The Impact of the Carrollton GreenBelt on Residential Housing Prices: A Spatial Approach

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ABSTRACT

The Carrollton GreenBelt is a linear park encircling the City of Carrollton Georgia. The GreenBelt differs from other linear parks in that it is an entirely new construction and was not built upon existing rail lines, as was the Atlanta Beltline and the nearby Silver Comet Trail. Using GIS, data from the Carroll County Tax Assessor's office and spatial econometric techniques, we estimate local fair-market housing values within the hedonic framework to measure the relationship between home prices and access to the GreenBelt. We find the expected positive effects from the number of bedrooms, bathrooms and square footage, but access to the GreenBelt is associated with lower housing sale prices during the period; however, these lower prices may also be the result of conscious location decisions of the GreenBelt developers in an attempt to lower land acquisition costs in the development phase. Despite our efforts to control for distance to the center of the city, the negative association between the GreenBelt and housing values may be impacted by the endogeneity between GreenBelt location and residential housing prices.

INTRODUCTION

As any real estate agent will attest, the market sales price of a residence depends on a multitude of factors, including characteristics of the structure and property itself, as well as other characteristics of the neighborhood. These other characteristics include measures of accessibility. Buyers are concerned with how close their new home is to various amenities or dis-amenities such as metrorails, energy facilities, coasts, and schools within the cityscape. In general, access to local amenities would tend to increase the value of nearby homes, so long as the amenity is itself attractive. A host of studies have empirically investigated the presence of and the size of such effects on property values (Sah et al., 2016; Hoen et al., 2011; Gatzlaff & Smith, 1993; Conroy & Milosch, 2009). However, access is not necessarily a binary characteristic of a property. Some properties may have better access than others, while all properties have some level of access. In our research, we use distance (in miles and feet) as a measure of the level of access for each property in our data set.

Previous studies have examined the effect of a park or facility that is spatially compact or located in a single place on neighboring property values (Cho et al., 2006; Biao et al., 2012; Crompton, 2005; Anderson & West, 2006; Troy & Grove, 2008; Heckret & Mennis, 2012; Irwin, 2002; Kuethe, 2012; Conway et al., 2008; Kong et al., 2007; Park et al., 2017; Votsis, 2017; Engstrom & Gren, 2017; Dehring & Dunse, 2006). Our analysis focuses on the impact of the Carrollton GreenBelt on nearby home prices. The Carrollton GreenBelt differs from other parks in that it is an eighteen-mile linear trail that wraps around the City of Carrollton, Georgia and traverses neighborhoods of various income levels and housing choices (www.carrolltongreenbelt.com). In many ways, the GreenBelt, and other parks like it, act as a recreational park and non-motorized transit corridor simultaneously. While new amenity options may be great for users, it is not at all clear how nearby homes may be affected by the presence of that amenity. For example, new highways can have either a positive or negative impact on nearby property values. Access to a major highway lowers the cost of transportation for people residing near the highway, which allows local residents the ability to redirect income towards other uses like housing; however, increased traffic and local congestion that comes from a new transit option is typically viewed as negative by homeowners and potential home-buyers. Likewise, building a new park will increase the accessibility to recreational facilities of nearby parcels, which may have previously had poor access to this type of feature, but the addition of a park may increase traffic volume, which may in turn increase congestion or result in other negative outcomes near properties that formerly had less access to these features. A similar argument has been proposed in the planning literature. Newman (1972) suggests that poorly designed parks for which security is difficult to ensure may result in increased crime or other activities and are associated with lower property values. Other studies reveal that even when there is no objective increased risk of crime, higher socioeconomic status white people perceive danger when parks connect with lower-income and racially diverse neighborhoods (Farr et al., 2015). Thus, the net effect of a park or open space is theoretically ambiguous, and is an empirical problem requiring data. This work is also novel in that it focuses on a city with a population of less than 50,000 residents, which represents the residential location of about a quarter of the U.S. population in incorporated areas (Cohen et al., 2015). Previous work has focused on more densely populated areas where open space may be relatively scarce by comparison (Nicholls & Crompton, 2005; Lindsey et al., 2004; Parent and vom Hofe, 2013; Campbell & Munroe, 2007; Park et al., 2017; Saphores & Li, 2012; Palardy et al., 2018; Immergluck & Balan, 2017).

Our research aims to predict the relationship between the creation of a new, novel park and transportation feature in a small Georgia city and nearby home prices. The GreenBelt differs from other linear parks in that it is an entirely new construction and was not built upon existing rail lines, as was the Atlanta Beltline and the nearby Silver Comet Trail. We estimate a hedonic regression to determine the effect of GreenBelt accessibility along with the other major characteristics as factors contributing to the final market value of homes in the City of Carrollton Georgia. A potential weakness of our model is the potential for the presence of endogeneity of the GreenBelt's location and the price of surrounding property. Developers of the GreenBelt likely chose to build it areas of the city that were less developed (i.e., with more greenspace) for aesthetic purposes; however, these less developed areas of the city may also be where land acquisition was also less expensive. Within the present framework, we are unable to conclusively determine the direction of causation between real estate prices and GreenBelt location. However, we control for distance to Adamson Square, traditionally viewed as the center of Carrollton in an attempt to partially address this endogeneity issue.

