |
| Δsummer | -0.08 | 0.68 | | | |
| Δsaleyear 1992 | -0.01 | 0.08 | | | |
| Δsaleyear 1993 | 0.00 | 0.07 | | | |
| Δsaleyear 1994 | -0.01 | 0.08 | | | |
| Δsaleyear 1995 | -0.01 | 0.08 | | | |
| Δsaleyear 1996 | 0.00 | 0.07 | | | |
| Δsaleyear 1997 | -0.01 | 0.08 | | | |
| Δsaleyear 1998 | -0.01 | 0.09 | | | |
| Δsaleyear 1999 | -0.01 | 0.13 | | | |
| Δsaleyear 2000 | -0.01 | 0.12 | | | |
| Δsaleyear 2001 | -0.02 | 0.15 | | | |
| Δsaleyear 2002 | -0.02 | 0.13 | | | |
| Δsaleyear 2003 | -0.02 | 0.15 | | | |
| Δsaleyear 2004 | -0.03 | 0.19 | | | |
| Δsaleyear 2005 | -0.05 | 0.23 | | | |
| Δsaleyear 2006 | -0.04 | 0.21 | | | |
| Δsaleyear 2007 | -0.05 | 0.22 | | | |
| Δsaleyear 2008 | -0.03 | 0.19 | | | |
| Δsaleyear 2009 | -0.04 | 0.19 | | | |
| Δsaleyear 2010 | -0.04 | 0.21 | | | |
| Δsaleyear 2011 | -0.04 | 0.20 | | | |
| Δsaleyear 2012 | -0.06 | 0.23 | | | |
| Δsaleyear 2013 | -0.07 | 0.27 | | | |
| Δsaleyear 2014 | -0.07 | 0.26 | | | |
| Δsaleyear 2015 | -0.07 | 0.25 | | | |
| Δsaleyear 2016 | -0.06 | 0.23 | | | |
| Δsaleyear 2017 | -0.10 | 0.31 | | | |
| Δsaleyear 2018 | 0.60 | 0.65 | | | |
| Δsaleyear 2019 | 0.21 | 0.41 | | | |

Note: Median, min, and max not shown for dummy variables. The mean represents the portion of dummy variables equal to one. N = 3,653.

*Table 7: Hedonic Model Results of Sale Price (log) on Historic Designation and Buffer Zones*

| | Full Sample | | Residential Only | |
|---|---|---|---|---|
| | (1) All HDs | (2) Activist-Nominated HDs | (3) All HDs | (4) Activist-Nominated HDs |
| HD ever | -0.010 | 0.011 | -0.018 | 0.042 |
| | (0.041) | (0.028) | (0.029) | (0.032) |
| HD post | 0.122*** | 0.108*** | 0.145*** | 0.107** |
| | (0.044) | (0.028) | (0.040) | (0.042) |
| HD post * Condo | -0.115*** | -0.127*** | | |
| | (0.032) | (0.007) | | |
| HD post * Single family home | -0.008 | -0.069* | 0.015 | -0.008 |
| | (0.046) | (0.022) | (0.030) | (0.028) |
| HD post * Multi family home | 0.094 | 0.123 | 0.043 | 0.053 |
| | (0.115) | (0.276) | (0.037) | (0.034) |
| HD post * Semi-detached home | -0.009 | -0.006 | -0.007 | 0.010 |
| | (0.030) | (0.015) | (0.025) | (0.023) |
| HD post * Townhouse end | 0.003 | 0.003 | 0.011 | 0.011 |
| | (0.011) | (0.010) | (0.009) | (0.009) |
| Buffer ever 250f | 0.48* | 0.039** | 0.011 | 0.011 |
| | (0.025) | (0.017) | (0.026) | (0.034) |
| Buffer post 250f | -0.031 | -0.026 | 0.024 | 0.032 |
| | (0.035) | (0.020) | (0.032) | (0.041) |
| Square footage (log) | 0.460*** | 0.458*** | 0.237*** | 0.239*** |
| | (0.027) | (0.031) | (0.014) | (0.014) |
| Room | -0.008* | -0.008* | -0.002 | 0.002 |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Bedroom | 0.008*** | 0.010*** | 0.013*** | 0.013*** |
| | (0.004) | (0.002) | (0.003) | (0.003) |
| Bathroom | 0.100*** | 0.100*** | 0.0.60*** | 0.059*** |
| | (0.005) | (0.002) | (0.004) | (0.004) |
| Half bathroom | 0.065*** | 0.065*** | 0.043*** | 0.042*** |
| | (0.04) | (0.002) | (0.003) | (0.003) |
| Land area (log) | -0.058*** | -0.051*** | 0.108*** | 0.106*** |
| | (0.016) | (0.003) | (0.007) | (0.007) |
| Fireplace | 0.0001** | 0.0001** | 0.040*** | 0.042*** |
| | (0.000) | (0.000) | (0.002) | (0.002) |
| Age | -0.006*** | -0.006*** | -0.0007 | 0.001 |
| | (0.001) | (0.000) | (0.001) | (0.001) |
| Age squared | 0.00005*** | 0.00005*** | 0.00004*** | -0.00004*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Condo | -0.047 | 0.029 | | |
| | (0.123) | (0.117) | | |
| Single-family home | 0.112 | 0.110 | -0.012 | -0.011 |
| | (0.111) | (0.116) | (0.048) | (0.047) |
| Multi-family home | -0.291** | -0.290** | -0.198*** | -0.185*** |
| | (0.117) | (0.117) | (0.060) | (0.061) |
| Semi-detached home | 0.051 | 0.045 | -0.046 | -0.046 |
| | (0.111) | (0.117) | (0.050) | (0.047) |

