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The impacts of the trails on property values surrounding Jejudo in Korea: using quantile regressions

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ABSTRACT
The purpose of this study is to quantitatively analyze the effect of Jeju Olle Trails on nearby land prices. Land sale prices are designated as the dependent variable and zoning type and land category, shape of the land, and the width of bordering roads as independent variables. Land price data for actual sales for seven areas surrounding Olle Trails were examined with a geographic information system program to determine the exact distance of land parcels from nearby trekking courses. A quantile regression model is used to estimate the effect of trail proximity to nearby land prices. Through this quantile regression model, the difference in the effects of trail proximity between low-priced and high-priced land is captured. This study shows no significance for the variable up to quantile 0.6; however, the variable becomes significant from the 0.7 quantile and up. This suggests that plots in the top 30% of land prices are affected by the presence of trails, but the plots in the bottom 70% are not affected by this variable. For every 100 m distance from an Olle Trail, land price falls by 0.054%.

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Introduction

As a tourism resource, trails attract visitors and positively affect the regional economy through the creation of wealth and development of new service industries in nearby areas. Trails foster the growth of existing tourism industries while also creating new jobs (Asabere & Huffman, 2009; National Park Service, 1992).

In Korea, the phenomenon of trails serving as a generator of regional wealth is unprecedented. This new trend is readily observable in one of Korea's top tourist destinations, Jeju Island. The concept for constructing a set of trekking trails, collectively called Olle Trails, was first developed in 2006 by a private not-for-profit corporation.[1] Initially, 3000 visitors per year visited Olle Trails. In 2014, however, 1.2 million tourists visited the trails. By 2015, Olle Trails became the representative growth sector of the local tourism industry and the benchmark other regions in Korea used for economic growth goals. This increase in visitors to Olle Trails coincided with an increase in tourists visiting Jeju Island, with Olle Trails serving as a major draw. Before 2006, there were 5 million visitors annually, an increase of one million visitors since 2000. Between 2007 and 2013, the number of tourists increased by approximately 1 million visitors per year to 11 million tourists.

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This increase in tourists has also coincided with a rise in local real estate values. Land values in Jejudo began rising markedly, beginning in 2008, when real estate markets in other regions of Korea were stagnating. Jeju experienced a real estate boom with prices increasing at a rate of 1.073% annually by 2010, whereas in Seoul, the rate was 0.52%. Even in 2013, the growth rate of real estate prices in Jeju outpaced Seoul, at 1.424% vs. 1.206%, respectively. Considering Seoul's prominence in the Korea as the nation's economic powerhouse, real estate bellwether, and the largest real estate market. Historically, land price growth rates in Jeju have been lower than in Seoul.[2]

The development of Olle Trails is the single most important factor in explaining booming land prices in Jeju. It is conjectured that the continued development of the Olle Trails and the increase in the number of tourists has positively affected land values in areas near the trails. The extent this holds true and the degree to which Olle Trails are attributable for this growth has not been objectively researched. Quantitative measurement of the economic effects of Olle Trails (specifically increased value assets) is essential for the continued development and preservation of these trails. Providing detailed evidence for the positive relationship between Olle Trails and adjacent land prices will allow local governments to properly invest in trail development and preservation with the support of local residents.

Providing empirical evidence of this link will inform stakeholders of the benefits of public and private trail development and assist in securing public spending for the maintenance of existing and future trails. This paper seeks to provide such evidence using data collected from Jeju Island in South Korea, where the development of numerous Olle Trails have greatly influenced the local tourism economy.

This study differs from existing papers in the following three respects. First, although numerous studies analyze the economic effects of newly built roads or railway lines on real estate prices, few studies examine the effect of trails on real estate prices. It is hoped that this study will provide a basis for regional, national, and international comparative studies on trails and real estate prices. Secondly, the majority of existing studies of trails relies on surveys or regression analysis, and thus do not distinguish between the effects of trails on the prices of high- and low-priced land. Quantile regression models, however, measure such differences.

This study is organized as follows. I review existing literature related to Jeju Olle Trails. Next I present the extent of spatial data collected and the models used to interpret them followed by an analysis of results. Finally, I present conclusions that may be drawn from these results.

Literature review

In most countries, there are not many studies on trails. Some studies that are loosely related to trails include studies on open space (Acharya & Bennett, 2001; Irwin, 2002) and urban forests (Czembrowski & Kronenberg, 2016; Tyrväinen, 1997; Tyrväinen & Väänänen, 1998; Tyrväinen & Miettinen, 2000; Tyrväinen, 2001).

