Accessory Dwelling Units' Contagion Effects:
New Spatial Evidence from Los Angeles

Xiangxin Liu, University of Connecticut

Jeffrey P. Cohen*, University of Connecticut

Chinmoy Ghosh, University of Connecticut

Ran Lu-Andrews, California Lutheran University

September 2024

Abstract:

We utilize several innovative approaches to investigate how adding Accessory Dwelling Units (ADUs) to single family houses impacts the property values of both the subject property and its surrounding properties. First, we use a repeat-sales dataset and construction permit data for the City of Los Angeles, to confirm that ADU additions are associated with lower future selling prices of the nearby properties. Second, a major contribution of our study is our use of a spatial Durbin hedonic model to provide evidence of heterogeneous spatial feedback effects of ADUs, by exploring the direct, indirect, and total house price effects of ADU proximity. Some of these indirect effects are significantly positive (in the range of 2 to 4 percent) and some others are significantly negative (approximately -2 percent) for contiguous properties with the spatial Durbin hedonic model. When some house prices change from their proximity to an ADU, those changes feed back to the subject property prices, which subsequently impact nearby property prices again. These spatial feedback effects are negative in some ZIP Code groups and positive for others, in the City of Los Angeles. The negative externalities associated with ADUs (e.g. traffic, higher density, and aesthetics) are concentrated in areas with higher property prices. Positive feedback effects dominate in ZIP Codes where the neighborhood effects from higher house values nearby dominate the negative effects. Overall, we find evidence that ADUs can have both positive and negative influences on their contiguous neighbors, depending on neighborhood characteristics.

JEL Code: R

Keywords: Accessory Dwelling Units; spatial Durbin model; house prices

*Corresponding Author: 2100 Hillside Road Unit 1041-RE, Storrs, CT 06269 USA.

+1-860-486-1277. Jeffrey.Cohen@uconn.edu

Accessory Dwelling Units' Contagion Effects: New Spatial Evidence from Los Angeles

I. Introduction

Accessory dwelling units (ADUs) have been encouraged by policymakers and academics as a potential source of relief for housing shortages in major U.S. cities, such as Los Angeles. However, in some cases, neighborhood residents have expressed concerns that the increase in the number of ADUs near their homes could devalue their own property through increased congestion and access to community resources (Dear, 1992; Pendall, 1999). Though ADUs have been found to increase the value of the subject property (Bruekner and Thomaz, 2024), it is unclear whether and to what extent the presence of an ADU impacts its neighboring properties. We aim to address this ambiguity. On the one hand, the potential for additional cash flows through rentals could augment the value of the subject property and consequently its neighboring properties through increases in value through comparison of neighboring properties (Brown and Watkins, 2012) and spatial autocorrelation (Basu and Thibodeau, 1998). On the other hand, an increase in residential density could generate negative spillover effects at the local level (Davidoff, Pavlov, and Somerville, 2022; Tanrisever, 2023), and an increase in housing supply could shift residential property prices downward (Olsen, 1987).

Our study addresses the potential for both positive and negative contagion effects using spatial analysis. Past works that examine the contagion effects of ADUs (Davidoff, Pavlov, and Somerville, 2022; Tanrisever 2023) find negative spillover effects associated with population density. Davidoff, Pavlov, and Somerville (2022) find that laneway homes (a similar type of ADU in Canada that is a separate structure) lower property sale prices for nearby homes. Similar to our research, Tanrisever (2023) examines ADU contagion effects in Los Angeles and finds negative spillovers that are largely concentrated in lower- to middle-income neighborhoods. In contrast, we account for potential feedback effects in housing prices using spatial modeling. Namely, when an ADU is associated with a higher price of neighboring properties, these price increases can further increase the price of a subject property, which in turn further increases the price of the nearby properties, etc.

Using data on repeat sales from the Los Angeles County Assessor's Office and ADU permit data from the City of Los Angeles website[1] we analyze the impacts of ADU additions on the values of the subject single-family homes in the City of Los Angeles and their nearby residential properties, using a spatial Durbin hedonic model[2]. Los Angeles from 2017 to 2021 is a prime location and timespan for examining the relationships between ADUs and property prices for the following reasons: 1). The City of Los Angeles is characterized by extensive variation in both income and property prices: for example, according to the 2021 census, the household median income for each ZIP Code in LA can vary from $22,291 (ZIP Code 90013, Wholesale District) to $200,625 (ZIP Code 90077, Bel Air). Kim et al (2023) find that the ADU development in the city of Los Angeles shows a high level of diversity in terms of the locations and the neighborhoods where the ADUs are built. 2). The addition of ADUs has grown over time in the city of Los Angeles: in our sample, approximately 300 permits were issued in 2017,

[1] All the ADU permits are within the city limit of Los Angeles in this study. As we examine home prices of nearby properties, some of the neighboring properties may be located outside the city of Los Angeles, but within the County of Los Angeles. Thus, we use the repeat sales data from the county assessor's office.
[2] The spatial Durbin hedonic model is described further in the methodology section, as well as LeSage and Pace (2009).

compared to almost 900 in 2021. 3). The surge in ADU permits coincides with the state's legislative easing of potential ADU construction barriers[3].

First, we establish that the addition of an ADU in the city of Los Angeles increases the sale price of the subject property by about 8.25% through a subject analysis of cross-sectional sales. In other words, a property with an ADU will sell for about 8.25% more than an otherwise similar property without an ADU, which is comparable to the findings of Bruekner and Thomaz (2024), who examine assessed values after sale and find an increase of approximately 9% for properties with ADUs. Our subject property analysis supplements our spatial analysis and forms a point of comparison for estimation of ADU direct effects. We define ADU direct effects as the impact that ADUs have on the subject property in our spatial models.

Next, we examine the contagion effect of ADUs on properties within a 0.25-mile radius. This contagion analysis forms a baseline point of comparison for our estimation of ADU indirect effects. We define ADU indirect effects as the impact of ADUs on neighboring properties in our spatial models. Using a repeat sales model, we find that the addition of an ADU near a property without an ADU within a 0.25-mile radius decreases the difference in selling price between the two most recent property sales by 2.25%. In other words, while properties increase in price for more recent sales, the price gap between sales shortens with the presence of nearby ADUs. This negative contagion effect scales with the number of ADUs nearby as well: each additional ADU that is added in a 0.25-mile radius between sales decreases the selling price difference by 0.72%

[3] Since 2016, the State of California has passed a series of legislations aimed to facilitate the construction of ADUs by easing certain restrictive zoning and land use regulations. See Assembly Bill (AB) 2299 and State Bill (SB) 1069 for examples.

on average. Our findings are consistent with those of Tanrisever (2023), which finds a negative impact of ADU density on home sale prices.

Moreover, we hypothesize that the positive ADU effects (such as increases in property prices associated with the increase in price of a neighbor's addition of an ADU) should be the strongest for adjacent neighbors. In contrast, negative effects (such as disutility from disamenity and congestion) should be more pronounced for properties further than adjacent. In addition, we leverage the passing of CA assembly bill 881, which eases restrictions on adding junior ADUs (JADUs) to single-family homes. we hypothesize that positive contagion effects will be most prominent for properties in ZIP codes with the highest and lowest average property sale prices and land values in the year 2020, directly following the enactment of these changes to ADU restrictions[4]. To directly test these hypotheses, we examine the effects of ADUs on contiguous properties using a spatial Durbin hedonic model. This spatial Durbin hedonic model enables us to separate the direct (for the subject property) and indirect (for the neighboring property) effects of the ADUs.

We examine how the average sale price and land value in the area influences whether the positive or negative contagion effects are more pronounced. We partition the sample into years and ZIP Code sale price quintiles and examine the direct and indirect effects of ADUs. The direct effects, or the effect of one's own ADU on the sale price of the subject property, are largely positive, with magnitudes ranging from 14 to 33% of the sale price; We attribute the higher estimates to the feedback effects resulting from spatially adjacent property sales. Indirect effects are a measure of feedback effects of adjacent ADUs on property sale prices (LeSage and

[4] For further details on hypothesis development, see the Data and Methodology section.

Pace, 2009). In other words, the positive feedback effects tend to amplify sale prices of a subject property by approximately 2 to 4 percent. But while there exist some year-quintiles with positive indirect effects, there are some with negative indirect effects. Negative indirect effects primarily occur in the second highest quintile for both sale price and land value, while positive ones tend to occur in the second lowest and highest of these quintiles. Overall, ADU contagion effects are not solely negative in all cases, in contrast to some of the findings in recent literature, such as Tanrisever (2023).

Our study contributes to the existing real estate literature along two dimensions. First, our results further and deepen the understanding of how ADUs are related to home prices by showing a wide range of heterogeneity in the contagion effects on nearby homes based on various home and/or demographic characteristics, such as the average sale price of single-family homes in the neighborhood.