LITERATURE REVIEW

The Carrollton GreenBelt broke ground in 2011 and was completed in early 2017. It was designed as a public-private partnership between the Friends of the Carrollton GreenBelt, LLC and the City of Carrollton, Georgia, with funding from private, city, state, and federal sources. Maximum connectivity was a central goal in its planning, and it links schools (K-12 as well as the university), major places of employment, commercial areas, and existing parks. It was designed to go through neighborhoods of various socioeconomic status, as revealed in census tract data.

As assets to their communities, parks and green spaces have many recreational, social, and health benefits, including positive contributions to perceived quality of life (Bricker et al., 2016). Spending time in nature also has mental health benefits (Bratman et al., 2015). Parks, as features of the built environment, are increasingly identified as critical to public health, especially because of the ways they facilitate physical activity (Coutts 2009; Fitzhugh et al., 2010).

These general findings were corroborated in a recent study of the Carrollton GreenBelt study, led by Gezon (Gezon et al., 2016). Her team used a mixed-method approach, combining surveys with in-depth interviews. Important findings were that,

> "the majority of people reported that the GreenBelt makes it easier for them to find time to exercise, allows them to get more exercise than before it was available, increases their enjoyment of doing moderate or vigorous physical activity and leaves them feeling like they are in a better state of health and/or physical ability than they were before they started using the trail (Gezon et al., 2016)."

Although the above study did not include any measure of accessibility to the GreenBelt as a variable, it was inferred that people who live closer to the GreenBelt would have easier access to the amenity, and as a consequence experience an increased quality of life. Based on this "amenity value" the authors suggested that proximity to the GreenBelt should increase a property's desirability (Gezon et al., 2016). Palardy et al., 2018 analyze residents' attitudes toward greenways, specifically, the Atlanta Beltline, using surveys. They find that support for this greenway is a mix of use and perceptions of the economic benefits the greenspace. However, the relationship between housing values and its distance to the GreenBelt is an empirical question.

Prior studies have analyzed the impact of different amenities such as parks and other open spaces on the value of properties within close proximity (Cho et al., 2006; Biao et al., 2012; Crompton, 2005; Anderson & West, 2006; Troy & Grove, 2008; Heckret & Mennis, 2012; Irwin, 2002; Kuethe, 2012; Conway et al., 2008; Kong et al., 2007; Park et al., 2017; Votsis, 2017; Engstrom & Gren, 2017; Dehring & Dunse, 2006). The literature has investigated the impact of parks using spatial hedonic regression and estimation techniques. As largely expected, properties near parks experience increases in value when compared to those properties further away (Cho et al., 2006; Biao et al., 2012; Crompton, 2005; Votsis, 2017; Engstrom &Gren, 2017). Anderson and West (2006) measured the effect of the nearest neighborhood park, special park (defined as national, state, and regional parks, arboretums, nature centers, natural areas, and wildlife refuges), golf course, and cemetery on home prices. They found higher values for properties in close proximity to open space in neighborhoods that are dense, near the central business district, high-income, high-crime, or home to many children. However, other studies have found negative effects for properties neighboring parks with high levels of crime such as rape and robbery (Troy & Grove, 2008).

In moderately distressed regions, premiums have also been found for properties adjacent to vacant land that has undergone the treatment of a greening program, although these areas are not parks or public greenspaces (Heckret & Mennis, 2012). Saphores and Li (2012) estimate the value of urban green areas (tree covered areas, grassy areas, parks, cemeteries, golf courses, lakes, and rivers) on single family houses in Los Angeles, CA. They find that being further away from the nearest greenspace decreases the value of a property. However, distance to nearest neighborhood park and cemetery were not statistically significant. Irwin (2002) examines whether open space is valued for its particular attributes versus for simply not being developed and found that the spillover effects from preserved open space are significantly greater than those associated with developable farmland and forest. The spillovers from pasture versus cropland are not significantly different, but there is a significantly greater effect on residential property next to pastureland when compared to that near forests. In contrast to most of the prior literature, Kuethe (2012) found that residential properties in the city of Milwaukee that were farther away from the open space experienced higher values. However, the author suspected this outcome may have been driven by the city's definition of open space which includes public parks, cemeteries, and undeveloped vacant lands.

Conway et al. (2008) estimate the impact of neighborhood greenspace on residential property values using data from near downtown Los Angeles. They found that a 1% increase in the amount of greenspace within 200 to 300 feet would add about 0.07% to the expected sales price or an increase of $171 of the median price. Distances greater than 300 feet were insignificant. Kong et al. (2007) examined the effects of urban green spaces, categorized into three groups: plaza, park, and scenery forest, on residential property values in Jinan City, China. They found that property prices are significantly influenced by the features of urban green spaces. Specifically, the aggregation of green space, number of green space patches, and percentage of green spaces had a positive impact on property values. Their results also indicated that residents appreciate green housing districts and easier accessibility to scenery forest areas, parks, and plaza green space types.

The contribution of other greenspaces such as greenways, greenbelts, or linear parks has become one amenity of great interest in the literature and is our primary focus here. Generally, as with parks, higher valuation of properties has been associated with shorter distances to the greenspace, i.e. greenbelts, greenways, etc. Immergluck and Balan (2017) find a 17.9 to 26.6 percent increase in value for properties within one half of a mile of the Atlanta Beltline. Herath et al. (2015) examine the effect of the greenbelt on apartment prices in the city of Vienna, Austria. As expected, a significant negative relationship was found between distance to greenbelt and apartment values, and their spatial Durbin model validated these results. Parent and vom Hofe (2013) estimate the effect of the Little Miami Scenic Trail (with focus on the 12 miles of the trail that runs through Hamilton County, Ohio) on residential property values. The results showed that the value of the average home declined by $3.98 per additional foot (along the network) from the residential property to the trail entrance.

