Received: 15 June 2021 | Accepted: 15 July 2021

DOI: 10.1111/jors.12554

RESEARCH ARTICLE

JOURNAL OF REGIONAL SCIENCE WILEY

Local economic growth and local government investment in parks and recreation, or five cheese pizzas for $2.6 million

David M. Brasington

Economics Department, University of Cincinnati, Cincinnati, OH, USA

Correspondence
David M. Brasington, Economics Department, University of Cincinnati, 2426 Lindner Hall, 2906 Woodside Dr, Cincinnati, OH 45221-0371, USA.
Email: david.brasington@uc.edu

Funding information
Charles P. Taft Research Center; University of Cincinnati; Carl H. Lindner College of Business

Abstract

Amenities have been linked to economic growth, which has been studied at the level of nations, regions, and urban areas. We look instead at economic development at the highly localized level of cities, villages, and townships. We use regression discontinuity to estimate the effect of renewing and cutting parks and recreation spending. We find an initial effect of $2.6 million in additional residential construction 1 year after voting to renew tax funding, with diminishing effects in subsequent years. We use votes to renew tax levies, arguing that the timing of tax proposals for new funding has endogenously chosen timing.

KEYWORDS
housing supply, local government taxation, local public services, regional development, regression discontinuity

1 | INTRODUCTION

Economic growth has traditionally been studied at the level of nations (Acemoglu, 2012; Ranis et al., 2000), states (Ravallion & Datt, 2002), and regions, like NUTS2 (Faggian & McCann, 2009) and metropolitan statistical areas (MSAs; Partridge, 2010). We collect economic growth data at the most localized level we have seen: the local municipal units of cities, villages, and townships, which we sometimes call 'cities' for shorthand. As an illustration, Lucas County, the primary county for the Toledo, Ohio MSA, has 400,000 people in an area of 341 miles^2 (880 km^2) spread across 5 cities, 6 villages, and 11 townships. Our measure of economic growth is novel, too. Prior studies often measure economic growth by population, income, gross domestic product, and indices that include factors, like health. The current study measures growth by the value of newly constructed residential structures. This measure captures redevelopment as well as the in-migration of population, both indicators of the attractiveness of a city. It is important to put population changes into context in Ohio, because the population of Ohio has remained constant since 2000. There is migration into and out of the state, of course, but with replacement-level birth rates it is fair to credit most changes in city-level population to intercity flows.

We find that barely renewing tax levies for parks and recreation causes $2.6 million more residential development than that in otherwise similar cities that barely fail the tax levies. The $2.6 million effect is for the first year after the vote alone. This effect diminishes to $2.0 million and $1.4 million 2 and 3 years after the tax levy, and essentially dissipates in the fourth year.

Tiebout (1956) sort over environmental quality, and the types of people who sort to it are more likely to attend or watch NASCAR, have higher incomes, and describe themselves as politically very liberal (Brasington, 2017a). These may be two distinct groups of people. The current study finds that cutting funding on parks and recreation reduces new residential construction, adding to the finding that cutting parks and recreation spending also causes more demolition of residential property (Brasington, 2021).

The results are based on a unique data set of 1745 votes on parks and recreation tax levies by local governments in Ohio. These votes are matched to other characteristics, including the value of newly constructed houses. Regression discontinuity compares the value of new residential construction for cities that barely renew and barely fail to renew the tax. There is an issue about the independence of votes uncovered by Cellini et al. (2010), and independence of votes is an assumption of the classical linear regression model. To preserve independence, the study examines only votes to renew spending. Park boards endogenously choose when to ask for additional tax money, while the timing to renew a tax that is about to expire is exogenous to the park board. The use of renewal levies provides different treatment effect estimates than the use of new tax levies. Part of the difference may stem from reduced bias, but part of the difference may reflect an asymmetric effect of spending more versus cutting spending on parks and recreation.

The estimates come from the use of the regression discontinuity design. Most studies on the economic impact of environmental amenities use least squares, spatial models, and input–output modeling. While these studies advance our understanding of the issues, they are not based on randomization and are therefore subject to omitted variable bias (Baum-Snow & Ferreira, 2015). Regression discontinuity essentially creates a randomized experiment in a narrow window around a cutoff point. As a consequence, it has been shown to produce estimates that are statistically identical to those from randomized experiments (Berk et al., 2010; Buddelmeyer & Skoufias, 2004; Shadish et al., 2011). The assumptions required are minimal and testable, so we believe that another contribution of the study is its use of the powerful causal inference technique of regression discontinuity.

2 | LITERATURE REVIEW

The current study is related to literatures on amenity-based economic growth, migration, house price capitalization, health effects, and ecological tourism.

Because of the importance of the topic, there is a rich literature on economic development at the level of nations, states, and regions. The current study deals with park and recreation spending, a local amenity, so a brief sampling of the economic development literature as it relates to amenities is now discussed. Rodríguez-Pose and Ketterer (2012) examines population flows between 133 European regions between 1990 and 2006. Using panel data techniques it finds evidence that contradicts the claims of Faggian and McCann (2009) and Faggian et al. (2012), which say that economic conditions and not amenities affect the relative attractiveness of European regions for population flows. Specifically, it finds a role for factors, like higher January temperatures, fewer clouds, scenic landscapes, and variety in landscapes with touristic or recreational value. These are exogenous factors, whereas the current study shows a role for public policy in providing quality parks and recreational opportunities in a geography that by and large mimics a flat, featureless plain.

Knapp and Gravest (1989) discuss the role of location-specific amenities in regional migration, which causes regional development. It separates the discussion into supply-side and demand-side factors, and suggests that amenities are capitalized into wages, rents, and other prices. Clark and Cosgrove (1991) find both economic factors and amenity differentials are important for explaining population flows between MSAs. Among the important factors are the murder rate, rain levels, and population levels. The murder rate is a factor that could be affected by local public spending on police protection (Levitt, 2002). Marré and Rupasingha (2020) show that it is not just natural amenities that can draw new residents but public services, like, schools as well. It finds that better schools can draw migrants to rural areas, and that the effect is larger for nonmetropolitan counties that are not next to metropolitan areas. This is an important finding for the current study, which also shows a role for public policy in development through the provision of public services. Like Marré and Rupasingha (2020), the current study includes rural areas.