Second, our empirical approach is enhanced through our use of a spatial Durbin model[5] to capture and measure the contagion effects of ADUs on the neighboring properties by identifying contiguous neighbors. The spatial modeling enables us to examine the feedback effects of ADUs and their neighboring properties in addition to the direct impacts of ADUs on their subject property values. Our results strengthen and broaden the understanding of how ADUs affect home prices by showing a wide range of heterogeneity in the contagion effects on nearby homes based on various home and/or demographic characteristics, such as the average sale price of single-family homes in the neighborhood. By focusing entirely on the impacts of an ADU on the subject property, without considering heterogeneity in the contagion effects, the

[5] See Osland (2010) for an application of spatial econometrics to hedonic house price modeling.

magnitudes of the relationship can be distorted. To our knowledge, we are the first to investigate the contagion effects of ADUs on neighboring homes by using spatial econometrics methods.

The remainder of the paper is structured as follows. Section II provides the background and the environment of ADUs in Los Angeles and reviews related literature. Section III describes the data used in our analyses and details our methodology and specifications. Section IV presents the results of the subject, contagion, and contiguity analyses. Section V concludes.

II. Background and Literature Review

Background of ADUs

In the United States, the rise in prices of single-family homes in the early 2020s has significantly impacted the affordability of housing, especially for first-time homebuyers. To illustrate, the Freddie Mac House Price Index has increased by at least 4% per year for every year since 2012 (Statista Research Department, 2023). In 2021 alone, the index increased by more than 18%, a surge that has not since been offset as of 2023. These increases have impacted first-time homebuyers the most: first-time homebuyers were 22% of all home purchases in 2022, compared to 34% in 2021 (Forbes, 2023). The availability of single-family homes in the United States during this time is also cause for concern. The first two quarters of 2023 were characterized by record-low homeowner vacancy rates of about 0.7% (Riddle, 2023). Moreover, historically high rents for the first half of 2023 (median approximately $1,450) have limited options for first-time homebuyers as well. In the wake of these trends, potential stopgaps and solutions are worth investigating and evaluating more than ever before.

ADUs have been proposed as an approach to increase the supply of housing, as ADUs seldom require the acquisition of new parcels of land (Coppage, 2017). An accessory dwelling unit (ADU) is accessory to a primary residence and has complete independent living facilities for one or more persons[6](ADU Handbook, updated July 2022, CAHCD).

The issue of housing availability is especially salient for California: in 2020, the California Department of Housing and Community Development (HCD) estimated that Southern California will need at least 1,300,000 new homes over the course of the 2020s. California has had two significant legislative pushes to encourage ADU additions. In 2017, SB 1069 and AB 2299 limit local authorities in how they can inhibit the approval of ADUs. In 2020, AB 3182, AB 68, AB 881, and SB 13 further limit the capability of local governments to limit and regulate ADUs and ease barriers to the construction of junior ADUS, or JADUs[7]. The HCD limits junior ADUs to under 500 square feet; they also require an exterior entrance and independent kitchen facilities. More specifically, they allow qualifying single-family homes to construct both an ADU and a JADU. Scheutz and Devens (2024) document the efforts of California policymakers to encourage ADUs via subsidies and legislation, as well as the costs associated with building and renting ADUs. Overall, it is evident that the state of California is a key proponent of eliminating barriers to ADU development.

The California Department of Housing and Community Development further describes the importance and definition of ADUs. They define ADUs as having "complete independent living facilities for one or more persons". With respect to types, they classify them into detached

[6] ADUs in California have a few variations: a). Detached: the unit is separated from the primary structure. b). Attached: the unit is attached to the primary structure. c). converted existing space: space on the lot of the primary residence that is converted into an independent living unit. d). JADU: a specific type of conversion of existing space that is contained entirely within an existing or proposed single-family residence.
[7] Our methodology for identifying ADU permits includes junior ADUs

(not connected to existing structures), attached (connected to existing structures), and converted existing space (little to no additional construction necessary). They propose that the primary advantages to ADUs include their relatively low costs due to decreased infrastructure needs and building materials. Lastly, they note that housing demand attributable to access to job opportunities and schools outpace the housing supply in these areas: ADUs can provide a benefit to those seeking housing in these areas as well as those who construct ADUs to bolster their finances with additional rental income.

In contrast, the rise in prevalence of ADUs have resulted in pushback from residents, particularly concerning issues of increased residential density (Brinig and Garnett, 2013). Residents in these neighborhoods voice concerns about decreases in property values, parking availability, and access to community resources due to increased residential density. Other potential concerns include negative impact on neighborhood aesthetics or power grid capacity. Consequently, policymakers impose regulations and requirements regarding the constitution and construction of ADUs (Mukhija, Cuff, and Serrano 2014). For example, local governments could restrict ADU construction in accordance with zoning density maximums or increase permit application fees.

California's state legislature is keenly aware and interested in ADUs as a crucial component in housing affordability. Government Code section 65852.150 declares ADUs to be a "valuable form of housing in California" and that "California faces a severe housing crisis". This same section specifies that "an accessory dwelling unit ordinance" at the local level should not "unreasonably restrict the ability of homeowners to create accessory dwelling units" in authorized zones. The state legislature provides for ministerial approval (not requiring discretionary action) of ADUs as well, which reduces subjectivity in the granting of ADU permits.

Literature Review

The literature on ADUs has grown significantly in recent years. The growing body of literature examines many different aspects of ADUs. Many research efforts examine the importance of ADUs due to demographic changes in social and population characteristics [see, e.g. Liebig et al. (2006), Antoninetti (2008), and Infranca (2014; 2016)]. Numerous studies focus on the importance of ADUs as a form of infill development to increase neighborhood density [see, e.g. Wegmann and Nemirow (2011), and Infranca (2014)] and to increase rental housing supply [see, e.g. Chapple et al. (2011), Brown and Palmeri (2014), and Ramsey-Musolf (2018)]. A number of papers center around the appraisal valuation approach to incorporate ADUs [see, e.g., Brown and Watkins (2012), and Adomatis (2021)]

There has been a tremendous effort in examining how ADUs impact the subject property values and its surrounding neighborhoods. Our research study falls into this category. Davidoff, Pavlov, and Somerville (2022) examine the contagion effect of ADUs in Vancouver, Canada. They identify the effects of a city-wide rezoning in Vancouver in 2009 to allow single family homes to construct a laneway home (a type of ADU) behind their property, and they find that the impact of laneway homes on the sale price of subject properties is only present for more recently constructed properties. Furthermore, they find that the construction of these laneway homes results in lower property sale prices for nearby homes, with the most pronounced effects for properties with high values. In sum, their findings highlight the differential impact of increased housing density among varying types of neighborhoods.

Our findings differ from the previous literature in several ways. We find that the negative effects of ADUs on properties in extremely close radii (.0625 miles) are most pronounced in neighborhoods with the lowest median incomes, while the addition of ADUs near properties within a larger radius (.25 miles) lower property prices across all neighborhoods. Thus, we find evidence that ADUs could result in lowering of housing prices due to a higher supply of housing, rather than due to increased congestion or limitation of neighbors' private space, as evidenced by the increased impact ADUs have on homes beyond their direct neighbors. The differences in our findings could be attributed to variation in housing price increases and population density between Los Angeles and Vancouver. The US Census Bureau estimates the population of Los Angeles to be around 3,819,538 over 470 square miles in 2022, while the 2021 population of Vancouver Metropolitan Area is estimated to be 662,248 over 44.47 square miles (Statistics Canada). Overall, the city of Vancouver is far more densely populated than the city of Los Angeles. Furthermore, the housing price index for Los Angeles has increased by 46.5% from 2019 to 2023 (Standard and Poor's), while the housing price index increase over the same time period for Vancouver is 20.5% (Statistics Canada).

Another paper examining how ADUs affect neighboring property values in Los Angeles is Tanrisever (2023). Using ADU-eligible parcel concentration as an instrumental variable, they find a negative contagion effect: a 0.48 percentage point increase in ADU concentration leads to a 3.6% average decrease in nearby property prices, using a radius of 150 meters. Further, the author finds these effects to persist when examining radii of up to 350 meters. This effect is greater in lower- and middle-income neighborhoods, in contrast to the findings of Davidoff, Pavlov, and Somerville (2022). In contrast, we find differential effects dependent on average property prices and land values which can be attributed to the impact of contiguous properties.

