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An Examination of the Potential Impact of Multi-Use Trails on Housing Prices and Gentrification

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By,

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While writing this thesis, I have not witnessed any wrongdoing, nor have I personally violated any conditions of the Skidmore College Honor Code.

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Abstract

The construction of green spaces in urban areas has shown to bring value to nearby properties. As this theory has held true for several multi-use trails constructed in cities in the United States, this paper uses the Champlain Canalway Trail, a multi-use trail in northeastern New York, as a case study to examine if housing prices respond similarly to the construction of multi-use trails in suburban and rural areas. Furthermore, this paper is used to test if theories of green gentrification also hold true outside of urban areas. A total of 8,619 house transactions conducted between 2005 to 2019 are used to conduct a spatial and difference-in-differences analysis to examine the effect of the construction and distance from the multi-use trail on the sales price of homes. The results of my research contradict previous green space theories and suggest that the construction of multi-use trails in suburban and rural areas can trigger a 17% decrease in the sales prices of houses within a half-mile from the trail, relative to the sales prices of houses two or more miles away. The results of this paper indicate that multi-use trails are unlikely to put urban and rural areas at risk of green gentrification.

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1. Introduction

Accessible trails enhance a community: they encourage people to stay active, revamp the aesthetics and improve local air quality. Constructing multi-use trails to increase pedestrian mobility and promote trail related health benefits is becoming increasingly more popular– especially in New York State.[1] This paper will be studying how the construction of multi-use trails impacts housing prices and the socio-economic compositions of rural and suburban neighborhoods, through an investigation of the impacts of multi-use trails on neighborhoods in northeastern New York State. The research in this paper employs a difference-in-differences hedonic pricing model to estimate how the construction and proximity to a multi-use trail impacts the selling price of houses. I incorporate spatial indicators into the basic hedonic pricing model, using Geographic information systems (GIS) analysis, to isolate the spatial effects that trail proximity has on housing prices. The Champlain Canalway Trail, a multi-use trail in Saratoga and Washington County, is used in this paper as a case study. Multi-use trails are characterized as 10-feet wide trails that are paved or made out of crushed stone. These types of trails can be used for a variety of recreational activities such as hiking, walking, running, biking, birdwatching, snowshoeing, and snowmobiling.

Through investigating the aftereffects of multi-use trail construction on housing prices, I will be engaging in the conversation about green gentrification and how the creation of green spaces can potentially change community demographics and displace vulnerable populations. Green gentrification is a paradoxical phenomenon that can occur when public green spaces are

[1] In 2017 New York State, Governor Cuomo released a $200 million plan to create a 750-mile trail, called the Empire State Trail, connecting all of New York State.

developed. Often, green spaces are used to provide trail benefits, like outdoor recreation opportunities, affordable transportation options and improved air quality, to low-to-moderate income communities, however, since green spaces are desirable goods, the development of green spaces can put a premium on nearby homes. Green gentrification occurs when higher-income families, and people that are willing to pay more to live near parks and trails, bid up the prices of surrounding properties. Low-to-moderate income families who can not compete with surging housing prices, are often forced to relocate when there is a spike in the value of homes in the neighborhoods. In this scenario where the construction of multi-use trails radically inflates the housing prices in the area, the development of these recreational amenities could potentially be displacing low-income families instead of making these recreational spaces–along with the health benefits that they provide–more accessible.

1. Background and Literature Review

The theory examined in this paper draws on literature from various disciplines: sociology, urban studies, and economics. This interdisciplinary approach allows for me to examine the plausible link between dynamics that have been observed within each of the disciplines.

In the United States, and in cities across the world, there is a pattern of an unequal distribution of green space (Heynen, Perkins, and Roy,2006; Dai, 2011). The reflexive response to this problem is to create more outdoor amenities in these green poor areas, however, this is often an inefficient response to this environmental justice problem. The introduction of green recreational spaces can potentially cause a paradoxical effect that displaces low-income residents (Wolch, 2014). This paradoxical effect will occur if the introduction of these public amenities

effectuates gentrification, and creates a higher potential value on the houses in the area and a higher potential ground rent that can be capitalized by property owners (Smith, 1979). Furthermore, it is possible that this process of green gentrification to occur in rural and suburban areas as well as urban areas, where the phenomena is most commonly studied (Darling, 2005). Previous economic literature, using variations of a hedonic pricing model, have shown that the introduction of trails and other green spaces increases housing prices in the local area. This analytical strategy can also be applied to indicate the risk of gentrification because a spike in housing prices, which can be identified through hedonic price modeling, is seen as one of the key indicators of gentrification (Smith, 1979). The Champlain Canalway provides an appropriate case study to study the how the construction of a multi-use trail impacts housing prices in rural and suburban areas, and to see if green gentrification can occur in nonurban areas that are not deprived of open space.

2.1. Trails and Green Space

When talking about green gentrification it is imperative to discuss distributions of green spaces because historically, a phenomenon of unequal distribution of green spaces, especially in urban areas, has been the root of several environmental justice problems. Outdoor recreational areas are proven to improve air quality and human health, however, there is a limited amount of recreational areas across cities and these recreational areas are often more difficult for vulnerable populations to access (Wolch, Byrne, and Newell, 2014). Geography research in cities has repeatedly found that green space is often correlated with locations with high income and white residents (Heynen, Perkins, and Roy, 2006; Dai, 2011). This pattern has been observed in several American cities like Milwaukee; a study in Milwaukee using canopy cover satellite imagery and census data revealed a positive correlation between residential canopy cover and median

household income (Heynen, Perkins, and Roy, 2006). The distribution of green space is not only distributed based off of residents income, green poor areas are often habited by minority ethnic/racial groups. Dai's (2011) study in Atlanta assessed the accessibility of public green spaces to different demographics and found that access to these areas was significantly poorer for African American communities.

2.2. Green Gentrification

Many cities in the United States have tried to implemented strategies to bring recreational green spaces to target communities that are deficient of them; planners and government institutions often build these spaces to solve environmental justice problems, by helping marginalized communities access green areas and help these communities reap the proven public health benefits that green spaces offer (Wolch, 2014). Often, however, the creation of green spaces in vulnerable communities has a paradoxical impact. These greening projects–that are intended to provide recreational access and improved environmental quality for poor and minority communities–often end up displacing the communities they were intended to serve (Wolch, 2014).