Albouy et al. (2021) compare immigration by US-born interstate migrants and foreign-born migrants to MSAs. It finds foreign immigrants are more willing to accept lower wages to locate in cities that are coastal, larger, and have deeper immigrant networks. They also choose cities that have similar winter temperatures, coastal proximity, and public safety as their home countries. Carlino and Saiz (2019) state that prior studies provide only indirect evidence of the link between leisure amenities and population growth in urban areas. It surveys residents to develop a measure of how picturesque an MSA is. It finds 10% higher population growth in urban areas between 1990 and 2010 in locations that are twice as picturesque—tied with taxes for importance.

Partridge (2010) compares the relative importance of natural amenities and the increasing returns to scale of new economic geography in explaining economic growth. Using MSA-level analysis the paper finds natural amenities to be much more important drivers of growth. Rickman and Wang (2017) find both natural amenities and urban agglomeration drive regional growth, but that demand for natural amenities is more important for growth outside of MSAs. Hong (2016) conducts a panel data estimation at the individual level for Mexican immigrants to the United States, finding that amenities matter for migration choices, especially for older migrants. Gao and Sam (2019) use prefecture-level data for China with a panel data model. It finds that income levels and employment opportunities matter, but that climate variables, like, winter and summer temperatures and availability of sunshine are also related to in-migration.

There is a substantial literature on the relationship between parks, urban forests, and green space on house prices. Most studies find a premium for proximity to such recreational areas that drops off with distance. Borgoni et al. (2018) look at the effect of park size and proximity in Milan. Li and Saphores (2012) use a spatial Durbin model to estimate the effect of forests and grassy areas on the value of multifamily housing units in Los Angeles. Wu and Dong (2014) find that the house price premium for proximity to parks in Beijing varies with a neighborhood's educational attainment, crime levels, population density, and the presence of subway stations and schools. Lutzenhiser and Netusil (2001) examines the effect of specialty parks, open area parks, and golf courses on house prices in Portland, OR. Melichar et al. (2009) look at the effect of proximity to urban forests on apartment prices in Prague. Garretsen and Marlet (2017) find that proximity to man-made recreational grounds can be negatively related to housing prices in the Netherlands.

There is a literature on the effect of park spending on health outcomes and participation in recreational activities. Humphreys and Ruseski (2007), for example, find that spending on parks and recreation gets people to participate more in group sports but not individual walking.

Another related strand of literature looks at tourism as an economic development tool. This is perhaps the most highly related branch of literature to the current study, although, unlike the current study, the geographies seem to be confined to rural areas. Typical of the genre is input–output modeling of recreational spending. Bergstrom et al. (1990) find recreation spending in five state parks in rural Georgia increases incomes, employment, and gross product. McDonald and Wilks (1986) find the same for Cooloola National Park in Australia, but the input–output models in Keith and Fawson (1995), which studies rural Utah, suggest economic tourism is not a viable strategy for economic development. English (2000) examines the economic impact of visitor spending in the Florida Keys, and Marcouiller and Prey (2005) show how tourism dependence is related to both man-made recreation sites and natural amenities.

3 | METHODOLOGY

3.1 | Independence of observations

Cellini et al. (2010) use regression discontinuity to gauge the effects of school building spending on house prices in California. It uses votes on new bond issues, and it is the first study we are aware of that raises the idea that votes may not be statistically independent. Subsequent studies preserve independence by choosing the first or the largest observation, like, the largest tax levy for the San Dimas school district during the sample period.

The current study suggests that any strategy that uses new tax levies is flawed because the timing of a new tax levy is endogenously chosen by the relevant taxing authority. In the case of parks and recreation tax levies in Ohio, the relevant taxing authority is city council for cities, or the board of trustees for townships and joint recreation districts. City council may choose a time of rising incomes to propose a new tax, or it may ask for new taxes if a large corporation relocates to the area.

New taxes in Ohio are proposed for a specific length of time. The majority of parks and recreation taxes in the sample expire 5 years after being voted in. At the end of 5 years city council will ask voters to renew the tax. If the tax passes, the funding continues; if the tax fails, the city must cut spending on parks and recreation services. The timing of renewal is not chosen by city council: if a new tax passed in 2006 to last 5 years, city council will propose to renew the tax in 2011. If the tax fails in 2011, the city can approach voters for new funding, but this will be a new tax, not a renewal. For this reason, the study considers only renewal taxes to preserve the independence of observations (Brasington, 2017b).

3.2 | Regression discontinuity design

Regression discontinuity is a study design first promulgated by Thistlethwaite and Campbell (1960), after which it was essentially ignored until recent decades. The approach is to find a situation where there is a fixed, known cutoff to some continuous variable called the running variable. Subjects to one side of the cutoff receive treatment, and subjects to the other side act as a control group because they do not receive treatment. Under a minimal set of testable assumptions, regression discontinuity controls for omitted variable bias, meaning that any estimate of a treatment effect represents the causal effect of receiving treatment.

The assumptions of regression discontinuity are that no agent can precisely assign subjects to a specific value of the running variable, and that subjects are similar in observable characteristics on either side of the cutoff. It is also important to test whether random jumps in the data cause statistically significant treatment effect estimates, and whether characteristics of the subjects are smooth at the cutoff or exhibit a discrete jump. These issues will be examined in Section 4.