Other papers focus on the impact that ADUs have on one's own property. Brueckner and Thomaz (2024) examine both the locational determinants and impact on assessed values of ADUs in Los Angeles. They find that ADUs are less common with newer houses, larger parcels of land, and properties located near the airport and beaches. In contrast, ADUs are more commonly found near commercial districts, educational establishments, and light-rail stations. Finally, ADUs are less prevalent in high-income areas and the effect of an ADU on assessed value is approximately 8% after accounting for California's Proposition 13 rules for property assessment, which caps the annual growth in assessed value of a property to 2%. In our research, we find a sale price premium of approximately 8.25% on average for properties with ADUs in Los Angeles, which aligns closely with their findings[8].

Gnagey, Gnagey, and Yencha (2022) examine property sale data from Ogden, Utah prior to and post the passage of legislation allowing rental of ADUs and find no significant impact for ADU-attached properties. Their findings support the idea that ADU rentals exist to ease the housing supply shortage without causing property prices to plummet. Our findings in Los Angeles show the differential impacts, both positive and negative, that ADUs can have on nearby properties.

Regarding the efficacy of policy intervention, Kim *et al.* (2023) investigate the impact of ADU-promoting city ordinances in Los Angeles and find that these ordinances increase the diversity of types and locations of ADUs. Also, the characteristics of homes where ADUs are built vary further following the passage of these ordinances. Overall, their findings speak for the efficacy of these policy changes in promoting ADU development. Our work builds on this

[8] Assessed values in California tend to be slow to adjust to market changes, because of limitations on the extent to which they can rise until a property sells. For further details, see Levy (1979).

analysis by looking at how ADUs affect property sale prices for the subject and neighboring properties, a prime concern for both proponents and detractors of ADU development.

Regarding methodology, our study follows in the footsteps of others who use spatial econometric analysis to evaluate the effects properties and locations have on others, otherwise known as spatial neighborhood effects. Spatial modeling helps to measure the feedback effects that property prices can have on nearby property prices. Pace et al. (1998a) detail the advantages that spatiotemporal modeling confers on hedonic pricing models for single family homes in Fairfax County, Virginia. They find that the spatiotemporal model resulted in reduced median absolute error by a factor of nearly 40% compared to indicator-based models. Pace et al. (1998b) find spatial inference helps account for same sign residuals due to geographic proximity that would lead to bias in OLS estimates. Sun, Tu, and Yu (2005) develop a model that divides spatial effects into building and neighborhood effects; they find this method to be more suitable for hedonic models for condominium sale prices in Singapore. Mussa, Nwaogu, and Pozo (2017) use the spatial Durbin model to document an increase in rents and house prices associated with nearby immigration flows at the U.S. metropolitan statistical area (MSA) level from 2002 to 2012. Finally, Feng, Yasar, and Cohen (2023) find evidence of a crowding-in of manufacturing firms following a rise in house prices in Chinese cities; they use the spatial Durbin model to detail significant feedback and spillover effects across cities.

In our research, we use the spatial Durbin model to enhance and deepen our understanding of the impacts of ADUs on property value. We examine how contiguous properties with ADUs can affect one's own property sale price through our use of spatial modeling. Through our analysis, we aim to isolate where ADUs have greater positive or negative impacts on their neighboring properties. We intend to show that, beyond the average contagion effects on nearby properties shown in previous studies, there is consistent evidence of heterogeneous variations of the contagion effects from ADUs on home values based on different neighborhood characteristics and property attributes.

III. Data and Methodology

Data

We obtained data on repeat sales in the city of Los Angeles from the Los Angeles County Assessor's Office. To limit the effect of outliers, we exclude sales of under $50,000 and over $10,000,000, as well as sales of properties with less than 1,500 square feet and over 500,000 square feet in lot size. Our analysis spans 2017 to 2021 for the most recent sale, to coincide with the time span of our data on ADU permits. For the contiguity analysis, we incorporate shapefile data for the county of Los Angeles from the Los Angeles County Planning website.

Data on ADU permits is obtained from the Los Angeles City website. We exclude ADU permit observations with a valuation of zero. We also note the type of ADU permit (detached, attached, or conversion). We illustrate the number of ADU permits issued per year in Figure 1, which shows that the permits issued per year greatly increase in the years 2017 and 2020[9], which aligns with the major legislative changes in California that loosen the restrictions on ADU constructions and/or conversions.

[Insert Figure 1 here]

We present summary statistics for our sample in Table 1, which includes all sales from 2017 to 2021 in the City of Los Angeles. Our total number of recorded sales is 45,147. These

[9] It is possible that ADU permits increased substantially prior to 2020, but not as much after 2020, due to the Coronavirus pandemic. This is a question worthy of further study and analysis.

sales are used in our cross-sectional analysis of sale prices of properties with ADUs. For the entire sample, the mean sale price is around $1.5 million, with a minimum of $50,500 and a maximum of $9,950,000; these limits are a result of our truncation of the sample to reduce the potential influence of outliers. Approximately 0.277% of our sample of property sales had an ADU at time of sale.

[Insert Table 1 here]

Table 2 presents summary statistics for sales of properties in 2017 to 2021 that have a recorded prior sale, numbering 32,707. Here, the mean sale price is slightly higher, at approximately $1.61 million; the mean prior sale price is significantly lower, as many of them occur outside the sample period of 2017 to 2021. The percentage of sales with an ADU at sale is higher than that of the full sample, at around 0.031%. These sales form the basis for our repeat sales analysis. Unlike the most recent sales in our sample, prior sales are not restricted with respect to when they take place. However, our repeat sales analyses include the holding period in months as an explanatory variable and temporal fixed effects to account for variation based on time. We also use logged and polynomial holding period variables instead with no substantial change in results to account for potential nonlinearity in these variables, which are not tabulated in the empirical findings section. The contiguity analysis makes use of the full dataset of sales, rather than only the repeat sales.

[Insert Table 2 here]

First, we model the direct effects of ADUs on one's own property (subject analysis) and the indirect effects of ADUs on other nearby properties (contagion analysis). Next, we examine the potential feedback effects with a spatial Durbin model via direct, indirect, and total effects. These results are presented in the subsequent subsections.

Subject Analysis

We examine the relationship between an ADU on the price of the subject property in the cross-section using Model (1):

$$log(Price)_i = \alpha + \beta_1\ ADUatSale_i + \gamma\ \boldsymbol{X_i} + ZipFE + TimeFE + \varepsilon_i \quad (1)$$

The primary dependent variable is the log of sale price. Here, *ADUatSale* is an indicator variable which has a value 1 if the subject property has an ADU permit at the time of sale, or 0 otherwise. $\boldsymbol{X_i}$ is a vector of control variables, including property age, lot size, interior square footage, the number of bedrooms, and the number of bathrooms. We control for ZIP Code fixed effects (ZipFE) and time fixed effects (TimeFE). These TimeFE include sale year or sale month-year fixed effects, depending on the specification. The use of cross-sectional specifications for the subject analysis rather than repeat sales is driven by the relatively low number of sales of properties with ADUs in comparison with the larger population of sales in Los Angeles; in our sample 125 sales (approximately 0.28% of the full sample) had an ADU at time of sale.

Contagion Analysis

We next evaluate the impact of the addition of ADUs on neighboring property sale prices, or the contagion effect. Here, we use a repeat sales model to address idiosyncratic differences between properties, as in Model (2), with two distinct independent measures of the effect of neighboring ADUs: whether any ADUs were added within a particular radius between the first and second sale and the change in number of ADUs in that radius between the two sales.

$$log(PriceDifference)_i = \alpha + \beta_1\ ADUinRadius_i + \beta_2\ HoldingPeriod_i + ZipFE + TimeFE + \varepsilon_i \quad (2)$$

The primary dependent variable for our repeat sales analysis is the price difference between the two most recent sales. The variable *ADUinRadius* is either an indicator for whether at least one ADU was added in the vicinity between sales or the change in the number of ADUs in the vicinity between sales. We control the holding period and include ZIP Code fixed effects and temporal fixed effects (either sale year or sale month-year), as well as whether the property had an ADU added between sales.

Contiguity Analysis

Lastly, we conduct a contiguity analysis of the feedback effects using a spatial Durbin model. The contagion analysis in the prior subsection looks only at whether ADUs were present and how many were present for specific levels of radius. We hypothesize that the greater influence on sale prices should be from the closer houses, or adjacent houses. These adjacent houses should form the strongest basis for valuation when determining sale prices. The negative contagion effects from the disamenity dominate for expanded radii, but it is less clear how closer properties are affected, as the increased price of a property through the addition of an ADU can greatly influence one's close neighbors through a spatial lag effect (and the associated feedback from the indirect effects). Thus, it is unclear how the installation of an ADU by one's immediate, contiguous neighbors influences one's own property. On the one hand, contiguous neighbors can devalue properties by negative externalities such as obstructing views and limiting parking. On the other hand, increased neighboring home values (due to the development of ADUs) can also increase one's own sale price when the time comes to sell, due to home value appraisal processes. In this way, ADUs could be associated with positive contagion. These contiguity effects could also vary depending on the average home value and other neighborhood qualities.