Theories of green gentrification and the green paradox are derived from original theories of gentrification. Neil Smith (1979), a gentrification theorist describes the concept as "an expected product of the relative unhampered operation of the land and housing markets." Gentrification is the natural result of a free market where actors are trying to make a profit. Smith (1979) uses what he refers to at the "rent-gap theory" to explain the mechanism of gentrification. The rent-gap theory says that gentrification occurs when there is a gap between the potential rent that could be gained from a property and the amount of rent that is currently

being obtained by the property owner (Smith, 1979). The term ‘rent-gap’ refers to the difference between ‘potential ground rent’ and ‘capitalized ground rent’. ‘Potential ground rent’ is the rent that could potentially be gained by the property, and the ‘capitalized ground rent’ the rent that is currently being obtained. Gentrification occurs when housing prices are low enough that the difference between the ‘potential’ and ‘capitalized’ ground rents are great enough that investors can profit off of rehabilitating properties (Smith, 1979). Ultimately, gentrification is an outcome of moving capital. The rent-gap widens when capital is divested from one area and then reinvested in the area, prompting a closing of the rent-gap and a rise of housing prices (Smith, 1979; Phillips, 1993).

Green gentrification can have two different explanations. The first potential reason for the unequal distribution of green space is that green spaces are created in areas with more wealth. The second potential explanation is that green spaces make neighborhoods more aesthetically attractive and healthier, therefore, the greening of an area makes it more desirable and attracts higher-income families. Using this explanation, the creation of green areas would attract more higher-income families and as a result, raises the local housing prices. Often, property prices and rent are raised to the point where less affluent families can not compete with rising prices (Wolch, Byrne, and Newell, 2014).

Some argue that there is a significant difference between urban and rural gentrification dynamics. This is likely true because the composition of consumers in the two markets is anomalous to each other; those who move to rural and suburban areas are often drawn to the prospects of being surrounded by green spaces and the homogenous cultural identity that is often associated with certain rural and suburban communities (Smith and Phillips, 2001). However, the

overall lack of research in the field of rural gentrification has led to a misinterpretation that gentrification is a dynamic that only occurs in cities.

2.3. Urban and Rural Gentrification

Most studies of green gentrification, and gentrification in general, have been conducted in cities. Green gentrification is a common study in cities because there is a greater shortage of green spaces in urban environments. Waking the perimeter of Central Park in New York City, it is easy to see that the park is a magnet to the socio-economic elite. However, since the park has long been established in the city, it is hard to examine how its development has changed the neighborhood. One of New York City's latest constructed urban park and trail, known as the High Line, is one of the most extreme examples of urban green gentrification. The High Line is an above-ground trail track in Lower Manhattan that was converted into a rail-trail. This trail quickly became a tourist destination and transformed the entire neighborhood. Yoon and Currid-Halkett (2014) studied the gentrification of the area following the development of the High Line by examining the transformation of the local industry and businesses. They conducted a discrete-time survival analysis to assess the risk of arts and cultural business closing and opening after 2000, when the local restructuring for the High Line started to occur. Existing businesses did not benefit from the construction of the High Line because the construction of the rail-trail caused a change in the local market and a spike in rent (Yoon and Currid-Halkett, 2014). The High Line is an important example of green gentrification because it shows the far-reaching impacts of the construction of green spaces. Examining the effects that the High Line trail had on the local neighborhood allows room for this paper to examine if a similar impact can occur on a smaller scale.

While the effects of gentrification are most commonly observed in urban areas, green gentrification is not only present in urban areas. This type of gentrification is also prevalent in wilderness areas where living in proximity to these areas is in high demand. Often the cause of gentrification is caused by the commodification of open-space, this has been a cause of gentrification in areas in the rocky mountains and the Adirondack Park, which is just north of the Champlain Canalway. This type of gentrification was also observed in Montana, where there was a migration of people in search of open space and the lifestyle that comes with it (Ghose, 2004). The migration to this area resulted in the displacement of long-term residents and new policies protecting open space is prevalent in the Adirondack Park in Upstate New York, where natural land is abundant, but there are development regulations that limit the amount of available residential space (Darling, 2005).

Smith and Phillips (2001) argue that it is also possible for forms of green gentrification to occur in rural and suburban areas that are not near significant parks or controlled by strict zoning regulations. This form of rural green gentrification has happened in areas like West Yorkshire England where high-income families in-migrated to rural areas to seeking more green area and prompted a surge in the property values in rural areas as they started to renovate properties and develop a community (Smith and Phillips, 2001).

2.4. Modeling Gentrification

Gentrification can be exhibited by changes in the local industry and businesses (Currid-Halkett, 2014), as well as changes in racial, educational and income demographics (Anguelovski, Connolly, Masip, and Pearsall, 2018). Since gentrification is the product of the unregulated

housing market, tracking the rapid appreciation of property prices is a common way of identifying gentrification.

Anguelovski et.al (2018) studied the impact of green gentrification by tracking demographic changes. The research found evidence of green gentrification in Barcelona following the creation of 18 new green spaces in undesirable neighborhoods during the 1990s and mid-2000s. The findings showed that green gentrification is a complex system; some areas are more prone to experiencing gentrification following the development of a new park than others. The research in Barcelona found that a green paradoxical effect occurred near the new parks that were created in formerly industrialized areas and the old city. However, gentrification did not occur in the more economically depressed areas. Following the creation of the parks, these areas experienced an influx of vulnerable populations that would be displaced in a scenario where gentrification was occurring (Anguelovski, Connolly, Masip, and Pearsall, 2018).

2.5. The Champlain Canalway Trail

The Champlain Canalway Trail is used in this paper to study the impacts of trail development on housing prices and gentrification because it passes through both urban and rural neighborhoods in upstate New York. Additionally, since the intent of the construction of the trail was to spur economic growth, this paper poses an interesting way of studying how effective trails are at drawing wealth to a community. Studying housing prices along this specific trail will provide insight into whether trail development actually increases the desirability of suburban and rural neighborhoods.