3.3 | Estimating equation

For each city i in time period t, let X_{it} denote the proportion of votes in favor of the tax levy. Treatment and control group dummies are denoted $D_{it} = 1$ if $X_{it} > \overline{x}$, where $\overline{x} = 0.50$, the cutoff of the running variable for passing the tax levy, and $D_{it} = 0$ otherwise. The observed outcome is

$$Y_{it} = \alpha + \tau D_{it} + BX_{it} + \delta W_{it} + \varepsilon_{it}, \tag{1}$$

where Y_{it} is the amount of new residential construction, and W_{it} is a set of covariates. The treatment effect τ measures the difference in the value of new residential construction between cities within a small bandwidth of the cutoff that barely renew and fails to renew their recreation tax levies. It is estimated using the bias-corrected estimator of Calonico et al. (2014, 2017, 2019).

There are many options for estimating the treatment effect in Equation (1). Five different bandwidth selection procedures are tried, and three different kernel functions are estimated for each bandwidth selection procedure: uniform, triangular, and Epanechnikov. By showing a variety of bandwidth selection options—and by allowing for local-linear and nonlinear estimation—readers are able to better gauge the robustness of the results.

4 | DATA

4.1 | Voting data

The crux of the data is the collection of votes on parks and recreation spending in Ohio from 1991 to 2018. These votes happen at the local governmental level. Ohio is divided into 88 counties. Each county is subdivided into about 15 townships. Residents may form a village or a city, the boundaries of which may cross township and county lines. The primary differences between cities and villages on the one hand and townships on the other hand are the form of government and tax structure. Townships are governed by a board of trustees, while cities and villages are governed by a mayor and city council. While townships rely entirely on the property tax, cities and villages may also levy an income tax. Although there are joint park districts formed by more than one village, city, or township, the typical case is for each local government to operate its own parks.

There are 1786 votes on park and recreation tax levies available to analyze. More recent years are available on the Ohio Secretary of State's website. The years 1995–2014 were available as .pdf files. A server crash in 1995 left earlier years of data unavailable in computerized format, but the remaining paper records were scanned into .pdf documents to rescue data from 1991 to 1994. As described in Section 1, to preserve the independence of votes, only the 832 renewal levies are analyzed. The value of the running variable X_i, Votes in Favor, is constructed from this data.

4.2 | Outcome data

The Ohio Department of Taxation keeps detailed records about the value of newly constructed property in each governmental unit in the state. Tax rates vary by special district, so the Department of Taxation keeps separate lines for property value in a particular city that may span multiple counties, school districts, and fire districts, for example, making it necessary to aggregate multiple lines of data up to the city level. In this way Y_i, the value of newly constructed residential property, is collected. It is denoted new residential construction in Table 1.

A key assumption of the regression discontinuity design is that no agent can precisely manipulate the running variable. In the current context, evidence of precise assignment of the running variable would show a glut of voting outcomes with just over 50% in favor, with a steep drop-off on the other side of the cutoff. To assess this possibility, researchers typically perform a density test, like the density test of Cattaneo et al. (2018, 2020). We perform the test for both the linear and nonlinear models. The test rejects the null hypothesis of no discontinuity only at p values of 0.14 for the linear model and 0.84 for the nonlinear model, both of which are higher than the current standard of 0.05. The evidence suggests that there is no precise manipulation of the running variable.

4.3 | Covariate data

A variety of covariates is available from the US Census. These covariates should be related to voting for parks and recreation spending, but they are not necessarily related to the outcome variable. The covariates also must not be

TABLE 1 Variable definitions

Variable name	Definition	Source
New residential construction	Value of newly constructed residential buildings in the city in hundreds of thousands of 2010 US dollars, the outcome variable	Ohio Department of Taxation
Votes in favor	Proportion of city residents' votes in favor of renewing a recreation tax levy in the city, the running variable	Secretary of State's Office
Covariates		
Poverty	Proportion of individuals 18 years and older living under the US poverty level	Census
% With kids	Proportion of households with own children under 18 living in the household	Census
Single-parent household	Proportion of households in the city with own children under age 18 living in the household with no spouse present	Census
Unemployment rate	Proportion of population 16 years and older that is unemployed	Census
Income	Median family income in city in 2010 US dollars	Census
% Rent	Proportion of housing units in the city that is renter-occupied	Census
% Under 5 years	Proportion of persons living in the city who are under 5 years old	Census
% Age 5–17	Proportion of persons living in the city who are from 5 to 17 years old	Census
% Age 18–64	Proportion of persons living in the city who are from 18 to 64 years old	Census
% Minority	Proportion of nonwhite persons in the city	Census
% Never married	Proportion of population 15 years and older who have never been married	Census
Separated	Proportion of population in the city aged 15 years and older married but separated	Census
Divorced	Proportion of population in the city aged 15 years and older who are divorced	Census
Labor force participation rate	Proportion of the population 16 years and older in the city that participates in the labor force	Census

Notes: Ohio Department of Taxation refers to Real Property Abstract by Taxing District. Secretary of State's Office refers to .pdf files obtained from Melanie Poole, Serena Henderson, and Mia Yaniko of the Ohio Secretary of State's Office. Recreation renewal tax levies occurred between 1991 and 2018. Census refers to US Census Bureau. The term 'city' means village, city, or township that the house resides in.

outcome variables themselves, and therefore not change discontinuously at the cutoff, testing for which is undertaken later in this subsection. Economic data, such as poverty status, income levels, and the labor force participation rate are included. Parks and recreation being normal goods, we would expect demand to rise with economic characteristics. Variables are also included that are related to marital status and household characteristics. These include the percent of households with children and the prevalence of single-parent households. Tenure status (rent vs. own) may be related to the demand for park services, as might the age distribution within a city, so these covariates are included in the estimation. The percent of nonwhite persons is also added to allow for different demands by ethnicity.