Using a spatial Durbin model, we address the ambiguity of whether and under what circumstances ADUs can positively or negatively impact neighboring property values. The key advantage spatial models offer is that they are divided into “direct”, “indirect”, and “total” effects for each covariate. A direct effect is how a change in a regressor affects the subject location. For our models, the presence of an ADU, as well as other hedonic variables will affect the sale price; the spatial direct effects are analogous to our subject analysis. As a point of comparison to our contagion analysis, the spatial indirect effects (the coefficients for the covariates left-multiplied by contiguity matrix **W**) measure the impact of contiguous properties on the subject properties: in our models, we examine the how the presence of ADUs and variation in other hedonic variables in neighboring properties affect the subject property. Lastly, the total effect is a combination of the direct and indirect effects, which is defined for each variable individually. Through this decomposition, we can isolate whether positive or negative contagions dominate across various neighborhoods in Los Angeles.

The spatial Durbin model (SDM) is specified in Model (3) as follows:

$$y = \alpha l_n + \rho W y + X\beta + WX\delta + \varepsilon \tag{3}$$

$$y = (I_n - \rho W)^{-1}(\alpha l_n + X\beta + WX\delta) + (I_n - \rho W)^{-1}\varepsilon$$

$$\varepsilon \sim (0, \sigma^2 I_n)$$

where I_n is an n by n identity matrix, l_n is an n by 1 column of 1’s, **W** is the contiguity weights matrix described below, and **W**y is the spatial lag term. The SDM model enables a rich set of interactions between y, X, and the disturbances, ε.

Elhorst (2014) describes how the direct and indirect effects are derived, for the kth independent variable, as follows:

$$\left[\frac{\partial E(y)}{\partial X_{1k}}\cdots\frac{\partial E(y)}{\partial X_{nk}}\right]=\begin{bmatrix}\frac{\partial E(y_1)}{\partial x_{1k}}\cdots\frac{\partial E(y_1)}{\partial x_{nk}}\\ \vdots \quad \ddots \quad \vdots\\ \frac{\partial E(y_n)}{\partial x_{1k}}\cdots\frac{\partial E(y_n)}{\partial x_{nk}}\end{bmatrix}=(I_n-\rho W)^{-1}\begin{bmatrix}\beta_k & w_{12}\delta_k & \cdots & w_{1n}\delta_k\\ w_{21}\delta_k & \beta_k & \cdots & w_{2n}\delta_k\\ \vdots & \vdots & \ddots & \vdots\\ w_{n1}\delta_k & w_{n2}\delta_k & \cdots & \beta_k\end{bmatrix} \qquad (4)$$

The indirect effects are given by the diagonal elements, while the spillover effects are given by the off-diagonal elements in (4). Elhorst (2014) notes that the direct and indirect effects "may be different due to the endogenous interaction effects **W**y. These interaction effects cause feedback effects…" (page 31). Also, Elhorst (2010b) describes how the intuition for the direct and indirect effects is not obvious, and they depend on the structure of **W** and the number of observations in the analysis.

Our SDM specification[10] essentially combines a spatial autoregressive model (SAR) and a spatial error model (SEM). This type of SDM specification is similar to the one used in Feng, Yasar, and Cohen (2023), who estimate their SDM model year by year. The SAR incorporates the dependent variable with a spatial lag (in this case, the sale price of adjacent properties), and the SEM has a spatial autoregressive term for the regression error term, shown below the main specification equation. **W** is a spatial weight matrix, defined with zeroes along the diagonal and a number between 0 and 1 designating the number of contiguous properties to the subject property. Using shapefiles for the county of Los Angeles, we construct matrices **W** outlining which properties are directly adjacent to each other within each of the ZIP Codes within Los Angeles. The nonzero elements are standardized such that each row adds to 1.

In the context of our analysis, the key advantage of spatial models is their ability to account for both the impact of changes in one property on adjacent property sale prices (the

[10] With the SDM, Elhorst (2010b) demonstrates the derivation of the direct, indirect, and total marginal effects, for each regressor in the model. Mussa, Mwaogu, and Pozo (2017) demonstrate there are very informative relationships contained in the regressors of the model.

indirect effect) and the impact on its own price (the direct effect), including feedback from the impact on the adjacent property. For example, the addition of an ADU to Property X influences the sale price of adjacent Property Y, which in turn affects the sale price of property X through property Y's impact on its own contiguous properties. While this analogy may be somewhat of a simplification of the mechanism of the direct and indirect effects, as implied by Elhorst (2010b, 2014), it is nevertheless a straightforward example of the most elementary form of potential feedback effects for hedonic house prices modeling with the presence of ADUs.

We hypothesize that the changes in California Government Code SS 65852.22 brought about by CA assembly bill 881 in December 2019 comprises a quasi-natural experiment for ADU construction and ADU contagion effects. California Government Code SS 65852.22 defines junior accessory dwelling units, or JADUs. Though JADUs were initially defined in 2016, CA assembly bill 881 limited local government ability to restrict JADUs and was put into effect starting January 1st, 2020. One key difference between JADUs and previously defined ADUs is the size maximums: junior ADUs cannot exceed 500 square feet. The CAHCD notes that JADUs "are typically bedrooms in a single-family home" that have been converted. They also note that JADUs offer homeowners "flexibility and an insurance policy in homes in case additional income or housing is required." While this additional flexibility is appealing to any homeowner, those with larger and more expensive properties are more likely to have spare bedrooms to convert. Furthermore, JADUs are comparatively less intrusive compared to other ADUs; they "present no additional stress on utility services or infrastructure", according to the CAHCD. Thus, negative contagion effects associated with ADUs should be mitigated starting in 2020, especially for areas with larger houses. Consequently, we hypothesize the positive contagion effects for ADUs are stronger for properties in areas where JADUs are most appealing. Areas with high average sale price and land value tend to have properties with more bedrooms, which can be more easily converted to JADUs. In addition, areas with low average sale price and land value may not be able to add an ADU as easily, but weakened restrictions on JADUs could encourage these properties with more limited space to add a JADU instead, for instance, over an attached garage. Since JADUs are not as intrusive as other ADUs, the negative contagion effects associated with JADUs are likely weaker, allowing the positive ADU contagion effects to dominate.

To test these hypotheses, we follow the approach of Feng, Yasar, and Cohen (2023), who demonstrate the estimation of causal effects in a SDM model. This is accomplished here by running separate SDM regressions with a sample of all houses in each year and ZIP Code. We extract the direct and indirect effects for each ZIP Code in each year and sort these estimates into quintiles to rank them based on two criteria: sale price and land value. We aggregate, present, and analyze the indirect effects of ADUs by year and quintile, with a focus on differences in the results after 2020 (the first year for which CA assembly bill 881 became effective).

IV. Empirical Findings

We present the results of our subject analysis, or the baseline effect of the addition of an ADU to the subject property in Table 3.

[Insert Table 3 here]

Through a cross-sectional analysis of property sales between 2017 and 2021, we find that the addition of an ADU increases the selling price of a property by 8.25%[11], as seen in Columns (1) and (2). Column (1) includes ZIP Code and sale year fixed effects, while Column (2) includes

[11] Estimated increase in dollars of approximately $90,000 (based on median property sale price)

ZIP Code and sale month-year. Column (3) includes indicator variables for whether the ADU is classified as an addition, an alteration, or a new installation. We find that the majority of the ADU premia is driven by those classified as additions (about 13.5%) and alterations (approximately 6.5%), rather than new installations. For the contagion and contiguity analyses, we do not distinguish between these ADU types, due to the limited number of observations of each ADU type. The coefficient for the impact of the addition of an ADU on the property's sale price is positive and significant at the 1% level, indicating a strong positive effect. Furthermore, each specification has an adjusted R-squared of over 80%, which indicates high explanatory power for the independent variables.