When fully constructed, the Champlain Canalway Trail will be 77-miles long (LA group, 2019). Currently, the trail passes through eight different towns: the town of Fort Ann, Fort

Edward, Halfmoon, Hudson Falls, Schuylerville, Stillwater, Waterford, and Whitehall. The segments of the trail that currently exist are frequently used for walking, hiking, biking, or in-link-skating. When there is no snow on the ground the trail is used for walking, running, and biking. In late winter, when there is deep snow cover, the trails are frequently used for snowmobiling (LA group, 2019). In addition to the recreational opportunities that the trail provides, the trail also holds cultural significance. The trail follows the historic Champlain Canal corridor that was used by Native Americans and the early European Settlements. Native Americans used the canal as a vessel for trade between the Hudson River and Lake Champlain. Later, during the French and Indian War, the American Revolution and the War of 1812, the canal was also used as a mode of transportation between New York and Canada. The construction of the Canalway that runs along the shore of the waterway, is intended to help residents access this historic landmark while also being able to engage in outdoor recreation.

The construction and planning of the Champlain Canalway Trail and funded by a community grant from the Hudson River Valley Greenway to the Town of Stillwater. The five criteria that projects need to achieve to receive the community grant are economic development, natural and cultural resource protection, regional planning, public access, and heritage and environmental education.

The Champlain Canalway Trail was proposed when the working group was formed in 2008, however, there were segments of trails along the route before the formation of the working group. The concept of a fully connected trail was proposed to the community; when the first draft of the Champlain Canalway Trail Action Plan was released in 2011. The potential economic benefits of the trail were one of the first topics discussed in the action plan. The economic impact of the constitution of the trail was described through two different perspectives,

it was assessed through the potential benefit to local businesses then it was assessed through the perspective of property owners and potential impact on housing prices. The expectation of the possible economic benefits that can be retained from such a project was influenced by an economic impact study that was released about the Erie Canalway Trail, a similar trail on the eastern side of upstate New York. This impact study concluded that each year this 277-mile long trail creates $253 million in visitor spending, $78 million in labor income, and supports 3,440 jobs (Scipione, 2014). When the trail was proposed, community members spoke out about concerns regarding the impact the trial could have on housing prices. Some of the local homeowners feared that the trail would have a negative impact on housing prices (LA group, 2011). However, most economists who have studied the housing market reaction to the introduction of a new trail system have found that housing prices increase as a result.

3. Empirical Strategy

3.1. Hedonic Pricing Framework

This paper analzes the impact of multi-use trails using housing prices. Housing prices is an indicator that has been shared by economic studies regarding green space and gentrification theorists. Housing market dynamics and the relationship between social preferences and property prices is the core of the rent-gap theory (Smith, 1979). Housing prices can reflect a change in demand for housing prices, therefore, surveying for a spike in housing prices can be a key method of indicating gentrification. A rise in housing prices and rent indicates a change in demand for housing in the area; this change in demand can be caused by shortages in housing in other neighborhoods or a more direct change in the perceived desirability of the affected

neighborhood itself. The increase of housing prices that results in a change in demand for the local housing market is often the causal factor that leads to gentrification.

Hedonic pricing models are a method for determining how a neighborhood amenity or feature of a property impacts housing prices. This type of model was devised by Lancaster (1966) and Rosen (1974). The basis behind all hedonic pricing models is that the sales price or perceived value of a good is a function of the internal and external characteristics. This type of model is commonly used to estimate the value people place on a public amenity because the equation can track if the amenity impact the sales price of the effected properties, holding all other characteristics constant. Hedonic pricing models all use the following form where V is the sales price and Z represents the house and location characteristics.

$$V = f(Z)$$

Economists have long been using hedonic pricing models as a tool to reveal preferences for certain neighborhood characteristics, they have been used to study how everything from the opening of a new Walmart (Pope and Pope, 2015) to the creation of a new freight trainline impacts the price of local houses (Simons and El Jaouhari, 2004). In the case of this paper, this type of model is used to determine preferences for multi-use trails as a public amenity, and identify if home buyers want own property that is in close proximity to a multi-use trail.

3.2. Hedonic Frameworks and Trails

Hedonic pricing models have been used by various studies that have researched the impact of trail development on homeowner preferences revealed by the housing market. Asabere and Huffman (2009) used a hedonic analysis to research the relative impact of trails and

greenbelts on housing prices. The research studied 10,000 homes in the San Antonio Texas area. Their model adopted a semi-logarithmic function to see the impact of amenity as a percent of the housing price. In their housing price model, they controlled for the impact of view, cul-de-sac, corner location, school districts, and time-of-sale. They studied the partial effects of trails with greenbelt by including an interaction variable 'trail x greenbelt' (Asabere and Huffman, 2009).

Similar to this study, Mark R. Correl (1978) specifically researched greenbelt trails. Correl (1978) investigates the quasi-public good effect, which is the commodification of public goods through the external reaction of private good markets, of greenbelts in Boulder, Colorado by using housing prices to see how much homeowners are willing to pay to be closer to a greenbelt trail. In their model, they estimated the sales price of a single-family home using its walking distance from the greenbelt trail, the year it was built, the number of rooms, square footage, and relative size of the lot (Correl, 1978). In this paper I draw on the spatial analysis and control variables used in Correl's (1978) hedonic pricing model to build off of his method of estimating the effects of a houses' distance from the trail.

Through hedonic pricing models economists have come to a consensus that the development of green spaces has a positive impact on local housing prices. Research in the field has proven that green spaces and trails are a desirable public amenity, therefore, the development of a trail and other green spaces in a town should lead to an increase in local property values (Asabere and Huffman, 2009; Correl, 1978). Asabere and Huffman (2009) found that houses near trails had a 2% price premium and that houses near trails, cutting through conserved land, had a 5% price premium. A study of multi-use greenbelt trails in Boulder Colorado found similar results. This research by Correl (1978) found that for every foot away you move away from the trail housing prices decreased by $10.20.

3.3. Difference-in-Differences Hedonic Framework

While the Correl (1978) and Asabere and Huffman (2009) cover a very similar topic of research, the model I use in the paper most closely mirrors the model used in Pope and Popes' (2015) study about how the opening of Walmart impacts local housing prices. Similar to Pope and Popes (2015), the research in this paper studies how the direct opening of a neighborhood amenity impacts housing prices by examining housing prices before and after the opening. Employing a difference-in-difference analysis in conjunction with the hedonic pricing framework isolates the impacts of other variables that impact housing prices to ensure the model is specifically examining the effect of the trail opening.

In this paper, I use a difference-in-difference hedonic pricing framework to study the impact of trail development, in the various neighborhoods that the Champlain Canalway Trail passes through, to test the theory that multi-use trails inflate local housing prices. If the theory holds true, I will be drawing a connection between the dynamics of the housing markets and urban studies theories of green gentrification to examine if the creation of multi-use trails helps bring benefits to low-income households or if it creates a competitive housing market that puts low-income households at risk of being displaced.