Nicholls and Crompton (2005) studied Barton Creek Greenbelt and Wilderness Park in Austin, Texas. Distance was represented two ways: as a continuous variable, measuring distance from each property to closest greenbelt entrance and as a dummy variable, measuring distance to nearest greenbelt entrance in quarter-mile increments. The model was estimated using the distance variables separately for three different locations: Barton, Lost Creek, and Travis neighborhoods. When using the continuous distance variables, significant premiums were found in 2 of the 3 neighborhoods. The view of the greenbelt and distance to nearest greenbelt entrance had no significant influence on property values. Using the dummy variables for distance instead, no significant relationship was found with sales prices for the Barton and Travis neighborhoods. However, in the Lost Creek area properties within a quarter of a mile from a greenbelt entrance experienced a significant $46,086 increase in property value. Those between three quarters and one mile saw a significant $28,715 increase in value, and a statistical decrease of $45,384 in sales price was found for properties one quarter to one mile away from a greenbelt entrance.

Campbell and Munroe (2007) provided an analysis of the impact of a projected extension of the Catawba Regional Trail through three counties on nearby single- and multi- family residential and commercial real estate values. The authors explored several distance relationships: linear distance decay, exponential decay, and threshold effects. The results showed that property values declined at an exponential rate as the distance from the greenway increased. More specifically, a 0.03% increase in value ($3,200) was found for single family properties, a 0.0013% increase ($230) for multi-family properties, and 0.0172% increase ($4,500) for commercial properties for every 1% decrease in distance. Properties within 1,000 feet of the greenway saw the maximum benefit, and all benefits were diminished for properties more than 5,000 feet (1 mile) from the greenway.

Correll et al. (1978) conducted an empirical analysis of three different greenbelt locations in Boulder, Colorado. They examined single-family residential property values as a function of walking distance (in feet) using the most direct public access to the greenbelt for the entire sample and for individual neighborhoods. Their findings suggested a negative relationship between distance and property values. Property values declined by an average of $4.20 per foot separating the residence from the greenbelt. Properties within 3,200 feet (walking distance from the greenbelt) experienced a 32% increase in value on average. When examining the neighborhoods individually, the distance variable had a different impact depending on the neighborhood. The authors find a $10.20 decline for every additional foot of distance from the greenbelt in the first neighborhood; however, they estimated a $3.40 increase per foot for the second neighborhood. No significant effects were found for the third neighborhood. These varied results, the authors suggested, is due to the timing and planning of the greenbelt purchases in relation to residential construction.

Lindsey et al. (2004) examined the effects of the Indianapolis Greenways System on residential property values. Dummy variables were used to indicate those properties within one half mile of the Monon Trail, those within one half mile of trails in other recreational areas, and those in the conservation area. They also included secondary data from surveys regarding individuals' perceptions about effects of the Monon Trail on property values. Some but not all of the greenways were found to have positive effects on property values. Specifically, a 14% ($13,056) increase in price was predicted for properties within one-half mile of the Monon Trail and a 2% ($2,239) increase for those properties in the greenway conservation areas. No significant impact was found for properties within one-half mile of trails in other recreational areas.

Lee and Linnerman (1998) focused on Seoul's greenbelt and its impact using the hedonic pricing model. Both urban and rural areas were included in their analysis. Several variables were used to measure accessibility to the greenbelt: air distance to greenbelt, dummy variables for areas near the inner boundary, outer boundary, and outside the greenbelt area, dummy variable for greenbelt area, and an interaction of distance to greenbelt and outside the greenbelt area. Changes at a single point in time and over time were examined. Results indicated the value added from the greenbelt was high, but the marginal benefits had declined over time.

DATA AND METHODS

The housing sales data and the physical descriptions used in our work come from the Office of the Carroll County Tax Assessor. The data includes all home sales within the Carrollton city limits from January 2014 through December 2016. We limit the sample to fair-market sales to eliminate transaction such as those between family members, those used to correct deeds, or some other type of recorded transaction that could potentially provide a value other than one derived from an arms-length fair market sale. We calculate the Great Circle distance from each home sold to the Carrollton GreenBelt, along with the distance to several other local geographic features that may be expected to affect housing prices. We do this using Maptitude GIS. We use the inverse of distance to each of these important local geographic features to account for the non-linear relationship between price of a particular house and its distance to a particular geographic feature within the city. As an added interpretative benefit of using the inverse of distance, the sign of the distance-based variables' coefficient indicates the actual direction of the correlation between home prices and the distance to each important local geographic feature. Inverse distance measures are calculated for the following features: The University of West Georgia (InvUWGd), Downtown Adamson Square or the restaurant/entertainment district (InvASd), Tanner Medical Center (InvTMd), Carrollton City Schools (InvCCSchd), and the variable of interest, the Carrollton GreenBelt (InvGBd). We calculate these distance measures for all of the qualified fair-market home sales within the city limits for years listed above.