TABLE 2 Variable means by tax levy renewal status

	Global sample		Local sample	
	Failed levies	Passed levies	Failed levies	Passed levies
Outcome variable				
New residential construction	19.1	15.6	16.8	9.9
Covariates				
Poverty	0.11	0.12	0.11	0.12
% With kids	0.40	0.39	0.41	0.39
Single-parent household	0.11	0.11	0.10	0.11
Unemployment rate	0.04	0.06	0.05	0.05
Income	65,548	60,939	67,286	61,804
% Rent	0.26	0.28	0.25	0.27
% Under 5 years	0.07	0.06	0.07	0.07
% Age 5–17	0.20	0.19	0.21	0.20
% Age 18–64	0.59	0.59	0.59	0.59
% Minority	0.05	0.05	0.05	0.04
% Never married	0.22	0.25	0.22	0.23
Separated	0.013	0.014	0.014	0.015
Divorced	0.11	0.11	0.11	0.11
Labor force participation rate	0.64	0.63	0.64	0.64
Number of observations	93	739	50	77

Notes: Sample means shown at the time of the recreation tax levy vote except for the outcome variable, which is new residential construction 1 year after the tax levy vote. The global sample is a full sample of votes; the local sample is the set of votes within a 0.038 bandwidth of the vote share cutoff of 0.50. The number of observations shown for covariates; see additional tables for the number of observations for outcome variables.

Another key assumption of regression discontinuity is that the sets of cities on either side of the cutoff have similar characteristics. Table 2 shows variable means for the group of cities that fails to renew the tax levy and the group of cities that passes the tax levy. Means are shown for the full sample and the local sample around the cutoff. The effective bandwidth of 0.038 on either side of the cutoff comes from the regression of outcomes 1 year after the vote using a uniform kernel and a linear functional form using the methodology of Calonico et al. (2019). The group of cities that fails to renew has somewhat higher incomes—about $5000 higher on a base of $64,000—but this difference in incomes is probably not driving a difference in outcomes because the magnitude of the difference is modest and the correlation between income and the outcome variable is only 0.35. Covariate means are remarkably similar otherwise. Note that new residential construction is higher for the set of cities that vote to cut park funding. This seems curious given that renewing cities will turn out to have a positive instead of a negative treatment effect, but the means in Table 2 are unadjusted means. A similar phenomenon happens in Meyersson (2014), which finds a negative correlation between the outcome and treatment in the raw sample but a positive treatment effect in regression discontinuity estimates.

It is also important to test whether the covariates change abruptly or smoothly at the cutoff. Figures S1–S3 plot the values of the covariates as a function of the running variable. None appears to have much of a discontinuity at the cutoff. A more formal test is to use each covariate as the dependent variable in the estimation of Equation (1). Of the 14 covariates, two have *p* values less than 0.05 for the treatment effect: % Under 5 years and % Minority. Lee and Lemieux (2010, p. 330) say researchers will find some false positives in the presence of many covariates, and it suggests a seemingly unrelated regressions approach. A system of simultaneous regressions is run with each covariate as the dependent variable. The chi-squared test of joint significance has a *p* value of 0.37, failing to reject the null that the continuity gaps for all covariates are zero.

5 | RESULTS

5.1 | One year after tax levy

Plots of new residential construction for various years after voting on parks and recreation tax levies against the proportion of votes in favor of renewal are available in Figures S4–S7. The formal analysis for construction 1 year after the vote appears in Table 3.

TABLE 3 Difference in new residential construction from renewing parks and recreation tax levies, 1 year after vote ($100,000s US)

	Bandwidth selection procedure				
	(1)	(2)	(3)	(4)	(5)
Linear estimates					
Uniform	2.48 (0.75)	−11.16 (0.13)	1.62 (0.84)	2.48 (0.75)	1.62 (0.84)
Triangular	19.77 (0.01)	4.43 (0.50)	14.42 (0.05)	19.77 (0.01)	14.92 (0.04)
Epanechnikov	24.04 (0.01)	3.97 (0.57)	21.82 (0.01)	24.04 (0.01)	21.92 (0.01)
Nonlinear estimates					
Uniform	18.26 (0.06)	6.50 (0.52)	25.52 (0.01)	25.52 (0.01)	18.26 (0.06)
Triangular	24.44 (0.01)	9.06 (0.30)	25.32 (0.01)	24.80 (0.01)	25.30 (0.01)
Epanechnikov	28.73 (0.01)	9.01 (0.31)	26.60 (0.01)	28.73 (0.01)	26.60 (0.01)

Notes: Regression discontinuity treatment effect estimates shown with *p* value in parentheses below using a variety of different options. Number of observations is 775. Bandwidth selection procedures are bias-corrected, mean-squared error optimal bandwidths based on the rdrobust command in Stata, as detailed in Calonico et al. (2014, 2017). (1) is a robust bias-corrected bandwidth selection procedure that uses a common bandwidth on both sides of the cutoff; (2) allows two distinct bandwidths on either side of the cutoff; (3) selects the bandwidth for the sum of the estimates; (4) selects the minimum of (1) and (3); and (5) selects the median of (1)–(3) for each side of the cutoff separately. The linear estimates use local-linear regression for the point estimates of the treatment effect and a local quadratic regression for the bias correction, which are the defaults for the rdrobust command. The nonlinear estimates allow quadratic and cubic regression for the point estimates and bias correction. Uniform, triangular, and Epanechnikov are different kernel functions to construct the local-polynomial estimators. The covariates listed in Table 1 are included in all regressions. The default variance–covariance matrix estimator is used, which mandates that at least three nearest neighbors are used in the calculations.

Table 3 shows a statistically significant treatment effect for 8 out of 15 linear regressions and 10 out of 15 nonlinear regressions. The average treatment effect is 20.1 for the linear regressions but a substantially higher 26.2 for the nonlinear regressions. The nonlinear regressions will turn out to show a stronger, more consistent pattern of significance. Further interpretation is reserved for the next set of regressions.

5.2 | Two years after tax levy

Table 4 shows regression results for the second year after voting on parks and recreation tax levy renewal.