4. Data

The analysis in this paper relies on a dataset that comprises information about single family houses sold within the towns along the Champlain Canalway Trail between 2005 and 20019. The analysis also uses information about the study site and the development of the Champlain Canalway Trail. In this section, I outline the source of the data, the dataset contents and how the dataset was prepared for empirical analysis.

4.1. Housing Price Data

The housing data used in this paper is from Global MLS Inc., which is a database that provides information about real estate in eastern New York. This information packaged in this database is targeted to real estate professionals; it provides in depth information about specific transactions, and general information about local housing market dynamics. The information from the database is sourced and maintained by the Saratoga Schenectady Schoharie Association of Realtors.

The dataset is comprised of 8,619 data points that represent single family houses sold within the eight towns along the trail from 2005 to 2019. The data set of houses sold includes information about the house's sales price, square footage, year built, number of bedrooms, number of bathrooms, address and other information about the transaction. The longitude and latitude of the houses sold was derived using geographic information systems (GIS) and later used to map the location of each of the houses in the dataset (Figure 1). Using the derived property coordinates and the map of the data points, I was able to deduct the distance each house from the Champlain Canalway Trail (Figure 2). Using GIS analysis functions, I was able to create three variables in the dataset that identifies whether the sold property falls within a half-mile, one-mile or two-miles from a segment of the Champlain Canalway.

Table 1 shows the distribution of data points in each of the distance categories along with a summary of the attributes of the houses within each category. Of the 8,619 houses observed, 5,674 are within two or more miles of the trail, 943 are within one to two miles of the trail, 567 are within a half mile to one mile away from the trail, and 1,435 are a half mile are closer to the trail (Table 1).

Figure 1 Map of data points of houses sold between 2000 and 2019.

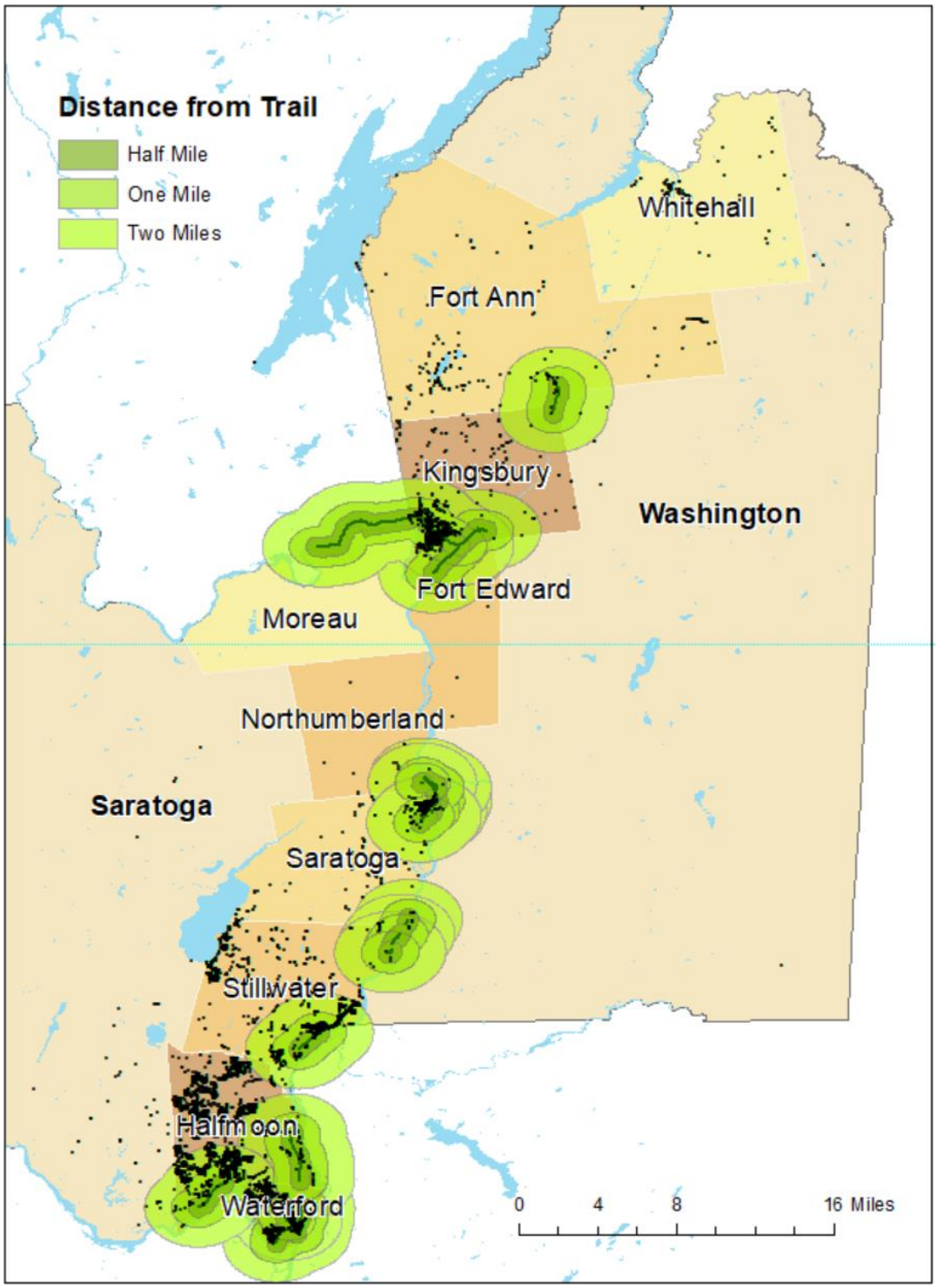

Figure 2 Map of the data points and the Champlain Canalway Trail with a half mile, one mile and two mile buffer.