To account for the potential for seasonality in home prices, we also include dummy variables for the month of the sale, as compared with December. We eliminate any sale $10,000 or less, as these properties upon visual inspection had no residential structures associated with the parcel. Our sample used in estimation includes 743 residential housing units representing fair-market sales with an average sales price of $170,350. On average, a house in this sample was about .25 miles from the nearest trail. The average residence was about 2.3 miles from the university, about 1.8 miles from the medical center, and about 2 miles from the city school complex. Adamson Square represents the core of the city's entertainment district, containing bars, restaurants, an outdoor amphitheater often featuring live music acts. On average, properties in our sample were about 1.5 miles from Adamson Square. The average house was a 3 bed-2 bath, with about 1,941 heated square feet of living space. Most of the 743 housing units in our sample sold during the spring and summer months of the year. Table 1 provides detailed descriptive statistics for the data used in estimation.

TABLE 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
saleprice	170350.7	146720.8	12000	1180000
InvGBd	3.971503	11.41995	0.4994197	192.6746
InvUWGd	0.6627203	0.7500524	0.2150147	10.29043
InvCCSchd	0.7412303	0.693097	0.2316769	6.600738
InvASd	1.177397	1.285016	0.2926087	16.30228
InvTHd	1.765325	2.075075	0.4150638	44.20165
no_bedrms	3.238223	1.175236	0	14
fullbaths	2.133244	0.9110055	0	6
heatedarea	1941.075	866.3106	432	5654
jansale	0.0592194	0.2361938	0	1
febsale	0.0430686	0.2031484	0	1
marsale	0.0847914	0.2787587	0	1
aprsale	0.0740242	0.2619867	0	1
maysale	0.1076716	0.310174	0	1
junsale	0.1170929	0.3217475	0	1
julsale	0.1130552	0.3168736	0	1
augsale	0.1184388	0.3233446	0	1
sepsale	0.0928668	0.2904411	0	1
octsale	0.0699865	0.2552962	0	1
novsale	0.0632571	0.2435887	0	1
year	2015.024	0.7938136	2014	2016

We estimate the sales price using three different specifications. The first specification is OLS. The second specification assumes a spatial lag model. We use this model because we want to account for the potential that the sales price of nearby houses affects the sales price of each individual house. This model assumes the form of a spatially weighted dependent variable Wy. We estimate the standard model as given by

$$\mathbf{y} = \rho\mathbf{W}\mathbf{y} + \mathbf{X}\beta + \varepsilon,$$

where ρ is the spatial autoregressive coefficient, and ε is a vector of error terms. In this model, Wy is correlated with the disturbances, even when all the standard OLS assumptions hold true for the remainder of the model. As a result, the spatial lag term is treated as an endogenous variable, and estimated as such. OLS will produce biased estimates. The method used must account for the presence of endogeneity. The third model we employ is the spatial error model. The standard equation for this model is:

$$y_i = x_i\beta + \lambda w_i \xi_I + \varsigma_i$$

We estimate the aforementioned three models. The determination as to which model is most appropriate is based on the processes affecting housing prices. If one house's value is directly shaped or affected by its neighbors' values, the spatially lagged model preferred; however, if a lurking variable affects the errors in predicting housing prices, and the effect is similar among neighbors, the spatial error model is likely to be the best model choice. The OLS model is included as a baseline for comparison.

RESULTS

Table 2 provides Moran's I, along with other diagnostic measures of spatial patterns in the model. For Moran's I, values range from -1 to +1 with the sign indicating the type of spatial autocorrelation detected in the model. The null hypothesis is no spatial patterns are present. A value of zero indicates a random spatial pattern (no spatial dependency). Based on Table 2, we reject the null for our data, which indicates the presence of spatial patterns.

The LM and robust LM are specification tests that aid in selecting the most appropriate specification. It is a test of the model with and without the spatial lag. In a spatial lag model a change in one home value cascades through the entire neighborhood's home values, so this complicates the interpretation of the results. The LM test for the SLM suggest that the addition of the spatial lag is an improvement to the model. The next two LM and robust LM refer to the spatial error model as the alternative. We only need to consider the robust versions of these statistics when the standard versions are significant. When they are not, the properties of the robust versions may no longer hold. If the standard tests are significant and the robust form is not, this suggests there is no spatial autocorrelation problem in the data; however, this is clearly wrong if the Moran's I is significant. The most appropriate model appears to be the spatial error model (column 3, of Table 3); however, all three models are presented and discussed.

TABLE 2: Spatial Test Statistics and Diagnostics

Spatial error:	
Moran's I	9.351***
Lagrange multiplier	74.928***
Robust Lagrange multiplier	43.022***
Spatial lag:	
Lagrange multiplier	35.339***
Robust Lagrange multiplier	3.432*

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3 provides the empirical results of our analysis. In the SLM model, the spatial lag coefficient ρ (Rho) appears as an additional parameter in the model. The coefficient reflects the spatial dependence present in the sample data. It measures the average influence on each observation exerted by its neighboring observations. In our model, ρ has both a positive and significant effect, indicating that higher housing prices in a neighborhood tend to cluster around one another. In other words, one relatively high-priced house in a neighborhood tends to lead to higher prices across the neighborhood, all else constant. By estimating the model as a spatially lagged model, we control for the presence of a spatial (or feed-back) relationship between the prices of housing units that are near one another. A simple OLS model would erroneously attribute price variation due to spatial endogeneity to other variables in the model. In the SEM model, λ (Lambda) indicates the pattern of spatial correlation within the errors.