Table 4 shows an even less robust pattern of significance for the linear regressions than the results for year $t + 1$, with only 4 out of 15 statistically significant treatment effects. The nonlinear results, on the other hand, are even more robust than before, with significance achieved in 14 out of 15 regressions. The magnitude of the treatment effect has fallen for both linear and nonlinear regressions. For the nonlinear regressions it has fallen from 26.2 to 19.8, which still indicates $1.98 million more residential new construction in cities that renew parks and recreation taxes relative to those that fail to renew.

TABLE 4 Difference in new residential construction from renewing parks and recreation tax levies, 2 years after vote ($100,000s US)

	Bandwidth selection procedure				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Linear estimates					
Uniform	13.12 (0.03)	2.31 (0.72)	13.79 (0.02)	13.79 (0.02)	13.12 (0.03)
Triangular	3.49 (0.49)	1.35 (0.79)	1.66 (0.75)	3.49 (0.49)	1.89 (0.71)
Epanechnikov	6.68 (0.22)	0.65 (0.91)	2.53 (0.65)	6.68 (0.22)	2.71 (0.62)
Nonlinear estimates					
Uniform	17.72 (0.02)	20.54 (0.01)	18.88 (0.01)	17.72 (0.02)	18.88 (0.01)
Triangular	19.01 (0.01)	13.96 (0.06)	19.32 (0.01)	19.32 (0.01)	19.24 (0.01)
Epanechnikov	20.22 (0.01)	24.41 (0.01)	20.75 (0.01)	20.39 (0.01)	20.96 (0.01)

Notes: Regression discontinuity treatment effect estimates shown with p value in parentheses below using a variety of different options. Number of observations is 769. Bandwidth selection procedures are bias-corrected, mean-squared error optimal bandwidths based on the rdrobust command in Stata, as detailed in Calonico et al. (2014, 2017). (1) is a robust bias-corrected bandwidth selection procedure that uses a common bandwidth on both sides of the cutoff; (2) allows two distinct bandwidths on either side of the cutoff; (3) selects the bandwidth for the sum of the estimates; (4) selects the minimum of (1) and (3); and (5) selects the median of (1)–(3) for each side of the cutoff separately. The linear estimates use local-linear regression for the point estimates of the treatment effect and a local quadratic regression for the bias correction, which are the defaults for the rdrobust command. The nonlinear estimates allow quadratic and cubic regression for the point estimates and bias correction. Uniform, triangular, and Epanechnikov are different kernel functions to construct the local-polynomial estimators. The covariates listed in Table 1 are included in all regressions. The default variance–covariance matrix estimator is used, which mandates that at least three nearest neighbors are used in the calculations.

5.3 | Three years after tax levy

Table 5 shows treatment effect estimates of new residential construction 3 years after the tax levy is held.

Statistical significance has vanished for the linear estimates but still remains the rule for the nonlinear estimates, where 12 out of 15 estimates are significant. The magnitude of the treatment effect continues to fall, from 19.8 in the previous period to 14.1 three years after the tax levy.

5.4 | Four years after tax levy

Table 6 shows treatment effect estimates 4 years after the tax levy.

Table 6 continues the trend of declining statistical and economic significance. Treatment effect estimates remain insignificant for the linear case, and the prevalence of significance has declined to 4 out of 15 estimates for the nonlinear regressions. If one were to interpret the nonlinear estimates, it would reveal an average treatment effect of 11.8, although zero would be a reasonable interpretation as well.

TABLE 5 Difference in new residential construction from renewing parks and recreation tax levies, 3 years after vote ($100,000s US)

	Bandwidth selection procedure				
	(1)	(2)	(3)	(4)	(5)
Linear estimates					
Uniform	5.65	1.10	5.68	5.68	5.65
	(0.33)	(0.86)	(0.33)	(0.33)	(0.33)
Triangular	1.81	−1.99	4.50	4.50	2.31
	(0.71)	(0.68)	(0.35)	(0.35)	(0.64)
Epanechnikov	−0.93	1.69	0.81	0.81	0.72
	(0.86)	(0.75)	(0.88)	(0.88)	(0.89)
Nonlinear estimates					
Uniform	14.58	10.80	11.79	14.58	12.95
	(0.02)	(0.25)	(0.07)	(0.02)	(0.04)
Triangular	14.20	9.88	12.00	14.20	13.53
	(0.01)	(0.14)	(0.03)	(0.01)	(0.02)
Epanechnikov	14.33	14.62	14.12	14.33	15.37
	(0.02)	(0.04)	(0.02)	(0.02)	(0.01)

Notes: Regression discontinuity treatment effect estimates shown with *p* value in parentheses below using a variety of different options. Number of observations is 767. Bandwidth selection procedures are bias-corrected, mean-squared error optimal bandwidths based on the rdrobust command in Stata, as detailed in Calonico et al. (2014, 2017). (1) is a robust bias-corrected bandwidth selection procedure that uses a common bandwidth on both sides of the cutoff; (2) allows two distinct bandwidths on either side of the cutoff; (3) selects the bandwidth for the sum of the estimates; (4) selects the minimum of (1) and (3); and (5) selects the median of (1)–(3) for each side of the cutoff separately. The linear estimates use local-linear regression for the point estimates of the treatment effect and a local quadratic regression for the bias correction, which are the defaults for the rdrobust command. The nonlinear estimates allow quadratic and cubic regression for the point estimates and bias correction. Uniform, triangular, and Epanechnikov are different kernel functions to construct the local-polynomial estimators. The covariates listed in Table 1 are included in all regressions. The default variance–covariance matrix estimator is used, which mandates that at least three nearest neighbors are used in the calculations.