Table 1 Summary of the number of bathrooms and bedrooms in the sold houses that comprise the housing dataset based on the houses distance from the Champlain Canalway Trail.

	mean	sd	min	max	N
Two or more miles					
Price	271000	147000	1	2950000	5674
Beds	3.092	.96	0	9	4510
Baths	1.881	.676	0	20	5673
Acres	75327.09	4210000	0	2.81e+08	4510
SQFT	1865.529	694.01	1	11650	5673
Two-miles					
Price	275000	95076.65	40000	930364	943
Beds	3.09	.863	0	9	943
Baths	1.892	.578	0	5.2	943
Acres	942.74	4801.008	0	95000	678
SQFT	1814.391	551.501	3	7374	943
One-mile					
Price	179000	97922.26	10	925000	567
Beds	2.94	.973	0	6	567
Baths	1.538	.55	1	3.1	567
Acres	1213.372	7191.624	0	100000	398
SQFT	1571.845	469.361	748	3933	567
Half-mile					
Price	139000	66540.85	1	649900	1435
Beds	3.08	1.032	0	6	1435
Baths	1.455	.692	0	10	1435
Acres	1231.4	17273.76	0	387000	1004
SQFT	1557.402	634.907	520	13921	1435

4.2. Study Site

Data on the population density of each of the eight studied towns was collected by the Census Bureau. The population density data is used to classify each town as rural, suburban or urban. If the town has an average population density of over 1,000 people per square mile (ppsm) it is classified as an urban area (Ratcliffe, Burd, Holder, and Fields, 2016). Towns that have an average population density less than 1,000 ppsm but greater than 500 ppsm are considered

suburban (Ratcliffe, Burd, Holder, and Fields, 2016). Any town with 500 ppsm or fewer is considered rural (Ratcliffe, Burd, Holder, and Fields, 2016).[2] Figure 3 shows the population densities of the towns within the study site. All of the towns are either suburban or rural; most of the towns are rural and have population densities that fall within the range of 50ppm to 700 ppm (Figure 3). The town of Waterford is the most population dense town, as it is closes to the city of Albany, however it is still far from being considered urban (Figure 3). I used population information about the study site to conduct a comparison of housing prices change among rural, suburban and urban areas and my synthesis of the potential of green gentrification to emanate following trail development.

[2] These classification specifications of urban, suburban, and rural areas, using population density, are based on the Census Bureau guidelines.

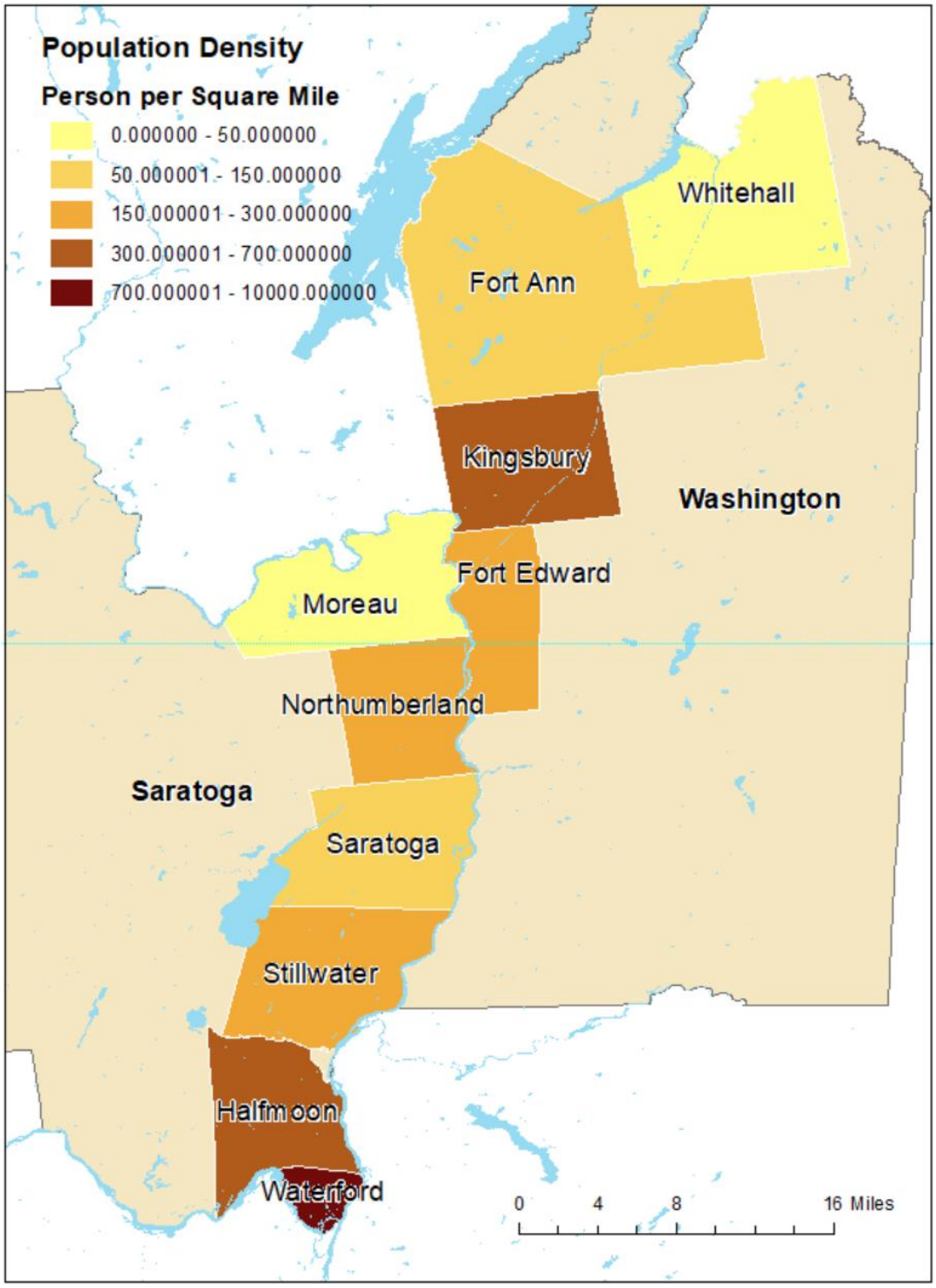

Figure 3 Population densities identified by persons per square foot in the studied towns.

4.3. Champlain Canalway Trail Development

The construction of the Champlain Canalway Trail has been a continuous process; while the comprehensive trail plan were created in 2008, the trail includes historic pathways that have existed long before the Champlain Canalway Trail plans were created. I overcame these challenges in this analysis of the Champlain Canalway Trail by only researching the segments of the trail that were fully constructed as of 2019 and only accounting for trailhead openings that occurred between 2005 and 2019 .