Next, we examine the impact of whether an ADU was added to another property between sales in a radius of a quarter of a mile on sale prices using a repeat sales model and present the results in Table 4[12]. Column (1) includes sale year and ZIP Code fixed effects, while Column (2) includes sale month-year and ZIP Code fixed effects. The primary explanatory variable is an indicator for whether one or more ADUs were added to properties within a radius of 0.25 miles of the subject property. We observe that the addition of one or more ADUs in the vicinity between sales decreases the difference in sale price between sales by around 2.4%[13], which indicates that ADUs in the neighborhood negatively affect the sale price of properties within 0.25 miles. Column (3) includes sale month-year and ZIP Code fixed effects, as well as an indicator variable for whether an ADU was added to the subject property and its interaction with whether one or more ADUs were added in the vicinity. We find that the effect of neighboring ADUs remains unchanged. The interaction between neighboring ADUs and a property's own

[12] In additional analyses available upon request, we extend the contagion analysis to radii of up to 1 mile and find weak to no significant contagion effects for these radii.
[13] Estimated decrease in dollars of approximately $29,000 (based on median property sale price)

ADU does not alter this effect. For each specification, the T-statistic for the ADU addition coefficient is between 4 and 4.5 in magnitude, indicating strong statistical significance more than 0.1%. The adjusted R-squared is lower than for the subject analysis, though still sizeable at around 65%.

[Insert Table 4 here]

Next, we look at the effect of the difference in the number of ADUs in the same radius and present the results in Table 5. Consistent with the previous table, Column (1) includes sale year and ZIP Code fixed effects, while Columns (2) and (3) include sale month-year and ZIP Code fixed effects. We find that a unit increase in the difference in the quantity of ADUs in the radius between sales decreases the sale price difference by 0.68% to 0.77%; since this analysis looks at the marginal impact of an additional ADU in the radius, the individual impact of each ADU is lower compared to the prior analysis. As seen in Column (3), having an ADU in the subject property increases the valuation gap by 28%, but each additional ADU in the vicinity weakens this effect by approximately 6%. The t-statistic for the key independent variable, or difference in ADUs, is between 2.3 and 2.7 in magnitude, indicating moderate statistical significance. The adjusted R-squared is close to that of Table 4, at around 66%.

[Insert Table 5 here]

We further limit the radii to see if negative externalities can be attributed to close neighbors (such as view obstructions or increased traffic). To examine this issue, we perform the same analyses with smaller radii (0.125 and 0.0625 miles). Table 6 repeats the analysis in Table 4 with sale month-year and ZIP Code fixed effects using these varying radii.

[Insert Table 6 here]

Similarly, Table 7 repeats the analysis from Table 5, which uses the difference in the number of ADUs between sales as the primary explanatory variable. In both analyses, the negative impact of the addition of neighboring ADUs is weakened both statistically and economically as we specify larger radii. These results imply that the impact of neighboring ADUs on property prices is significantly negative for properties in a wider vicinity, but insignificant for properties that are close neighbors. This disparity could potentially be attributed to the relative rarity of properties with close neighbors with ADUs compared to properties with neighbors in the larger search radius of 0.25 miles. Alternatively, it is possible that there are too few instances of properties that have one or more ADUs within a small radius in our repeat sales dataset, which is limited to properties that had a prior recorded sale in our sample.

[Insert Table 7 here]

Overall, the contagion analysis indicates that having properties nearby will devalue one's own property. However, this analysis does not directly address the effect of contiguous neighbors with ADUs, which can bolster property sale prices through improved appraisal comparisons, as we have established the increase in sale price associated with an ADU for the subject property. We proceed to examine this possibility using spatial analysis and the SDM.

To investigate the channels through which differing contagion effects can impact contiguous properties, we compute the average number of bedrooms for each year and either sale price or land value in our sample. Housing quintiles were computed based on prior data, using a "training" versus "test" set logic. Specifically, we compute quintiles using housing sales data from the years 2010 to 2016 to avoid having covariates and response variables directly determining the quintile sorting. We also omit the year 2017 from the following analyses due to the low number of ADUs at time of sale for that year.

Table 8 shows the average number of bedrooms for property sales data from 2018 to 2021, and sale price quintiles based on 2010 to 2016 data. The average number of bedrooms for the two lowest quintiles ranges from approximately 3 to slightly greater than 3, while the average for the highest quintile ranges from approximately 3.5 to 3.6. Table 9 shows the average number of bedrooms by year and land value quintiles. Again, the average number of bedrooms for the highest quintile ranges from 3.5 to 3.6. However, the second lowest land value quintile has a consistently lower number of bedrooms compared to even the lowest land value quintile. It is likely that any JADUs added to properties in the second lowest quintile would be comparatively unintrusive, while the highest quintiles are most able to convert spare bedrooms to JADUs.

[Insert Tables 8 and 9 here]

For the contiguity analysis, to examine the differential impacts of ADUs based on neighborhood sale prices, we first conduct one separate spatial regression for each year and ZIP Code sale price quintile in our sample[14]. In Table 10, we divide the sample into years and quintiles based on average sale price by ZIP Code. We present the direct and indirect coefficients and T-statistics for the ADU at sale variable in each year and quintile below.

[Insert Table 10 here]

The direct effects (that is, ADU price impacts on the subject property) are largely positive, with magnitudes spanning 16 to 22% for statistically significant year-quintiles, such as the second and fourth sale price quintiles for 2021 and the first and second sale price quintiles in 2019. Compared to the subject analysis, these values are high due to the additional feedback

[14] Each regression uses the generalized spatial two-stage least-squares estimator in Stata, with robust standard error adjustments.

effects that are accounted for when evaluating neighboring properties in tandem using the spatial model. The relatively weaker direct effects in 2019 could be attributed to stronger feedback from negative indirect effects for that year.

Indirect effects, or spillover effects that measure how ADUs impact neighboring properties, vary in both their magnitude and significance. A strong negative effect is present for the 4th sale price quintile in 2019: for properties in higher price areas, the impact of neighboring ADUs is large. The magnitude of the price decrease is around 1.8%, indicating that negative contagion effects dominate the positive ones in this quintile. The disamenity effects of neighboring ADUs are at their greatest here, for properties with high prices.

In contrast, there exist year-quintiles for which the indirect effect of ADUs is positive and significant. We find evidence supporting the hypothesis that the indirect effects are positive and significant for the second lowest (by approximately 2%) and highest sale price quintiles (by approximately 3.6%) in 2020. Homes in the second lowest quintile benefit most from easier access to JADU installation due to their low number of bedrooms while having access to more resources to convert parts of the property to an ADU. On the other hand, the highest quintile has the greatest number of bedrooms on average. Thus, JADUs become a more attractive option, especially for properties that already have ADUs. Since JADUs are comparatively less intrusive than standard ADUs, negative ADU contagion effects are mitigated in 2020, which allows positive ADU effects to dominate.

The indirect effects of ADUs are not significant in either direction for the year 2021. While a shortage of sales with ADUs and adjacent properties in 2017 and 2018 could be the cause of weak indirect effects in those years, that is less likely to be the case for 2021. Rather, it is more likely that the impact of adjacent ADUs has stabilized as ADUs become more common and more understood by property evaluators.

In Table 11, we divide the sample into years and land value quintiles. ADU direct effects are again either positive and significant, or insignificant, but the magnitudes vary more, from approximately 14% to 33%. The quintiles with significant positive ADU direct effects are analogous to those from the sale price quintile analysis. Similarly, the ADU indirect effects are mostly analogous to the sale price quintile indirect effects. Strong positive indirect effects are present for the 2nd lowest and highest land value quintiles in 2020. However, there is also a significant negative indirect effect for the second highest quintile in the same year.

[Insert Table 11 here]

Overall, it is evident that both positive and negative indirect effects exist, depending on whether the value an ADU brings to a property's sale price bolsters adjacent property values or whether those adjacent properties suffer disamenities from the ADUs. The state legislature's promotion of JADUs in 2020 coincides with a reduction in the negative indirect effect for that year for the properties that are likely to be the most affected.

When compared to the findings of Davidoff, Pavlov, and Somerville (2022), our findings differ in part due to differences in how ADUs are defined in Vancouver compared to Los Angeles. They find that negative externalities exist primarily for high-value properties. Vancouver ordinances restrict laneway homes to detached structures and impose strict restrictions with respect to their design and construction, including a required minimum distance between the main structure and laneway home. In contrast, Los Angeles allows for attached and converted structures and the state of California restricts local governments from limiting ADUs based on allowable residential density (Government Code 65852.2, subdivision (a)(1)(C)) or minimum lot size requirements (Government Code 65852.2, subdivision (c)(2)(C)). Thus, a laneway home constructed in Vancouver is generally more noticeable from outside the home, which can negatively impact direct neighbors, especially those with higher-priced properties[15].

V. Conclusion

In this paper, we examine the effects of ADUs on the future sale prices of their subject properties and their neighboring properties in the City of Los Angeles. We find that ADUs have positive effects on their subject properties, which is consistent with recent literature findings. When we investigate the contagion effects of ADUs on their neighboring properties, we use a spatial Durbin model (SDM) estimated year-by-year at the ZIP Code level, which effectively enables us to test for heterogeneity by disentangling positive and negative contagion effects that ADUs have on neighboring properties. We provide evidence that the effects of contiguous ADUs vary depending on some neighborhood characteristics. Furthermore, we find evidence that negative contagion effects are mitigated when JADUs are encouraged, due to the lack of intrusiveness of most JADUs. In other words, since JADUs do not usually require new structures, they tend not to block the views of neighbors or change the landscape of the neighborhood. The quasi-natural experiment features of one regulation (California Government Code SS 65852.22 brought about by CA assembly bill 881 in December 2019) offers some causal evidence supporting the finding that negative contagion is dampened after the regulation.