TABLE 6 Difference in new residential construction from renewing parks and recreation tax levies, 4 years after vote ($100,000s US)

	Bandwidth selection procedure				
	(1)	(2)	(3)	(4)	(5)
Linear estimates					
Uniform	−2.29	−1.21	−0.93	−0.93	−2.46
	(0.71)	(0.84)	(0.88)	(0.88)	(0.68)
Triangular	−2.08	−0.22	−2.46	−2.08	−2.03
	(0.69)	(0.97)	(0.64)	(0.69)	(0.70)
Epanechnikov	−1.70	−1.47	−2.38	−1.70	−1.68
	(0.77)	(0.80)	(0.68)	(0.76)	(0.77)
Nonlinear estimates					
Uniform	13.74	6.26	12.06	13.74	12.06
	(0.05)	(0.32)	(0.07)	(0.05)	(0.07)
Triangular	9.38	13.03	9.21	9.37	9.27
	(0.11)	(0.03)	(0.08)	(0.11)	(0.08)
Epanechnikov	9.16	7.27	8.80	9.16	8.80
	(0.13)	(0.18)	(0.14)	(0.13)	(0.14)

Notes: Regression discontinuity treatment effect estimates shown with p value in parentheses below using a variety of different options. Number of observations is 734. Bandwidth selection procedures are bias-corrected, mean-squared error optimal bandwidths based on the rdrobust command in Stata, as detailed in Calonico et al. (2014, 2017). (1) is a robust bias-corrected bandwidth selection procedure that uses a common bandwidth on both sides of the cutoff; (2) allows two distinct bandwidths on either side of the cutoff; (3) selects the bandwidth for the sum of the estimates; (4) selects the minimum of (1) and (3); and (5) selects the median of (1)–(3) for each side of the cutoff separately. The linear estimates use local-linear regression for the point estimates of the treatment effect and a local quadratic regression for the bias correction, which are the defaults for the rdrobust command. The nonlinear estimates allow quadratic and cubic regression for the point estimates and bias correction. Uniform, triangular, and Epanechnikov are different kernel functions to construct the local-polynomial estimators. The covariates listed in Table 1 are included in all regressions. The default variance–covariance matrix estimator is used, which mandates that at least three nearest neighbors are used in the calculations.

6 | FALSIFICATION TESTING AND EXTENSIONS

The results suggest a treatment effect that starts 1 year after voting on tax levy renewal and diminishes in magnitude in successive years. This is a standard pattern of results for regression discontinuity studies. However, it may be possible to find treatment effects in years before treatment even occurs. This would be curious. If a vote in 2011 causes a change in new residential construction in 2010, it casts into question the validity of the treatment effect estimates. To this end we test whether there is a difference in the value of newly constructed residential property between communities that pass and fail parks and recreation tax levies 1 and 2 years *before* voting occurs. Treatment effect estimates are shown in Tables S1 and S2, with Figures S8 and S9 the associated graphs. While there are occasional statistically significant treatment effects, they are the exception rather than the rule. The linear models show statistical significance in 3 out of 30 cases, and the nonlinear models show statistical significance in 5 out of 30 cases.

We also compare the results of using renewal tax levies to those of the 662 new tax levies during the same timeframe—levies that ask for additional money for parks and recreation spending. We replicate Tables 3 and 4 which show treatment effect estimates 1 and 2 years after voting. Unlike renewal tax levies, the new tax levies show no statistically significant treatment effects. The results could indicate bias from the endogenous timing of new tax levies, but three other explanations are possible. One, the psychological effects of taking away existing

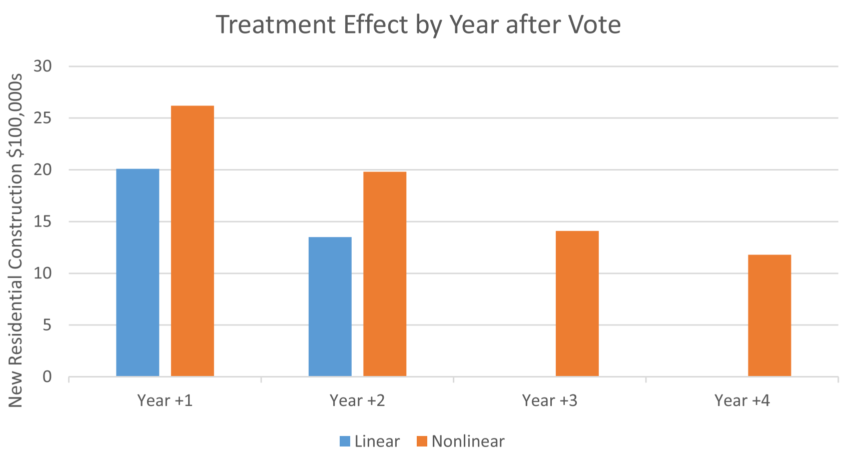

FIGURE 1 Treatment effect by year after vote

park funding may be stronger than the effects of adding new park funding, as the theory of loss aversion implies (Tversky & Kahneman, 1991). Two, prosperous communities may propose new park levies more often than poorer ones, so comparing the treatment effects between renewal levies and new levies is not an apples-to-apples comparison. Three, house price hedonic studies usually find park and recreational amenities positively capitalized. When tax rates are not controlled for but a change in spending is analyzed, as in the current case, positive capitalization implies an inefficiently low amount of spending on the public service (Brueckner, 1979). If true, cutting funding on an already inefficiently underprovided public service could seriously depress developer activity; whereas adding spending from passing a new tax levy might not have as big an effect.

We now compare the results of the regression discontinuity analysis to estimates using two-way fixed and random-effects panel data models. The voting data are merged with the outcome data and the same covariates from Table 1. The fixed-effects model yields an estimate of park spending renewal of 10.9 with a p value of 0.01. The corresponding estimate for the random-effects model is 10.6. This is about half the magnitude of the estimates achieved with regression discontinuity. The panel data estimates may be biased from time-varying unobserved variables, but comparing the estimates is not an apples-to-apples comparison because the panel data models identify treatment from the full sample of cities that have votes to renew parks and recreation tax levies, while the regression discontinuity model uses only the set of cities within a narrow bandwidth around the 0.50 cutoff.