The Champlain Canalway Trail data is comprised of information about the location of the trail, status of the trail, and opening dates of the trail. Location data of the trail was collected from the public GIS data records of trial data. Information about the openings of the trails was collected from the 2011 and 2019 Champlain Canalway Trail Action Plans.

Table 2 Lists the towns that the Champlain Canalway Trail cuts through and if and when a segment of the trail opened in the town from 2005 to 2019. The table also notes the development type

Town	**First Opening Year**	**Town Type**
Saratoga Springs	2019	Suburban
Fort Ann	2005	Rural
Fort Edward	2005	Rural
Schuylerville	2019	Suburban
Stillwater	Pr-existing	Suburban
Waterford	2016	Urban

Whitehall	2005	Rural
Halfmoon	2016	Suburban

5. Empirical Model

The empirical model is comprised of three different components: the hedonic pricing framework, spatial analysis and difference-in-difference estimation. The combination of these economic tools enables me to analyze how the housing prices are impacted by the construction of multi-use trails and how this impact varies based on the distance the house is from the trail.

5.1 Hedonic Pricing Method

The purpose of using a hedonic pricing method is to isolate the impacts of how the construction and proximity to the trail impacts the sales prices of houses. The hedonic pricing model employed in this study is based on the reduced forms derived from empirical literature.

The hedonic pricing models in this paper are adopting a semi-logarithm (also known as a log-linear) functional form. I use this type of functional form in the analysis because it produces coefficients for variables in percent form, indicating the effect of the variables as a percentage change in the total selling price of the house. This form is easier to understand, especially in the case of this paper where there is high variability of average housing prices throughout the towns that are within the study area and within neighborhoods in each of the towns. The leading rational is that semi-logarithm functional form is the predominate interpretation used in hedonic studies, especially literature examining green spaces. Both Correl (1978) and Asabere and Huffman (2009) estimated the impact of housing prices using a semi-logarithmic form;

continuing the use of the form in this multi-use trail research aids the ability to compare the findings of this paper to other trail studies.

The base hedonic pricing model, that excludes the trail related variables, estimates the sales price of the property using the number of bedrooms, number of bathrooms, above ground square footage, and property acres. The pricing model also controls for the town and the month the property was sold. The model includes a variable for town to account for location based amenities (school district quality, local landfills nearby, proximity to downtown) that may impact the sales price of the house. I also control for the month that the house was sold to account for any seasonal effects that occur in the housing market that can impact the sales price.

Model 1:

$$\log(Y_{iym}) = \beta_0 + \beta_1 Beds_{iym} + \beta_2 Baths_{iym} + \beta_3 SQFT_{iym} + \beta_4 Acres_{yim} + \beta_5 Town_i + \varepsilon_{iym}$$

Where:

Y_{iym} = The price that the single-family house sold for in year y and month m.

$Beds_{iym}$ = A variable that denotes the amount of bed rooms in the home in year y and month m

$Baths_{iym}$ = A variable that denotes the amount of bathrooms in the home in year y and month m.

$SQFT_{iym}$ = A variable, only included in the models estimating price, representing the square footage of the home in year y and month m.

$Town_i$ = A control variable that accounts for other town effects and amenities.

This equation estimates sales price of the house, in year (y) and month (m), as the function of the bundle of goods that comes with the house. This basic equation provides a framework to later examine if variables concerning the houses relationship to the Champlain Canalway Trail can be used to predict the sales price of the single family house.

5.2 Spatial Indicators

The hedonic specification that isolates the effect of proximity to an amenity have been used by Correl (1978) and Pope and Pope (2015). Correl (1978) examined spatial affect in feet, while Pope and Pope (2015) grouped the data in mile ranges. Since there is a limited amount of data on sales prices of housing in the examined study site, there is not enough data to make valid conclusions the effect of distance from the trail in feet; therefore, the data is categorized into houses located within a half-mile, one-mile, two-miles and greater than two-miles from the trail. The single family houses that fall within a half-mile buffer around the trail are given a value of '3', houses between a half-mile and one-mile are given a value of '2', between one-mile and two-miles is '1', and everything greater than two-miles away has a value of '0'.

In the case of this paper, I use two different model specifications to examine the impact of proximity of the trail on the housing price; I examine distance by including it as a categorical variable and I also use a fixed effect model to control for each of the distance categories. The fixed effect model factors in distance from the trail into the hedonic model by creating a dummy variable for each of the four distance ranges. The fixed effect specification is beneficial because it breaks down individual effects of each distance category, so the impact of moving from one

distance range to another can be isolated individually. The following is the generalized equation for the hedonic pricing model including the spatial effects:

Model 2

$$\log(Y_{iym}) = \beta_0 + \beta_1 Beds_{iym} + \beta_2 Baths_{iym} + \beta_3 SQFT_{iym} + \beta_4 Acres_{yim} + \beta_5 Town_i + \beta_6 Distance + \varepsilon_{iym}$$

5.3 Difference-in-Difference Specifications

To further identify the effects of the Champlain Canalway Trail on housing prices, I employ a difference-in-difference specification on the traditional hedonic pricing model; this is an adaption of the classical hedonic pricing model based on the model used by Pope and Pope (2015) to study how the introduction of Walmart locations impacted housing prices. I use a similar difference-in-differences estimator in this study to examine the direct impact of the introduction of the trail to test if the sales prices of houses increases following the trail construction. Model 3 uses the base hedonic control variables used in Model 1 and the additional spatial specifications from Model 2.

Model 3:

$$\log(Y_{iym}) = \beta_0 + \beta_1 Beds_{iym} + \beta_2 Baths_{iym} + \beta_3 SGFT_{iym} + \beta_4 Acres_{yim} + \beta_6 Town + \beta_7 Distance_i + \beta_8 Post_i + \beta_9 PostxDistance_i + \varepsilon_{it}$$

In the equation, the variable 'Post' identifies whether the house was sold before a segment of the trail was constructed in the town the house is located. The variable 'Distance' behaves like a treatment variable; it identifies the houses that would be impacted by the

proximity to the trail. The interaction term 'PostxDistance' is used to identify the cumulative effect of the introduction of the trail and the treatment of the trail; I test the interaction term using a fixed-effect model. The fixed-effect model creates three dummy variables that test the interaction between the variable 'Post' with each of the distance buffers from the trail. The interaction term is identified by three different interaction dummy variables; the dummy variables indicates houses that were sold after the local trail construction and are within a half-mile, one to two miles, or two or more miles from the trail. Isolating the effects of the different distance buffers helps to test the theory that trail construction raises the selling prices of houses closest to the trail, by independently testing if houses within a half-mile buffer are most affected by the trail construction.