We find a positive and significant effect for the typical controls for characteristics of the housing such as the number of bedrooms, bathrooms and square footage of the heated living space. An additional bedroom adds between $30 and $47 thousand to the price of the residence. Another bathroom added between $24 and $29 thousand. An additional square foot of living space adds between $68 to $87 dollars to the value of the house. December represents the month with the lowest estimated sale price, but only sales in January and July were estimated to result in a significantly higher price for an otherwise identical house. During the period of the data, housing prices rose an average of about $9 to $10 thousand per year.

In each of the models we include measures of accessibility to local points of interest by using the inverse of distance between the housing unit and the point of interest. A positive and significant coefficient would therefore suggest that a house located closer to the amenity would fetch a higher sales price, all else equal.

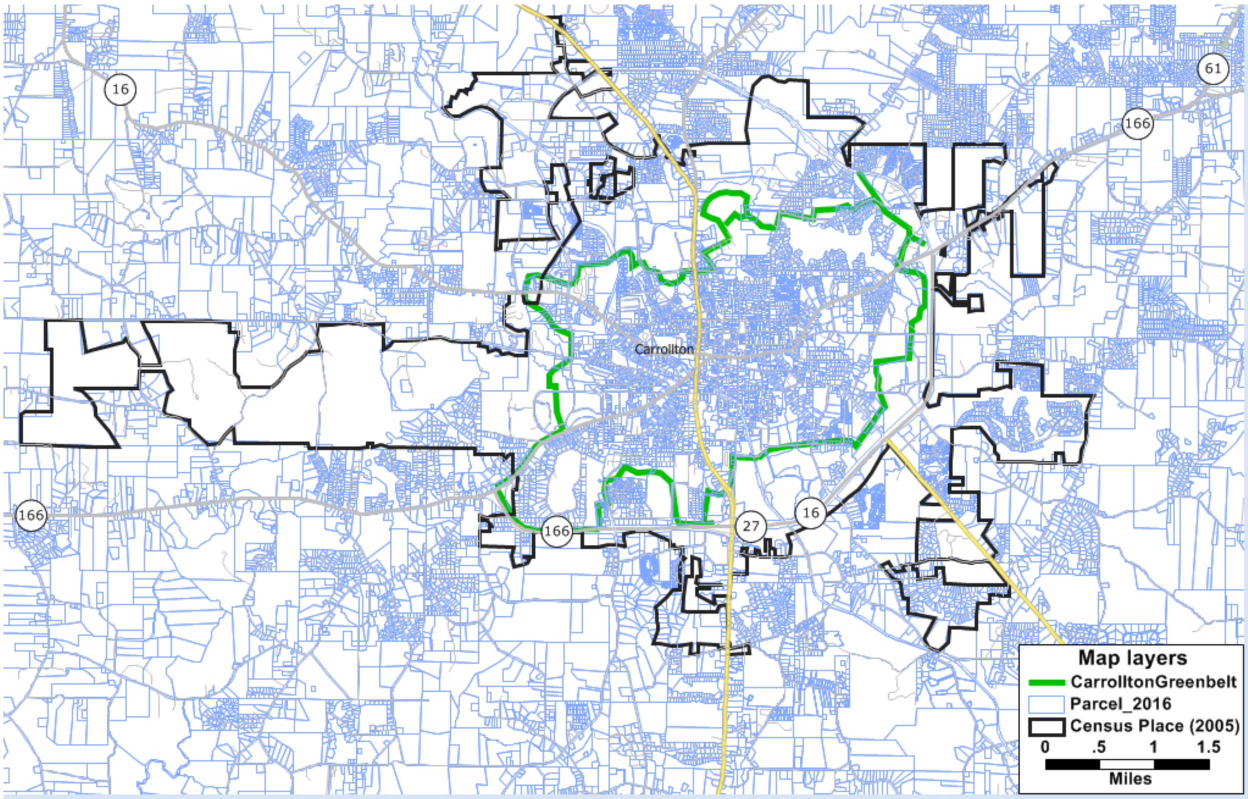
The University of West Georgia is one of the largest employers in the area, and the grounds are often used by locals as a recreational amenity (e.g., walking, running, cycling). The coefficient for InvUWGd can be interpreted as the change in home price associated with a unit change in the inverse of distance (in miles). For example, moving a house from 1 mile away from the University of West Georgia to 0.5 miles away results in a 1-unit change in inverse distance (from 1 unit to 2 units). The impact of such a change from the mean is estimated to increase the price of the home by $15,757 in the OLS model, by $13,638 in the spatial lag model and by $5,608 in the spatial error model, though only the OLS and SLM models' estimates are statistically significant.

Adamson Square contains government buildings, restaurants, a music venue, and boutique shops that attracts visitors from across the region; however, the area is also often congested with traffic and emits noise that may negatively affect nearby residents. The OLS and SLM models suggest that access to Adamson Square is associated with significantly higher housing values, but the SEM model suggests the relationship is negative and insignificant. A one unit increase in InvASd (i.e., moving toward Adamson Square) results in a price increase between $4,210 estimated in the OLS model and $6,473 estimated in the spatially lagged model. This suggests Adamson is attractive to both visitors and residents alike.