(Table 7 continues onto the next page)

*Table 7: (Continued)*

| | Full Sample | | Residential Only | |
|---|---|---|---|---|
| | (1) All HDs | (2) Activist-Nominated HDs | (3) All HDs | (4) Activist-Nominated HDs |
| Townhouse end | 0.030 | 0.024 | -0.038 | -0.037 |
| | (0.115) | (0.117) | (0.012) | (0.050) |
| Hardwood floor | 0.105*** | 0.102*** | 0.056*** | 0.055*** |
| | (0.006) | (0.009) | (0.012) | (0.012) |
| Metro close | 0.006 | 0.006 | 0.011 | 0.010 |
| | (0.026) | (0.010) | (0.024) | (0.031) |
| stories | | | 0.018** | 0.017** |
| | | | (0.007) | (0.007) |
| kitchens | | | -0.006 | -0.008* |
| | | | (0.005) | (0.005) |
| Condition: Average | | | -0.261*** | -0.261*** |
| | | | (0.008) | (0.008) |
| Condition: Excellent | | | 0.060** | 0.060** |
| | | | (0.029) | (0.029) |
| Condition: Fair | | | -0.273*** | -0.266*** |
| | | | (0.090) | (0.100) |
| Condition: Default | | | -0.135*** | -0.136*** |
| | | | (0.007) | (0.007) |
| Condition: Poor | | | -0.353*** | -0.370*** |
| | | | (0.090) | (0.094) |
| Constant | 8.880*** | 8.945*** | 10.394*** | 10.378*** |
| | (0.203) | (0.126) | (0.127) | (0.133) |
| Number of Observations | 88,741 | 82,001 | 54,433 | 51,947 |
| Adj R squared | 0.830 | 0.830 | 0.888 | 0.888 |
| RMSE | 0.304 | 0.305 | 0.262 | 0.261 |
| AIC | 39983.238 | 38492.972 | 8500.756 | 7780.464 |

Note: upper values are the coefficients, t-statistics shown in parentheses. Neighborhood trends models include 171 census tract dummies interacted with each sale year. All models use robust standard errors clustered at the census tract level. * p<0.1, ** p<0.05, *** p<0.01

*Table 8: Repeat Sales Regression of Change in Sale Price (log) on Historic Designation and Buffer Zones*

| | Fixed Effects | | Neighborhood Trends | |
|---|---|---|---|---|
| | (1) All HDs | (2) Activist-Nominated HDs | (3) All HDs | (4) Activist-Nominated HDs |
| HD always | 0.058* | 0.042 | 0.037 | 0.114 |
| | (0.032) | (0.019) | (0.142) | (0.203) |
| ΔHD | 0.106** | 0.090* | 0.056* | 0.039 |
| | (0.052) | (0.049) | (0.031) | (0.031) |
| ΔHD * Condo | -0.185** | -0.153** | -0.142** | -0.136* |
| | (0.080) | (0.064) | (0.063) | (0.076) |
| Buffer 250feet always | -0.087*** | -0.082** | 0.005 | -0.009 |
| | (0.032) | (0.035) | (0.032) | (0.053) |
| ΔBuffer 250feet | 0.019 | -.040 | 0.001 | -0.017 |
| | (0.078) | (0.066) | (0.055) | (0.053) |
| Δsaledate | 0.0002*** | 0.0002*** | 0.0002*** | 0.0002*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Δspring | -0.016 | -0.016 | -0.003 | -0.004 |
| | (0.013) | (0.013) | (0.000) | (0.000) |
| Δfall | -0.020* | -0.020* | -0.010 | -0.011 |
| | (0.011) | (0.011) | (0.013) | (0.010) |
| Δsummer | -0.007 | -0.001 | 0.008 | 0.007 |
| | (0.010) | (0.010) | (0.009) | (0.009) |
| Constant | 0.335*** | 0.335*** | 0.053 | 0.072 |
| | (0.043) | (0.043) | (0.055) | (0.056) |
| Number of Observations | 3,653 | 3,568 | 3,653 | 3,568 |
| Adj R squared | 0.424 | 0.421 | 0.551 | 0.550 |
| RMSE | 0.314 | 0.298 | 0.314 | 0.298 |
| AIC | 2467.342 | 2435.996 | 1186.386 | 1158.413 |

Note: upper values are the coefficients, t-statistics shown in parentheses. Fixed effects models include census tract fixed effects. Neighborhood trends models include 171 census tract dummies interacted with Δsaledate. All models include change in year dummies and use robust standard errors clustered at the census tract level.
* p<0.1, ** p<0.05, *** p<0.01