6. Results

6.1 Basic Model Results

The basic hedonic pricing model is the framework that I used to estimate the ln(Price), the natural log of the selling price, before including the trail related variables (*Model 1*). Table 3 shows the results of the three different specifications of Model 1 (Table 3). The signs of the amenity variable coefficients are consistent in all three model specifications (Table 3). The coefficients indicating the effect of the amount of acres, number of bedrooms and house square footage are all positive (Table 3). This means that increasing any of these variables increases the selling price of a house (Table 3). The resulting coefficient for number of bedrooms is surprising; in all three variations the results indicated that increasing the number of bedrooms decreases the

selling price (Table 3). All of the variables in the basic models in columns (2) and (3) all have a high level of significance (Table 3).[3]

The most basic model, shown in columns (1), has the least significance. The models ability to explain the variation in sales price significantly increases in the model shown in column (2) when the town/city control variables are included. The model again becomes more significant when the seasonal and year controls are included. The specifications from columns (3) is used as the basis to test the spatial indicators and the difference-in-differences treatment in *Model 2* and *Model 3.*

Table 3 Variations on Model 1, the hedonic pricing models estimating effect housing qualities have on the sales price of houses. The values are adjusted using the seasonal effects and time control variables.

	(1)	(2)	(3)
VARIABLES	ln(Price)	ln(Price)	ln(Price)
Beds	-0.0407***	-0.0180***	-0.0178***
	(0.00774)	(0.00682)	(0.00684)
Baths	0.261***	0.183***	0.181***
	(0.0113)	(0.00997)	(0.00998)
SQFT	0.000374***	0.000306***	0.000305***
	(1.26e-05)	(1.11e-05)	(1.11e-05)
Acres	4.84e-09**	5.32e-09***	5.31e-09***
	(1.90e-09)	(1.64e-09)	(1.64e-09)
i. Town/City	–	Yes	Yes
i. Month	–	–	Yes
i. Year	–	–	Yes
Constant	11.23***	11.94***	11.90***
	(0.0242)	(0.464)	(0.465)
Observations	6,589	6,589	6,589

[3] All of the variables in the basic models in columns (2) and (3) are significant under a 99% confidence level; all but the variable identifying the acres of land are also significant under a 99% level of confidence in the model in column (1) (Table 3).

R-squared	0.326	0.500	0.505

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

6.2 Spatial Indicators Results

The regression results presented in Table 4 test the impact of proximity to the trail on the selling price of the single family houses. The first specification tests for distance by including a categorical variable that identifies the distance range the house falls under: half-mile, one-mile, two-miles or greater than two-miles. The second specification, identified in Column (2) uses a fixed effect model, which factors the houses distance from the trail using dummy variables.

If the theory that housing prices rise as distance from the trail increases where to hold true, there would be a significant positive coefficient in the distance related variables especially in the distance dummy variable that isolates houses within a half mile of the trail; houses in the nearest buffer where predicted to experience the greatest impact on price.[4] The results in Table 4 show the opposite scenario occurring. The coefficient for categorical variable 'distance' has a negative coefficient, the interpretation of this result indicates that a house moves to a closer buffer area, the sales price of the house drops by -7.6% (Table 4).[5]

The theory is further tested to not hold true in the second specification of the spatial hedonic pricing model; the model in column (2), which uses a fixed effect approach to examine each of the buffer areas as a dummy variable shows that houses within the half-mile buffer have a -24.1% lower selling price (Table 4). Houses within a one-mile, decrease by -8.1%, however, the sales prices of houses between the one-mile and two-mile buffer increase by 9.27%. (Table 4).[6]

[4] The variable 'Distance' is defined so that the distance values decreases as houses get further from the trail: houses within a half-mile of the trail have a value of 3, between a half-mile and one-mile have a value of 2, between one-mile and two-miles have a value of 1, and all houses greater than two-miles from the trail hold a value of 0.
[5] The negative coefficient for the variable 'Distance' is significant under a 99% level of confidence (p<0.01).
[6] The coefficients for the dummy variables 'Two-miles', 'One-mile', and 'Half-mile' are all significant under a 99% level of confidence (p<0.01).

Table 4 The regression results of Model 2, the hedonic pricing model with the spatial dummy variables.

	(1)	(2)
VARIABLES	ln(Price)	ln(Price)
Beds	-0.0168**	-0.0146**
	(0.00677)	(0.00674)
Baths	0.173***	0.169***
	(0.00991)	(0.00987)
SQFT	0.000305***	0.000305***
	(1.10e-05)	(1.09e-05)
Acres	5.27e-09***	5.26e-09***
	(1.63e-09)	(1.62e-09)
Distance	-0.0760***	–
	(0.00682)	
Two-miles	–	0.0927***
		(0.0219)
One-mile	–	-0.0811***
		(0.0265)
Half-mile	–	-0.241***
		(0.0207)
i.Town/City	Yes	Yes
12.Month	Yes	Yes
i.Year	Yes	Yes
Constant	11.90***	11.92***
	(0.461)	(0.458)
Observations	6,589	6,589
R-squared	0.514	0.519

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

6.3 Difference-in-Difference Results

The purpose of the difference-in-differences is to examine the percent change in housing price near the Champlain Canalway Trail, in each of the towns, after segments of the trail were constructed. If the theory where to hold true, the results would indicated a spike in housing prices

after the construction of the trail and, more specifically, a spike in the sales price of houses around the newly constructed trail. [7]

The difference-in-difference model employs two different specification; the first specification identified in column (1) does not include the basic hedonic pricing variables while the specification in column (3) does. The variable 'Post', which is identifying the houses sold post trail construction is positive indicating that trail construction increases the selling price of houses within the town. After a segment of the trail is constructed, houses between two-miles and one-mile from the trail have an insignificant -2.7% to -2.5% decrease in sales prices compared to houses two or more miles away from the trail. Houses within a half-mile to one-mile range from the trail have around a 6.98% to a 5.98% increase in price relative to houses two or more miles away after trail construction (Table 5). Most importantly, houses within a half-mile distance from the trail have a significant -17.5% to -12.9% decrease in selling prices, relative to houses two or more miles away, following trail construction (Table 5).[8] This found decrease in selling price of houses that are closest to the trail opposes the theory that multi-use trails bring value to houses near the trail.