Our study focuses on the single-family home prices and how they are affected by the additions of ADUs to nearby properties. A natural follow-up would be to focus on whether and how ADUs affect rent prices nearby. It may be the case that a rise in ADUs can lead to

[15] See Davidoff, Pavlov, and Somerville (2022) for a visual representation of a laneway home in Vancouver

attenuation of rent increases in their neighborhoods. Such findings would provide evidential support in favor of ADUs as a worthwhile step towards alleviating housing availability concerns.

For future research, it is also worth exploring whether ADUs have network effects. More specifically, do neighbors with ADUs increase the likelihood that a property adds an ADU to their property? If there exist strong network effects associated with ADUs, it may lead to high densities of ADUs in certain areas, which would mitigate the effect they have on housing availability. Alternatively, if strong network effects exist, ADUs in clusters could manifest concerns regarding neighborhood resource allocations, such as parking availability, public schooling, and power grid strain. Such empirical evidence could support local and state policy makers as they consider the benefits and drawbacks of additional measures to mitigate the persistent housing shortage in California, and elsewhere.

References

Basu, Sabyasachi, and Thomas G. Thibodeau. "Analysis of spatial autocorrelation in house prices." *The Journal of Real Estate Finance and Economics* 17 (1998): 61-85.

Brown, Martin, and Taylor Watkins. "Understanding and Appraising Properties with Accessory Dwelling Units." *Appraisal Journal* 80, no. 4 (2012).

Brueckner, Jan K., and Sarah Thomaz. "ADUs in Los Angeles: Where are they located and by how much do they raise property value?." *Real Estate Economics* (2024).

Coppage, Jonathan, "Accessory Dwelling Units: A Flexible Free-Market Housing Solution," Rstreet.org, R Street Institute, March, 2017 https://www.rstreet.org/wp-content/uploads/2018/04/89-1.pdf

Dear, Michael. "Understanding and overcoming the NIMBY syndrome." *Journal of the American planning association* 58, no. 3 (1992): 288-300.

Elhorst, J.P. (2014). Spatial Econometrics: From Cross-sectional Data to Spatial Panels. Springer, Heidelberg New York Dordrecht London.

Elhorst, J.P. (2010). Applied spatial econometrics: raising the bar. *Spatial Economic Analysis*, *5*(1), 9-28.

Feng, Ping, Mahmut Yasar, and Jeffrey P. Cohen. "Do Higher House Prices Crowd-Out or Crowd-In Manufacturing? A Spatial Econometrics Approach." *The Journal of Real Estate Finance and Economics* (2023): 1-26.

LeSage, James P., and R. Kelley Pace. "Spatial econometric models." In Handbook of applied spatial analysis: Software tools, methods and applications, pp. 355-376. Berlin, Heidelberg: Springer Berlin Heidelberg, 2009.

Levy, Frank. "On understanding proposition 13." The Public Interest 56 (1979): 66.

Mussa, A., Nwaogu, U.G., & Pozo, S. (2017). Immigration and housing: a spatial econometric analysis. *Journal of Housing Economics*, 35(3), 13-25.

Olsen, Edgar O. "The demand and supply of housing service: a critical survey of the empirical literature." In *Handbook of regional and urban economics*, vol. 2, pp. 989-1022. Elsevier, 1987.

Osland, Liv. "An application of spatial econometrics in relation to hedonic house price modeling." *Journal of Real Estate Research* 32, no. 3 (2010): 289-320.

Pace, R. Kelley, Ronald Barry, John M. Clapp, and Mauricio Rodriquez. "Spatiotemporal autoregressive models of neighborhood effects." *The Journal of Real Estate Finance and Economics* 17 (1998): 15-33.

Pace, R. Kelley, Ronald Barry, and Clemon F. Sirmans. "Spatial statistics and real estate." *The Journal of Real Estate Finance and Economics* 17 (1998): 5-13.

Pendall, Rolf. "Opposition to housing: NIMBY and beyond." *Urban affairs review* 35, no. 1 (1999): 112-136.

Riddle, Safiyah, "U.S. housing availability rate slips in second quarter," Reuters.com, Reuters, August 2, 2023, https://www.reuters.com/markets/us/us-housing-availability-rate-slips-second-quarter-2023-08-02/

Scheutz, Jenny and Eve Devens, "Can income-restricted ADUs expand the affordable housing stock in Los Angeles," Brookings.edu, Brookings Institute, March 4, 2024, https://www.brookings.edu/articles/can-income-restricted-adus-expand-the-affordable-housing-stock-in-los-angeles/

Statista Research Department, “Freddie Mac House Price Index price appreciation from 1990 to 2023,” Statista.com, Statista, September 25, 2023, https://www.statista.com/statistics/275159/freddie-mac-house-price-index-from-2009/

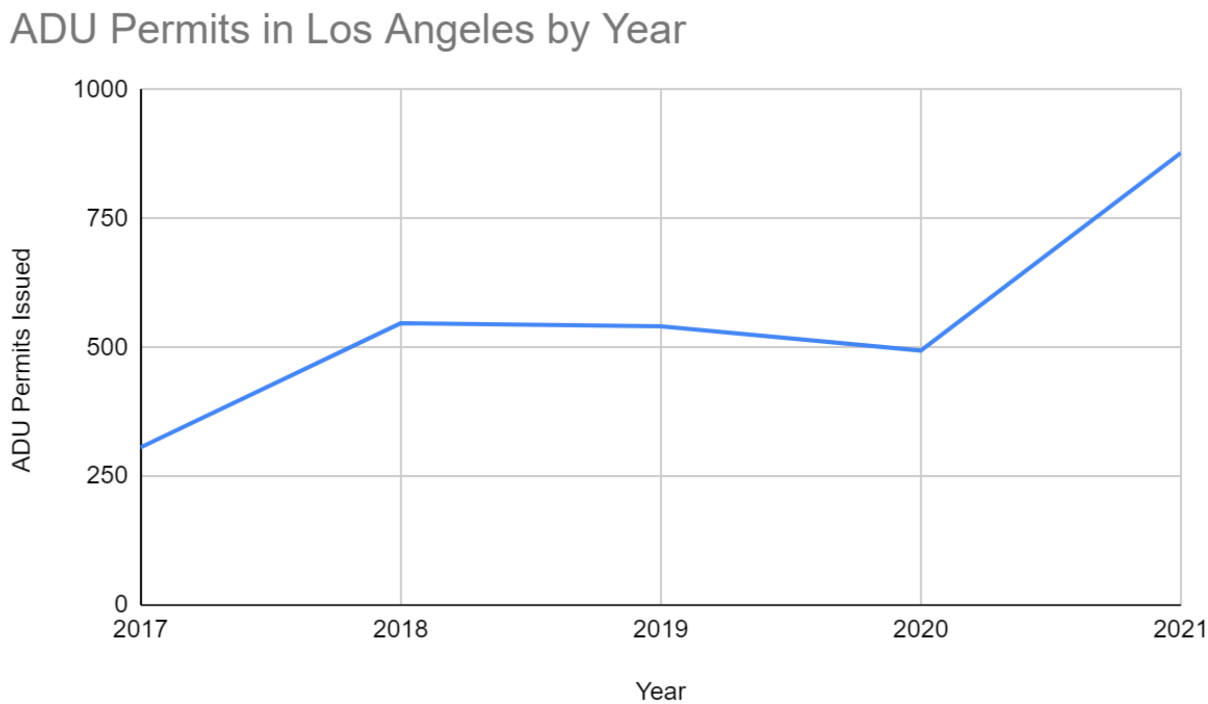
Statistics Canada, “Census Profile, 2021 Census of Population,” Statcan.gc.ca, Government of Canada, https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/details/page.cfm?Lang=E&SearchText=Vancouver&DGUIDlist=2021A00055915022&GENDERlist=1&STATISTIClist=1&HEADERlist=0

Tanrisever, Idil. "Spillover effects of ADU development." *Available at SSRN 4539878* (2023).

United States Census, “QuickFacts Los Angeles city, California,” Census.gov, United States government, https://www.census.gov/quickfacts/fact/table/losangelescitycalifornia/POP010220

Figures and Tables

Figure 1: ADU Permits by Year



This figure shows the number of ADU permits in our dataset by year. Permit data is obtained from the Los Angeles City Planning website. ADU permits are identified by looking at the work description for words pertaining to accessory dwelling units or ADUs.