7 | CONCLUSION

Natural and man-made amenities have been linked to migration and economic growth. The current study examines growth at the highly localized level of municipal government—cities, villages, and townships in Ohio. Our measure of growth is novel, too: the value of newly constructed residential buildings. Unlike most prior growth studies, the current study uses regression discontinuity to identify its estimates. Regression discontinuity is a powerful causal inference technique with minimal, testable assumptions that mimic the estimates of randomized experiments.

We find renewing funding for parks and recreation causes more new residential construction than in cities that vote to cut funding. The amount of extra new construction diminishes as time passes, as summarized in Figure 1.

The linear estimates dissipate 3 years after the vote, while some nonlinear estimates remain statistically significant 4 years after the vote, albeit at a lower magnitude. The typical parks and recreation tax levy is 1 mill, or 0.1%. The typical house in Ohio is worth $161,507 (Zillow, 2020), and Ohio assesses property at 35%, so voting against the tax levy saves a household about $56,527 ∗ 0.001 = $56.5, about the cost of five large cheese pizzas.

Using the nonlinear estimates, the $56.5 savings to a household costs the community $2.62 million in lost new residential construction. The average property tax in Ohio is 1.57%, so that $41,134 in tax revenue would be lost in the first period alone—almost enough to pay the $48,000 salary of a firefighter (CareerExplorer, 2020).

We explored other possible outcomes of parks and recreation tax levy renewal, but there was no consistent pattern of significant treatment effect for commercial new construction, industrial new construction, or agricultural new construction. A sufficiently large sample of votes with a concomitant increase in power might reveal an effect. The estimates do complement those of Brasington (2021), however, which finds that cutting parks and recreation funding causes an increase in the demolition of residential structures. In a state with stagnant population, like, Ohio, demolition is less likely to make way for higher-value reconstruction and more likely to remove derelict houses that are eyesores and magnets for crime (Immergluck & Smith, 2006). The two studies together suggest that renewing funding for parks and recreation causes increased investment in housing through maintenance, rehabilitation, and new construction. Cutting park spending, by contrast, causes decreased maintenance and rehabilitation, leading to increased demolition of abandoned structures and less new construction.

ACKNOWLEDGMENTS

The author is thankful for funding to secure the housing data set from the James C. and Caroline Kautz Chair in Political Economy, the University of Cincinnati Third Century grant, and the Lindner College of Business. Thanks also to Melanie Poole, Serena Henderson, and Mia Yaniko of the Ohio Secretary of State's office for providing voting data, and to students for painful data work: Thai Binh Tran, Alex Rack, Rucha Patil, Dhanashree Pokale, Deepthi Arumalla, Duy Tran, Eugene Owusu-Awuah, Stormi Stevens, Vaibhav Kamble, and Disha Shende. Special thanks to the Taft Research Center for a sabbatical extension award.

FUNDING INFORMATION

Brasington received funding from the Lindner College of Business and the University of Cincinnati University Research Council Third Century Grant. Brasington worked on this paper during a Faculty Release Fellowship provided by the Charles P. Taft Research Center.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

Data available from the author upon request.

ORCID

David M. Brasington http://orcid.org/0000-0001-5406-8543

REFERENCES

Acemoglu, D. (2012). Introduction to economic growth. *Journal of Economic Theory*, *147*(2), 545–550.

Albouy, D., Cho, H., & Shappo, M. (2021). Immigration and the pursuit of amenities. *Journal of Regional Science*, *61*(1), 5–29.

Baum-Snow, N., & Ferreira, F. (2015). Causal inference in urban and regional economics. In G. Duranton, V. Henderson, & W. Strange (Eds.), *Handbook of regional and urban economics* (Vol. 5, pp. 3-68). Elsevier.

Bergstrom, J. C., Cordell, H. K., Ashley, G. A., & Watson, A. E. (1990). Economic impacts of recreational spending on rural areas: A case study. *Economic Development Quarterly*, *4*(1), 29–39.

Berk, R., Barnes, G., Ahlman, L., & Kurtz, E. (2010). When second best is good enough: A comparison between a true experiment and a regression discontinuity quasi-experiment. *Journal of Experimental Criminology*, *6*(2), 191–208.

Borgoni, R., Michelangeli, A., & Pontarollo, N. (2018). The value of culture to urban housing markets. *Regional Studies*, *52*(12), 1672–1683.

Brasington, D. M. (2017a). What types of people sort to which public services? *Papers in Regional Science*, *96*(3), 537–553.

Brasington, D. M. (2017b). School spending and new construction. *Regional Science and Urban Economics*, *63*, 76–84.

Brasington, D. M. (2021). *The unexpected role of parks and recreation tax levies on the demolition and redevelopment of residential property (Working paper)*. Economics Department, University of Cincinnati.

Brueckner, J. K. (1979). Property values, local public expenditure and economic efficiency. *Journal of Public Economics*, *11*(2), 223–245.

Buddelmeyer, H., & Skoufias, E. (2004). *An evaluation of the performance of regression discontinuity design on PROGRESA*. The World Bank

Calonico, S., Cattaneo, M. D., Farrell, M. H., & Titiunik, R. (2017). rdrobust: Software for regression-discontinuity designs. *The Stata Journal*, *17*(2), 372–404.

Calonico, S., Cattaneo, M. D., Farrell, M. H., & Titiunik, R. (2019). Regression discontinuity designs using covariates. *Review of Economics and Statistics*, *101*(3), 442–451.

Calonico, S., Cattaneo, M. D., & Titiunik, R. (2014). Robust nonparametric confidence intervals for regression-discontinuity designs. *Econometrica*, *82*(6), 2295–2326.

CareerExplorer. (2020). Accessed 11/24/20. https://www.careerexplorer.com/careers/firefighter

Carlino, G. A., & Saiz, A. (2019). Beautiful city: Leisure amenities and urban growth. *Journal of Regional Science*, *59*(3), 369–408.

Cattaneo, M. D., Jansson, M., & Ma, X. (2018). Manipulation testing based on density discontinuity. *The Stata Journal*, *18*(1), 234–261.