Table 5 Difference-in-difference models identifying the percent change in housing price before and after the trail.

	(1)	(2)
VARIABLES	ln(Price)	ln(Price)
Post	0.0349	0.0640**
	(0.0268)	(0.0258)
Two-miles	0.138***	0.0976***

[7] The trail was constructed in several different segments; the variable 'post' which indicated the construction of the trail indicates the times the Champlain Canalway Trail opened in each of the towns.
[8] The coefficients for the interaction dummy variables for the half-mile distance is significant under a 99% level of confidence ($p<0.01$).

	(0.0258)	(0.0256)
One-mile	-0.150***	-0.0764***
	(0.0292)	(0.0294)
Half-mile	-0.299***	-0.218***
	(0.0223)	(0.0223)
1.postxtwo-mile	-0.0274	-0.0251
	(0.0412)	(0.0424)
1.postxone-mile	0.0698	0.00598
	(0.0619)	(0.0634)
1.postxhalf-mile	-0.175***	-0.129***
	(0.0468)	(0.0457)
Beds	–	-0.0148**
		(0.00674)
Baths	–	0.171***
		(0.00989)
SQFT	–	0.000304***
		(1.10e-05)
Acres	–	5.29e-09***
		(1.62e-09)
City	Yes	Yes
Month	Yes	Yes
Year	Yes	Yes
Constant	12.85***	11.88***
	(0.536)	(0.458)
Observations	8,619	6,589
R-squared	0.367	0.520

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

7. Discussion

7.1 Discussing the Impact of Mutli-Use Trails

The results of this study diverge from the theory, tested in previous papers, that the introduction of recreational and green spaces –multi-use trails included– increases the sales prices of houses in close proximity to the amenity. While both Correl (1978) and Asabere and Huffman (2009) found that housing prices increase the closer they are to a trail, the results in this

paper indicate, the selling prices of houses that are in closer proximity to multi-use trails have lower sales prices. However, the coefficient for houses sold after the trail development suggests that the introduction of the Champlain Canalway increased the selling prices of houses within the overall community by around 6.4%; this is higher than the overall 2% to 5% increases in housing prices found in Asabere and Huffman's (2009) study in San Antonio Texas. Asabere and Huffman's (2009) found this surge in housing prices to be most prominent in properties closest to the trail, while the results of this study found that the increase in housing prices occurred in areas between a half-mile and one-mile away from the trail.

The results in this study may differ from findings found in similar trail studies because the towns along the trail are urban and rural, where there is already an abundance of green space. The found negative impact on houses neighboring the trail may also indicate a distaste for living near trails due to concerns for lack of privacy and/or fears of crime that may be attributed to unattended trails. These attitudes may be more prevalent in areas like Saratoga County and Washington County, where there is lower population density because people may value privacy more and there are less "eyes" on the trail making them more susceptible to crime. The found positive impact on houses between a half-mile to one-mile away from the trail show that buyers see it as beneficial to live within a walking distance from the trail, even though it is not desirable to live adjacent to the trail. It is also possible that the findings of this paper where greatly impacted by research error and study limitations.

7.2 Study Limitations

As in all hedonic pricing studies, there are likely outside factors that are unaccounted for in the model that influence the sales prices of houses in the area; the effects of outside factors

could be especially apparent in this study because the dataset is collected from a wide range of areas. Although the hedonic models used in the study controlled for the effects of cities and towns, within these areas there could be other amenities or undesirable attributes that impact certain properties (lakefront, busy street, proximity to a landfill, ext.). The effects of potential omitted variables likely could bias the explanatory variables. In addition, the complete models drop 2,030 observations, the dropping of these variable reduced the dataset to 6,589 and could have skewed the results.

Ideally, this paper would use smaller and closer buffer ranges around the trail to more accurately isolate houses that were impacted by the construction of the trail, however, since the dataset was limited, I needed to widen the buffer range to ensure that each distance category had a representative sample size. These general buffer ranges could have resulted in the unexpected results that showed houses closer to the trail had lower selling prices, especially since previous studies that have found the theory to hold true tested houses within distances less than a half-mile (Correl, 1978).

The availability of public information was also a large limitation for this study. There was no public data collection about the exact opening day of different segments of the trail, due to this challenge the difference-in-difference calculations were based on the year that the segments of the trail were opened rather than the exact day. The lack of information about trail openings along with the continuous nature of the trail construction process made it difficult to identify the exact construction of the trail. These uncertainties are likely to skew the difference-in-differences results presented in Table 5.

8. Conclusion

The primary objective of this study is to engage in the field of literature studying green spaces by examining how the development of multi-use trails impacts housing prices to assess the potential of green gentrification occurring in rural and suburban communities. The study found significant evidence showing that houses that are within a half-mile from the trail, and were sold after the trail was constructed, have between a -17.5% to -12.9% lower sales price in comparison to houses two or more miles away from the trail. However, the study indicates that it may be more desirable to live slightly further from the trail, but still within walking distance; houses within a half-mile to one-mile away from the trail that were sold after the trail construction have around a 6% to 7% higher sales price in comparison to houses two or more miles away from the trail.

The results of the study imply that the introduction of multi-use trails in suburban and rural areas do not put neighborhoods within a half-mile away from the trail at risk of green gentrification, however, the average increase in housing prices that occurs in the towns indicates that the construction of multi-use trails may have the ability change the demographics of the overall community. Since the magnitude of the negative impact was much greater and more significant on houses within a half-mile of the trail, in comparison to the found overall impact, it is unlikely that the construction of the trail will cause a paradoxical effect on the community. This means that urban and regional planners who are looking to build multi-use trails in suburban and rural areas, in effort to make recreational spaces more accessible to vulnerable populations, should consider the greater implications of trail development for the community.

More research in other disciplines can be done in rural and suburban areas to further assess the potential threat that multi-use trails may pose on rural and suburban gentrification.

Hedonic pricing models can only assess the risk of multi-use trails triggering a paradoxical effect, but other research tracking populations and health of a business can be used to see if the creation of the green space can effectuate a legitimate change in the demographic composition of rural and suburban neighborhoods. While this paper did not show clear evidence indicating that the construction of the Champlain Canalway Trail put the impacted communities at risk of gentrification, planners should not discount the possibility of greening projects triggering a paradoxical effect in rural and suburban neighborhoods.

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