Table 1: ADU Summary Statistics, All Sales, 2017 - 2021

Variable	Obs	Mean	SD	Median	Min	Max
Sale Amount	45,147	1,525,203	1,218,842	1,111,111	50,500	9,950,000
ADU at Sale	45,147	0.002769	0.052546	0	0	1
Age	45,147	58.94161	25.40671	63	0	100
Lot Size	45,147	10,103.64	10,182.17	7,503.122	1,505	475,759.8
Interior	45,147	2,557.539	1,106.695	2,209	1,500	21,812
Bedrooms	45,147	3.906638	1.360582	4	1	18
Bathrooms	45,147	3.139345	1.338629	3	1	16

This table shows summary statistics for the sale amount and key covariates for all sales in the sample from 2017 to 2021. *ADU at Sale* is an indicator variable equal to 1 if the property had an ADU at time of sale. *Age* is the difference between the year of sale and the year built. Lot size and interior are given in square feet.

Table 2: ADU Summary Statistics, Repeat Sales Only, 2017 – 2021

Variable	Obs	Mean	SD	Median	Min	Max
Sale Price	32,707	1,608,466	1,251,552	1200000	50,608	9,950,000
Previous Sale Price	32,707	917,889.8	916,997.7	650000	50,000	9,525,095
ADU at Sale	32,707	0.003088	0.055485	0	0	1
ADU Add in Rad. (0.25)	32,707	0.252056	0.4342	0	0	1
Diff. in Rad. ADUs (0.25)	32,707	0.400434	0.829988	0	0	12
ADU Add in Rad. (0.125)	32,707	0.099618	0.299486	0	0	1
Diff. in Rad. ADUs (0.125)	32,707	0.117773	0.379259	0	0	6
ADU Add in Rad. (0.0625)	32,707	0.03351	0.179966	0	0	1
Diff. in Rad. ADUs (0.0625)	32,707	0.035986	0.199112	0	0	3
Age	32,707	58.17614	25.74331	62	0	100
Holding Months	32,707	142.3924	138.8871	89	4	686
Lot Size (sqft)	32,707	10,142.79	10,106.46	7,505.877	1,505	422,979.9
Interior (sqft)	32,707	2,597.954	1,123.627	2,253	1,500	21,812
Bedrooms	32,707	3.915798	1.357852	4	1	18
Bathrooms	32,707	3.197389	1.351279	3	1	16

This table shows summary statistics for the sale amount and key covariates for repeat sales only in the sample from 2017 to 2021. *ADU at Sale* is an indicator variable equal to 1 if the property had an ADU at time of sale. *ADU Added in Radius* is equal to 1 if at least 1 ADU was added to another property in the stated radius between the current and previous sale of the subject property. *Diff. in Radius ADUs* is the difference in the number of ADUs associated with other properties in the given radius between the current and previous sale of the subject property. *Age* is the difference between the year of sale and the year built. *Holding Months* is the difference in months between the current and previous sale of a property. Lot size and interior are given in square feet.

Table 3: ADU Subject Analysis, Cross-Sectional

	(1)	(2)	(3)
	Log Sale Price	**Log Sale Price**	**Log Sale Price**
ADU at Sale	0.0846***	0.0827***	
	0.0285	0.0282	
Addition at Sale			0.135**
			0.6553
Alteration at Sale			0.0652**
			0.0321
New Building at Sale			-0.00182
			0.0607
N	45138	45138	45138
adj. R-sq	0.812	0.814	0.814
	*** p<0.1**	**** p<0.05**	***** p<0.01**

This table presents the effects of ADU additions on the sale price of the subject single-family homes. The sample consists of arm's-length transactions from 2017 to 2021 in the city of Los Angeles. All specifications are cross-sectional ordinary least squares. Log price is the dependent variable. *ADU at Sale* is equal to 1 if the property had an ADU at time of sale. (1) includes ZIP Code and sale year fixed effects, while (2) and (3) include ZIP Code and sale month-year fixed effects. In (3), this variable is split by the type of ADU: addition to property, alteration of property, and new building. Control variables include the property's age, lot size, the interior square footage, number of bedrooms, and the number of bathrooms.

Table 4: ADU Contagion Analysis, Repeat Sales, ADU Added in Radius Indicator

	(1)	**(2)**	**(3)**
	Log Sale Diff.	**Log Sale Diff.**	**Log Sale Diff.**
ADU Added in Radius (0.25 mi)	-0.0228***	-0.0240***	-0.0238***
	0.0055	0.0055	0.0055
Holding Months	0.00409***	0.00409***	0.00409***
	0.0000	0.0000	0.0000
ADU Added to Subject			0.233**
			0.0951
Radius x Subject			-0.0640
			0.1032
N	32598	32598	32699
adj. R-sq	0.658	0.658	0.658
	*** p<0.1**	**** p<0.05**	***** p<0.01**

This table shows the effects of ADUs on the sale price of single-family homes in the vicinity. The sample consists of arm's-length transactions with at least one prior transaction from 2017 to 2021 in the city of Los Angeles, otherwise known as the repeat-sales sample. All specifications are cross-sectional ordinary least squares. The difference in log price between sales is the dependent variable. *ADU Added in Radius* is equal to 1 if at least 1 ADU was added to another property in the stated radius between the current and previous sale of the subject property. *Holding Months* is the difference in months between the current and previous sale of a property. Column (1) includes ZIP Code and sale year fixed effects, while Columns (2) and (3) include ZIP Code and sale month-year fixed effects. In Column (3), we control whether an ADU was added to the subject property between sales as well as its interaction with the *ADU Added in Radius* variable. Hedonic control variables are excluded from these specifications due to cancellation via the repeat-sales equation.

Table 5: ADU Contagion Analysis, Repeat Sales, Difference in Radius ADUs

	(1)	(2)	(3)
	Log Sale Diff.	**Log Sale Diff.**	**Log Sale Diff.**
Diff. in Radius ADUs (0.25 mi)	-0.00678**	-0.00766***	-0.00765***
	0.00286	0.00287	0.00287
Holding Months	0.00408***	0.00408***	0.00408***
	0.0000	0.0000	0.0000
ADU Added to Subject			0.280***
			0.0614
Radius x Subject			-0.0611**
			0.0304
N	32598	32598	32699
adj. R-sq	0.657	0.658	0.658
	*** p<0.1**	**** p<0.05**	***** p<0.01**

This table shows the effects of ADUs on the sale price of single family homes in the vicinity with different levels of radius. The sample consists of arm's-length transactions with at least one prior transaction from 2017 to 2021 in the city of Los Angeles, otherwise known as the repeat-sales sample. All specifications are cross-sectional ordinary least squares. The difference in log price between sales is the dependent variable. *Diff. in Radius ADUs* is the difference in the number of ADUs associated with other properties in the given radius between the current and previous sale of the subject property. *Holding Months* is the difference in months between the current and previous sale of a property. Column (1) includes ZIP Code and sale year fixed effects, while Columns (2) and (3) include ZIP Code and sale month-year fixed effects. In Column (3), we control whether an ADU was added to the subject property between sales as well as its interaction with the *Diff. in Radius ADUs* variable. Hedonic control variables are excluded from these specifications due to cancellation via the repeat-sales equation.

Table 6: ADU Contagion Analysis, Repeat Sales, ADU Added in Radius Indicator, Varying Radii

	(1)	(2)	(3)
	Log Sale Diff.	**Log Sale Diff.**	**Log Sale Diff.**
ADU Added in Radius (0.25 mi)	-0.0240***		
	0.0055		
ADU Added in Radius (0.125 mi)		-0.0108	
		0.0074	
ADU Added in Radius (0.0625 mi)			-0.0160
			0.0118
Holding Months	0.00409***	0.00408***	0.00408***
	0.0000	0.0000	0.0000
N	32598	32598	32598
adj. R-sq	0.658	0.658	0.658
	*** p<0.1**	**** p<0.05**	***** p<0.01**

This table looks at the impact of ADUs on the sale price of single family homes in the vicinity using varying effect radii. The sample consists of arm's-length transactions with at least one prior transaction from 2017 to 2021 in the city of Los Angeles. The difference in log price between sales is the dependent variable. *ADU Added in Radius* is equal to 1 if at least 1 ADU was added to another property in the stated radius between the current and previous sale of the subject property, evaluated over radii of 0.25, 0.125, or 0.0625 miles. *Holding Months* is the difference in months between the current and previous sale of a property. All specifications include ZIP Code and sale month-year fixed effects.