Cattaneo, M. D., Jansson, M., & Ma, X. (2020). Simple local polynomial density estimators. *Journal of the American Statistical Association*, *115*(531), 1449–1455.

Cellini, S. R., Ferreira, F., & Rothstein, J. (2010). The value of school facility investments: Evidence from a dynamic regression discontinuity design. *The Quarterly Journal of Economics*, *125*(1), 215–261.

Clark, D. E., & Cosgrove, J. C. (1991). Amenities versus labor market opportunities: Choosing the optimal distance to move. *Journal of Regional Science*, *31*(3), 311–328.

English, D. B. (2000). Calculating confidence intervals for regional economic impacts of recreation by bootstrapping visitor expenditures. *Journal of Regional Science*, *40*(3), 523–539.

Faggian, A., & McCann, P. (2009). Human capital, graduate migration and innovation in British regions. *Cambridge Journal of Economics*, *33*, 317–333.

Faggian, A., Olfert, M. R., & Partridge, M. D. (2012). Inferring regional well-being from individual revealed preferences: The 'voting with your feet' approach. *Cambridge Journal of Regions, Economy and Society*, *5*(1), 163–180.

Gao, L., & Sam, A. G. (2019). Does climate matter? An empirical study of interregional migration in China. *Papers in Regional Science*, *98*(1), 477–496.

Garretsen, H., & Marlet, G. (2017). Amenities and the attraction of Dutch cities. *Regional Studies*, *51*(5), 724–736.

Hong, G. (2016). Examining the role of amenities in migration decisions: A structural estimation approach. *Papers in Regional Science*, *95*(4), 733–754.

Humphreys, B. R., & Ruseski, J. E. (2007). Participation in physical activity and government spending on parks and recreation. *Contemporary Economic Policy*, *25*(4), 538–552.

Immergluck, D., & Smith, G. (2006). The impact of single-family mortgage foreclosures on neighborhood crime. *Housing Studies*, *21*(6), 851–866.

Keith, J., & Fawson, C. (1995). Economic development in rural Utah: Is wilderness recreation the answer? *The Annals of Regional Science*, *29*(3), 303–313.

Knapp, T. A., & Gravest, P. E. (1989). On the role of amenities in models of migration and regional development. *Journal of Regional Science*, *29*(1), 71–87.

Lee, D. S., & Lemieux, T. (2010). Regression discontinuity designs in economics. *Journal of Economic Literature*, *48*, 281–355.

Levitt, S. D. (2002). Using electoral cycles in police hiring to estimate the effects of police on crime: Reply. *American Economic Review*, *92*(4), 1244–1250.

Li, W., & Saphores, J. D. (2012). A spatial hedonic analysis of the value of urban land cover in the multifamily housing market in Los Angeles, CA. *Urban Studies*, *49*(12), 2597–2615.

Lutzenhiser, M., & Netusil, N. R. (2001). The effect of open spaces on a home's sale price. *Contemporary Economic Policy*, *19*(3), 291–298.

Marcouiller, D. W., & Prey, J. (2005). The tourism supply linkage: Recreational sites and their related natural amenities. *Journal of Regional Analysis & Policy*, *35*(1), 23–32.

Marré, A. W., & Rupasingha, A. (2020). School quality and rural in-migration: Can better rural schools attract new residents? *Journal of Regional Science*, *60*(1), 156–173.

McDonald, G. T., & Wilks, L. C. (1986). The regional economic impact of tourism and recreation in national parks. *Environment and Planning B: Planning and Design*, *13*(3), 349–366.

Melichar, J., Vojáček, O., Rieger, P., & Jedlička, K. (2009). Measuring the value of urban forest using the hedonic price approach. *Regional Studies*, *2*, 13–20.

Meyersson, E. (2014). Islamic rule and the empowerment of the poor and pious. *Econometrica*, *82*(1), 229–269.

Partridge, M. D. (2010). The dueling models: NEG vs. amenity migration in explaining US engines of growth. *Papers in Regional Science*, *89*, 513–536.
Ranis, G., Stewart, F., & Ramirez, A. (2000). Economic growth and human development. *World Development*, *28*(2), 197–219.
Ravallion, M., & Datt, G. (2002). Why has economic growth been more pro-poor in some states of India than others? *Journal of Development Economics*, *68*(2), 381–400.
Rickman, D. S., & Wang, H. (2017). US regional population growth 2000–2010: Natural amenities or urban agglomeration? *Papers in Regional Science*, *96*, S69–S90.
Rodríguez-Pose, A., & Ketterer, T. D. (2012). Do local amenities affect the appeal of regions in Europe for migrants? *Journal of Regional Science*, *52*(4), 535–561.
Shadish, W. R., Galindo, R., Wong, V. C., Steiner, P. M., & Cook, T. D. (2011). A randomized experiment comparing random and cutoff-based assignment. *Psychological Methods*, *16*(2), 179–191.
Thistlethwaite, D. L., & Campbell, D. T. (1960). Regression-discontinuity analysis: An alternative to the ex post facto experiment. *Journal of Educational Psychology*, *51*(6), 309–317.
Tiebout, C. M. (1956). A pure theory of local expenditures. *Journal of Political Economy*, *64*(5), 416–424.
Tversky, A., & Kahneman, D. (1991). Loss aversion in riskless choice: A reference-dependent model. *The Quarterly Journal of Economics*, *106*(4), 1039–1061.
Wu, W., & Dong, G. (2014). Valuing the "green" amenities in a spatial context. *Journal of Regional Science*, *54*(4), 569–585.
Zillow. (2020). *Ohio home values*. Accessed 11/24/20. https://www.zillow.com/oh/home-values/

SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

How to cite this article: Brasington, D. M. (2022). Local economic growth and local government investment in parks and recreation, or five cheese pizzas for $2.6 million. *Journal of Regional Science*, 62, 81–95. https://doi.org/10.1111/jors.12554