Although access to medical facilities and neighborhood schools were expected to have a positive impact on housing prices, we failed to find support for this in our sample. Tanner Medical Center is located near the center of the city, but is surrounded by industrial, commercial, and professional buildings with limited direct access to residential neighborhoods. Carrollton City Schools is a partner of the Georgia Safe Routes to School Program (https://www.carrolltoncityschools.net/parents/walkbike-to-school), which promotes walking and biking to school. Furthermore, the school system provides a map on its website suggesting "safe routes" for walking and biking to its campus. The routes, however, do not extend across the majority of the City of Carrollton. Additionally, the school system provides access to bus transportation throughout the city (with the exception of adjacent neighborhoods), which may reduce the relative appeal of walking. Accessibility to the Tanner Medical Center and to Carrollton

City Schools were insignificant in determining home prices in this sample. There may not be a significant difference in perceived access to medical services for different neighborhoods across the City of Carrollton. For Carrollton City Schools, the relatively few neighborhoods within a comfortable walking distance and access to alternative modes of transport to campus may diminish the value of accessibility to these local amenities.

FIGURE 1: Map of Carrollton Georgia



In early 2017, the Carrollton GreenBelt was completed. Figure 1 (above) depicts the locational relationship between the GreenBelt (green) and the city limits (black) of Carrollton. Greater access to the GreenBelt appears to be associated with significantly lower property values. This relationship may be the result of concerns associated with actual or expected changes in local foot traffic, privacy, and security. It also may be the result of the developer locating trails where they have the lowest cost of land acquisition. The greenbelt is situated near the edge of the more populated areas of the city. To a certain degree, Carrollton's population is distributed much like other similarly sized cities, with greater population density near the center of the city and lower density near the edge of the city limits. With this in mind, decreasing population density may provide an expectation of lower property values as one moves away from the center of the city. However, there has been substantial growth in housing and in population density south of Highway 166 (Bankhead inside Carrollton) and near the Carrollton's southern by-pass (166 and 16 in Figure 1). As a result, some of the newer, and most affluent neighborhoods are located near the southern edge and not at the center of the city (e.g., Oak Mountain Golf, Sunset Hills, Heritage Hills). Although we control for distance to Adamson Square (traditionally viewed as the center of Carrollton), we are unable to address the potential endogeneity of housing price and GreenBelt location directly. Nevertheless, decreasing the distance from the mean of about .25 miles to .2 miles results in a value reduction of somewhere between $428 to $557.

TABLE 3: Estimates

VARIABLES	OLS	SLM	SEM
InvGBd	-556.8**	-428.1*	-499.8**
	(260.4)	(251.6)	(254.6)
InvUWGd	15,757***	13,638***	5,608
	(4,234)	(4,091)	(7,101)
InvCCSchd	-1,844	-829.1	3,483
	(4,785)	(4,608)	(7,735)
InvASd	4,210*	6,473***	-348.6
	(2,414)	(2,356)	(4,038)
InvTHd	995.1	1,159	0.681
	(1,466)	(1,411)	(1,614)
BEDRMS	31,084***	37,345***	47,191***
	(3,453)	(3,495)	(3,522)
FULLBATHS	29,352***	25,728***	24,571***
	(5,087)	(4,935)	(4,768)
HEATEDAREA	87.00***	73.79***	68.57***
	(5.095)	(5.408)	(5.419)
jansale	51,238***	49,208***	31,316**
	(17,203)	(16,557)	(15,544)
febsale	-2,848	3,515	8,249
	(18,337)	(17,680)	(16,505)
marsale	1,609	1,586	-496.0
	(15,676)	(15,085)	(14,289)
aprsale	9,007	8,016	3,803
	(16,076)	(15,471)	(14,373)
maysale	4,636	5,252	513.8
	(14,937)	(14,373)	(13,463)
junsale	9,094	10,716	13,153
	(14,797)	(14,241)	(13,376)
julsale	25,763*	26,535*	18,829
	(14,832)	(14,273)	(13,414)
augsale	1,943	4,315	-236.0
	(14,707)	(14,158)	(13,325)
sepsale	18,752	18,604	13,202
	(15,414)	(14,833)	(13,883)
octsale	-5,856	-2,359	3,775
	(16,119)	(15,523)	(14,697)
novsale	466.0	4,945	3,425
	(16,545)	(15,940)	(15,081)
year	10,132***	10,545***	9,567***
	(3,743)	(3,602)	(3,373)

Constant	-2.060e+07***	-2.146e+07***	-1.95e+07***
	(7.541e+06)	(7.258e+06)	(6.796e+06)
Lambda			0.584***
			(0.0534)
Rho		0.218***	
		(0.0376)	
Sigma		74,522***	71,022***
		(1,934)	(1,873)
R^2 or Squared Correlation	72.9	74.2	71.2

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

CONCLUSION AND DISCUSSION

The hedonic housing price model we have developed in this research produces similar results as in prior work. Increasing the size of the house, either through more heated space, or through added features, such as bedrooms or bathrooms all have positive and significant impacts on the price of the house. Similar to other estimates, Carrollton's housing prices exhibit spatial patterns in the data. The prices of homes are affected by the values of nearby homes, or other omitted spatially correlated regressors. Access to the university was associated with a positive impact on price, though it was significant only in the OLS and spatial lag models. The university employed more 1,100 faculty and staff and had and enrollment of 12,206 in 2014. Housing near the university is desirable for both students and faculty alike. Furthermore, the university grounds are viewed by locals as a park amenity due to its size (645 acres), open access, and rural setting.