Table 7: ADU Contagion Analysis, Repeat Sales, Difference in Radius ADUs, Varying Radii

	(1)	(2)	(3)
	Log Sale Diff.	**Log Sale Diff.**	**Log Sale Diff.**
Diff. in Radius ADUs (0.25 mi)	-0.00766**		
	0.0029		
Diff. in Radius ADUs (0.125 mi)		-0.00718	
		0.0058	
Diff. in Radius ADUs (0.0625 mi)			-0.0157
			0.0110
Holding Months	0.00408***	0.00408***	0.00408***
	0.0000	0.0000	0.0000
N	32598	32598	32598
adj. R-sq	0.658	0.658	0.658
	*** p<0.1**	**** p<0.05**	***** p<0.01**

This table looks at the impact of ADUs on the sale price of single family homes in the vicinity using varying effect radii. The sample consists of arm's-length transactions with at least one prior transaction from 2017 to 2021 in the city of Los Angeles. The difference in log price between sales is the dependent variable. *Diff. in Radius ADUs* is the difference in the number of ADUs associated with other properties in the given radius between the current and previous sale of the subject property, evaluated over radii of 0.25, 0.125, or 0.0625 miles. *Holding Months* is the difference in months between the current and previous sale of a property. All specifications include ZIP Code and sale month-year fixed effects.

Table 8: Average Number of Bedrooms by Sale Price Quintile and Year

	1	**2**	**3**	**4**	**5**
2018 (n)	3,321	2,864	3,142	2,921	2,909
Mean	3.26	3.19	3.37	3.48	3.61
Std. Dev.	1.92	1.06	1.61	1.26	1.43
2019 (n)	3,452	3,080	3,176	3,280	3,126
Mean	3.36	3.19	3.31	3.48	3.59
Std. Dev.	2.08	1.20	1.15	1.27	1.34
2020 (n)	3,011	3,062	3,399	3,668	3,661
Mean	3.13	3.16	3.30	3.43	3.51
Std. Dev.	1.81	1.14	1.13	1.17	1.32
2021 (n)	3,178	3,241	3,441	3,888	4,091
Mean	2.98	3.14	3.26	3.39	3.52
Std. Dev.	1.50	1.10	1.13	1.19	1.31

This table displays the average number of bedrooms for each mean sale price quintile and year from 2018 to 2021. Mean sale price rankings are determined by ZIP Code using data from 2010 to 2016 to address simultaneity in determination. The lowest quintile is 1, while the highest is 5. The highest sale price quintile has the most bedrooms on average.

Table 9: Average Number of Bedrooms by Land Value Quintile and Year

	1	2	3	4	5
2018 (n)	3,321	2,864	3,142	2,921	2,909
Mean	3.26	3.19	3.37	3.48	3.61
Std. Dev.	1.92	1.06	1.61	1.26	1.43
2019 (n)	3,452	3,080	3,176	3,280	3,126
Mean	3.36	3.19	3.31	3.48	3.59
Std. Dev.	2.08	1.20	1.15	1.27	1.34
2020 (n)	3,011	3,062	3,399	3,668	3,661
Mean	3.13	3.16	3.30	3.43	3.51
Std. Dev.	1.81	1.14	1.13	1.17	1.32
2021 (n)	3,178	3,241	3,441	3,888	4,091
Mean	2.98	3.14	3.26	3.39	3.52
Std. Dev.	1.50	1.10	1.13	1.19	1.31

This table displays the average number of bedrooms for each mean land value quintile and year from 2018 to 2021. Mean land value rankings are determined by ZIP Code using data from 2010 to 2016 to address simultaneity in determination. The lowest quintile is 1, while the highest is 5. The highest land value quintile has the most bedrooms on average, while the second lowest land value quintile has the fewest bedrooms on average.

Table 10: ADUs and Sale Price by Year and Sale Price Quintiles

2018	**1**	**2**	**3**	**4**	**5**
ADU Direct Effects	-0.082	0.217 ***	0.26	0.229	0.164
T-stat	-0.56	3.25	2.03	2.17	1.16
ADU Indirect Effects	0	-0.006	0	0	0.008
T-stat	-0.46	-0.93	-1.2	-0.65	0.34
2019	**1**	**2**	**3**	**4**	**5**
ADU Direct Effects	0.163 *	0.118 *	0.13	0.085	-0.102
T-stat	1.71	1.85	1.19	1.36	-0.42
ADU Indirect Effects	-0.005	0.004	0.008	-0.018 ***	0.046
T-stat	-0.83	0.17	0.8	-3.2	0.65
2020	**1**	**2**	**3**	**4**	**5**
ADU Direct Effects	0.03	0.225 ***	0.173 **	0.139	0.021
T-stat	0.52	2.87	2.29	1.36	0.23
ADU Indirect Effects	-0.009	0.021 **	-0.012	-0.003	0.036 **
T-stat	-0.87	2.03	-1.61	-0.23	2.28
2021	**1**	**2**	**3**	**4**	**5**
ADU Direct Effects	0.048	0.196 ***	-0.018	0.215 ***	0.102
T-stat	0.39	3.41	-0.11	3.18	1.37
ADU Indirect Effects	0.001	-0.018	0.054	-0.029	0.021
T-stat	0.12	-1.49	0.6	-1.48	1.24
	*** p<0.1**	**** p<0.05**	***** p<0.01**		

This table shows the direct and indirect effects of ADUs on sale prices, spliced by the ZIP Code's mean sale price quintile and year, for a spatial Durbin model. Mean sale price rankings are determined using data from 2010 to 2016 to address simultaneity in determination. The dependent variable is the log sale price of a property. For the indirect effect, the key independent variable is the number of adjacent properties with ADUs, scaled by the number of adjacent properties. One spatial regression is done per ZIP Code quintile and year. Each regression uses the generalized two-stage least squares estimator and heteroskedastic standard errors. The indirect effect coefficient represents the difference in expected value of the log sale price resulting from the addition of an adjacent ADU, prior to scaling based on the number of adjacent properties. For example, a coefficient of 0.1 indicates the sale price will increase by approximately 10.5% following an additional adjacent ADU, prior to scaling. The lowest quintile is 1, while the highest is 5. The second lowest and highest quintiles in 2020 have significant positive indirect effects.

Table 11: ADUs and Sale Price by Year and Land Value Quintiles

2018	**1**	**2**	**3**	**4**	**5**
ADU Direct Effects	0.059	0.103	0.329 ***	0.195	0.145
T-stat	0.54	0.78	3.76	1.55	1.02
ADU Indirect Effects	0	0	-0.009	0	0.004
T-stat	0.25	-0.75	-1.35	-0.77	0.17
2019	**1**	**2**	**3**	**4**	**5**
ADU Direct Effects	0.068	0.243 ***	0.1	0.103 *	-0.092
T-stat	0.8	6.19	0.59	1.92	-0.39
ADU Indirect Effects	-0.012	0.026	0	-0.007	0.049
T-stat	-1.58	1.3	-0.49	-1.23	0.67
2020	**1**	**2**	**3**	**4**	**5**
ADU Direct Effects	0.072	0.237 ***	0.254 ***	0.146*	0.046
T-stat	1.28	3.05	2.65	1.9	0.46
ADU Indirect Effects	-0.003	0.021 **	0.007	-0.032 ***	0.035 **
T-stat	-0.25	2.3	0.76	-2.81	2.1
2021	**1**	**2**	**3**	**4**	**5**
ADU Direct Effects	-0.048	0.188 ***	0.115	0.253 ***	0.062
T-stat	-0.49	2.63	1.35	3.25	0.94
ADU Indirect Effects	0.003	-0.014	-0.01	-0.01	0.019
T-stat	0.63	-1.03	-0.97	-0.46	1.09
	*** p<0.1**	**** p<0.05**	***** p<0.01**		

This table shows the direct and indirect effects of ADUs on sale prices, spliced by the ZIP Code's mean land value quintile and year, for a spatial Durbin model. Mean land value rankings are determined using data from 2010 to 2016 to address simultaneity in determination. The dependent variable is the log sale price of a property. For the indirect effect, the key independent variable is the number of adjacent properties with ADUs, scaled by the number of adjacent properties. One spatial regression is done per ZIP Code quintile and year. Each regression uses the generalized two-stage least squares estimator and heteroskedastic standard errors. The indirect effect coefficient represents the difference in expected value of the log sale price resulting from the addition of an adjacent ADU, prior to scaling based on the number of adjacent properties. For example, a coefficient of 0.1 indicates the sale price will increase by approximately 10.5% following an additional adjacent ADU, prior to scaling. The lowest quintile is 1, while the highest is 5. The second lowest and highest quintiles in 2020 have significant positive indirect effects, while the second highest quintile in 2020 has a significant negative indirect effect.