We find that increased access to the GreenBelt is associated with lower housing values. The negative coefficient on access to the GreenBelt, though counter to previous studies (Immergluck & Balan, 2017; Herath et al., 2015; Parent & Hofe 2013; Campbell & Munroe, 2007; Lee & Linnerman, 1998; Lindsey et al., 2004), is not entirely unexpected. In 2017, Carrollton's population density was 1,175 people per square mile. The City of Atlanta, the core city of the metropolitan statistical area in which Carrollton is located and the location of the Atlanta Beltline studied by Immergluck & Balan, had 3,483 people per square mile. Their positive impact may have been the result of lower overall access to greenspace for Atlanta residents. Carrollton, however, is less densely populated and thus naturally has more open greenspace. The Carrollton GreenBelt is in addition to other city parks, surrounding farmland, and a university with ample open-access greenspace. Because of the higher level of overall access to greenspace in Carrollton, the value of additional park amenities, such as the GreenBelt, may be limited. Additionally, some may view the increased foot traffic through their neighborhood as inconvenience. Furthermore, rural parks are typically accessed by car, hence housing prices may not be adversely (or positively) affected by small changes in the distance to the amenity. In larger cities with limited parking and heavier traffic, access to parks may be more difficult by car, and thus a premium is placed on housing located within walking distance to these amenities (Immergluck & Balan 2017). Another characteristic differentiating the Carrollton GreenBelt from the Atlanta Beltline is that the GreenBelt was an entirely new construction, whereas the Atlanta Beltline (in large part) was built on top of existing rail lines. It is unclear if these unused rail lines represented local amenities or dis-amenities prior to their conversion. However, if they were viewed as dis-amenities, their conversion to a park may have resulted in a significant positive impact because it simultaneously removed a dis-amenity and added an amenity.

Although we fail to find a positive housing price impact from the Carrollton GreenBelt, our model may not provide causal inference. A shortcoming of our model is the potential for endogeneity of the GreenBelt's location and the price of surrounding property. It is plausible that the location of the GreenBelt was selected to reduce land acquisition costs. Our model may attribute the lower values to the presence of the GreenBelt, when the presence of the GreenBelt in an area of the city is due to lower property values in that area. Within the present framework, we are unable to determine if lower housing values are the result of increased access to the GreenBelt, or alternatively that the GreenBelt location decisions were made to reduce land acquisition costs. To distinguish between these two alternatives would require repeat home sales data. Unfortunately, from our sample of 743 sales, we were only able to identify 43 homes that sold more than once during our sample period, which is too few to provide reliable estimates, given the variation in home attributes.

Our work is among the first to examine the relationship between housing prices and a new form of linear park. Furthermore, this research is the first to focus on these relationships in less densely populated areas (i.e., cities of fewer than 50,000 in population). Accessibility is currently measured as the straight-line distance to the GreenBelt trail, even though some neighborhoods have direct (unobstructed) access to the GreenBelt, whereas others, though located very near, may be blocked by obstructions such as walls, fences, or busy roads. Although straight-line distance provides the most direct measure of access, network distance through surface streets or sidewalks may provide an improved measure of access where obstructions occur.

As home sales within our current sample are fixed, our alternatives to address the potential endogeneity issue is to include additional sales from outside the City of Carrollton, from a larger window of time, or locate similar amenity in another city that experienced more sales. Thus, future improvement should focus on adding more historic housing sales data, using sales data from multiple cities, and estimating using the repeat sales method. Additionally, future research should examine other similar linear parks (the Atlanta Beltline, the Silver Comet Trail, etc.) to measure the impact on real estate prices across the region. If these parks enhance the quality of life in the communities in which they are built, the expectation is that more linear parks would both increase local property values, and also provide spillovers to nearby communities. Furthermore, our research focuses on residential property values. Future research should also examine a greenbelt's impact on other property types or uses. The presence of a greenbelt may make a city attractive to investors, whether for residential or commercial purposes.

REFERENCES

Anderson, S. T., & West, S. E. (2006). Open space, residential property values, and spatial context. *Regional Science and Urban Economics, 36*(6), 773-789.

Biao, Z., Gaodi, X., Bin, X., & Canqiang, Z. (2012). The effects of public green spaces on residential property value in Beijing. *Journal of Resources and Ecology, 3*(3), 243- 252.

Bratman, G. N., Daily, G. C., Levy, B. J., & Gross, J. J. (2015). The benefits of nature experience: Improved affect and cognition. *Landscape and Urban Planning, 138*, 41- 50.

Bricker, K. S., Hendricks, W. W., & Aschenbrenner, C. A. (2016). Californians' perceptions of the influence of parks and recreation on quality of Life. *Journal of Park & Recreation Administration*, *34*(3), 64-82.

Campbell, H. S., & Munroe, D. K. (2007). Greenways and greenbacks: the impact of the Catawba Regional Trail on property values in Charlotte, North Carolina. *Southeastern Geographer*, *47*(1), 118-137.

The Carrollton GreenBelt (2016). Retrieved from https://www.carrolltongreenbelt.com/

The Carrollton City Schools Walk/Bike to School Program. Retrieved from https://www.carrolltoncityschools.net/parents/walkbike-to-school

Cho, S.-H., Bowker, J. M., & Park, W. M. (2006). Measuring the contribution of water and green space amenities to housing values: an application and comparison of spatially weighted hedonic models. *Journal of Agricultural and Resource Economics*, 485-507.

Cohen, D.T., Hatchard, G.W., & Wilson, S.G. (2015). Population Trends in Incorporated Places 2000 to 2013 (P25-1142). Retrived from US Census Bureau Website: https://www.census.gov/content/dam/Census/library/publications/2015/demo/p25-1142.pdf

Conroy, S.J. & Milosch, J.L. (2011). An Estimation of the Coastal Premium for Residential Housing Prices in San Diego County., *Jouranl of Real Estate Finance and Economics, 42,* 211-228.

Conway, D., Li, C. Q., Wolch, J., Kahle, C., & Jerrett, M. (2010). A spatial autocorrelation approach for xxamining the effects of urban greenspace on residential property Values. *The Journal of Real Estate Finance and Economics, 41*(2), 150-169.

Correll, M. R., Lillydahl, J. H., & Singell, L. D. (1978). The effects of greenbelts on residential property values: some findings on the political economy of open space. *Land Economics*, *54*(2), 207-217.

Coutts, C. J. (2010). Public Health Ecology. *Journal of Environmental Health, 72*(6), 53- 55.

Crompton, J. L. (2005). The impact of parks on property values: empirical evidence from the past two decades in the United States. *Managing Leisure, 10*(4), 203-218.

Dehring, C. & Dunse, N. (2006). Housing Density and the Effect of Proximity to Public Open Space in Aberdeen, Scotland. *Journal of Real Estate Economics, 34*(4), 553-566.

Engstrom, G. & Gren, A. (2017). Capturing the value of green space in urban parks in a sustainable urban planning and design context: pros and cons of hedonic pricing. *Ecology and Society, 22*(2):21

Farr, M. A., Brondo, K. V., & Anglin, S. (2015). Sustainability in the Global City: Shifting Gears: The Intersections of Race and Sustainability in Memphis. Cambridge: Cambridge University Press, 285-305.

Fitzhugh, E. C., Bassett Jr, D. R., & Evans, M. F. (2010). Urban trails and physical activity: a natural experiment. *American Journal of Preventive Medicine, 39*(3), 259-262.

Gatzlaff, D.H. & Smith, M.T. (1993). The Impact of the Miami Metrorail on the Value of Residences near Station Locations. *Land Economics, 69*(1), 54-66.

Gezon, L.L., McKendry-Smith, E., & Hunter, A.K. (2016). The health benefits of a bicycle-pedestrian trail, 51(12), 16-17.

Heckert, M. & Mennis, J. (2012). The economic impact of greening urban vacant land: A spatial difference-in-differences Analysis. *Environment and Planning A, 44*(12), 3010-3027.

Herath, S., Choumert, J., & Maier, G. (2015). The value of the greenbelt in Vienna: a spatial hedonic analysis. *The Annals of Regional Science*, *54*(2), 349-374.

Hoen, B., Wiser, R., Cappers, P., Thayer, M., & Sethi, G. (2011). Wind Energy Facilities and Residential Properties: The Effect of Proximity and View on Sales Prices. *The Journal of Real Estate Research*, *33*(3), 279-316.

Immergluck, D. & Balan, T. (2017). Sustainable for Whom? Green urban development, environmental gentrification, and the Atlanta Beltline. *Urban Geography, 39*(4), 546-562.

Irwin, E. G. (2002). The Effects of Open Space on Residential Property Values. *Land Economics, 78*(4), 465-480.

Kong, F., Yin, H., & Nakagoshi, N. (2007). Using GIS and landscape metrics in the hedonic price modeling of the amenity value of urban green space: A case study in Jinan City, China. *Landscape and Urban Planning*, *79*(3–4), 240-252.

Kuethe, T. H. (2012). Spatial fragmentation and the value of residential housing. *Land Economics, 88*(1), 16-27.

Lee, C.-M. & Linneman, P. (1998). Dynamics of the greenbelt amenity effect on the land market—The case of Seoul's Greenbelt. *Real Estate Economics, 26*(1), 107-129.

Lindsey, G., Man, J., Payton, S., & Dickson, K. (2004). Property values, recreation values, and urban greenways. *Journal of Park and Recreation Administration*, *22*(3), 69-90.

Newman, O. (1972). Defensible space; crime prevention through urban design. New York: Macmillan.

Nicholls, S., & Crompton, J. L. (2005). The impact of greenways on property values: Evidence from Austin, Texas. *Journal of Leisure Research*, *37*(3), 321.

Palardy, N.P., Boley, B.B., & Gaither, C.J. (2018). Residents and urban greenways: Modeling support for the Atlanta Beltline. *Landscape and Urban Planning, 169*, 250-259

Parent, O., & vom Hofe, R. (2013). Understanding the impact of trails on residential property values in the presence of spatial dependence. *The Annals of Regional Science, 51*(2), 355-375.

Park, J.H., Lee, D.K., Park, C., Kim, H.G., Jung, T.Y., & Kim, S. (2017). Park Accessibility Impacts Housing Prices in Seoul. *Sustainability, 9*(2),185.

Sah, V., Conroy, S.J., & Narwold, A. (2016). Estimating School Proximity Effects on Housing Prices: the Importance of Robust Spatial Controls in Hedonic Estimation. *Journal of Real Estate Finance and Economics*, *53*, 50-76.

Saphores, J.-D & Li, W. (2012). Estimating the value of urban green areas: A hedonic pricing analysis of the single family housing market in Los Angeles, CA. *Landscape and Urban Planning 104*, 373-387.

Troy, A., & Grove, J. M. (2008). Property values, parks, and crime: A hedonic analysis in Baltimore, MD. *Landscape and urban planning*, *87*(3), 233-245.

Votsis, A. (2017). Planning for green infrastructure: The spatial effects of parks, forests, and fields on Helsinki's apartment prices. *Ecological Economics, 132,* 279-289.

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