Some studies on open space use the hedonic price model to compare the values of permanent open space and developable open space. Geoghegan (2002) analyzed the effect of permanent and developable open spaces on housing value as it was hypothesized that their economic value might play an important role in housing choice. According to the study's hedonic price model, the permanent open space variable was found to have significance with a positive sign but the developable open space variable was not significant. Irwin (2002) is also a similar study. The study uses a hedonic price model to analyze real estate transaction data from Maryland to estimate instrumental variables. Irwin finds that permanently preserved open space has a higher value than developable agricultural and forested lands. Both Geoghegan and Irwin find that permanent open spaces exert a larger effect on property values than do developable green spaces and recommend that such open spaces be preserved.

Studies which emphasize the importance of preserving the natural environment for improvement of housing comfort include papers on open spaces in addition to those on urban forests. Tyrväinen (1997) estimated the value of urban forests capitalized in property prices. The study examined apartment prices in North Carolina and found that urban forests do have a positive effect. Tyrväinen and Miettinen (2000) is also a similar study using a hedonic price model to estimate the value of urban forest amenities in Finland. The difference between Tyrväinen (1997) and the subsequent study is that the former used the ratio of total forested area in housing districts, while Tyrväinen and Miettinen (2000) used the distance from forested areas. The latter study found that every 1 km of closer proximity to forested areas was associated with a 5.9% average increase in the market price of dwellings.

Just as open spaces and urban forests exert a positive influence on property prices, it is proposed that Olle trails also have such an effect. Previous studies of trail have shown the positive effect the creation of new trails has on the value of nearby real estate. The effect is similar to that of new roads, in that accessibility is greatly improved. New roads and trails expose people to locations otherwise inaccessible and consequently raise the likelihood of real estate transactions (Crompton, 2001; Nicholls & Crompto, 2005). Trail creation increases accessibility and leads to improvements in real estate amenities. Trails situated toward the front of real estate plots increase openness while providing a peaceful venue and spiritual comfort with the added bonus of increased real estate values (Crompton, 2001).

A land plot's distance from a trail is a key variable in estimating the effect of trails on real estate prices, necessitating the use of geographic information system (GIS) in calculating this distance.

While the research on the correlation between trails and real estate prices is limited, a review of existing literature reveals that most studies measure the distance between trails and land plots using a single central point, such as a trailhead. In other studies, more simplistic techniques were used, such as defining a dummy variable to indicate whether or not a land plot is located "close" to a trail. Asabere and Huffman (2009) used a semi-logarithmic hedonic model for analyzing the impact of trails and greenbelts on housing values in San Antonio, Texas. Using 10,000 data points from real estate transaction records from 2001 to 2002, they found that the presence of trails and greenbelts was associated with 5% higher real estate sale prices. Rather than taking actual distance into account, Abhere and Huffman used a dummy variable to signal a house's relative proximity to a trail or greenbelt. This approach has notable shortcomings. The likelihood of over- or underestimating price effects is greater compared to estimates derived from more accurate distance measurements. Additionally, it is not possible to measure marginal effects of land plots that differ in trail proximity by small increments, say 100 m.

In contrast, the model designed by Nicholls and Crompto (2005) uses a variable measuring the distance from trails to residential properties. Applying a hedonic price model to analyze the effect of greenways on residential property values in Austin, Texas, they were

Table 1. Overview of Existing Research.

Author	Model	Dependent variable	Type of real estate analyzed	Type of variable for trails
Nicholls and Crompto (2005)	Hedonic	Actual sales prices	Residential	Dummy
Asabere and Huffman (2009)	Semi-log model	Actual sales prices	Residential	Dummy
Parent and Hofe (2013)	Spatial econometric	Appraisal prices	Residential	Distance measurement (Arc view)

able to use actual real estate transaction data to create a more objective model than survey or anecdote-based models. Distance from each property to a trail was calculated using the trailhead. This method has the advantage of being straightforward and simple to compute, as only the Euclidean distance between the trailhead's geographical coordinates and the land plots' coordinates need to be calculated.

Most studies estimating the effect of trails of property value use hedonic models with regression analysis for parameter estimation. Parent and Hofe (2013), however, created a spatial econometric model to increase methodological accuracy in their analysis of the effect of trails on residential real estate prices in Miami, Florida. They found that trails exerted a statistically significant positive effect on nearby housing prices for properties within a twelve-mile radius of a trail. Assessed value or market value was designated as the dependent variable, rather than real estate transaction prices. Using of actual transaction data markedly reduces the quantity of data for analysis and is thus less desirable for researchers. From a methodological standpoint, Parent and Hofe's method is superior as it takes spatial dependence among properties into account. Like Nicholls and Crompton, however, they also measure distance between land plot and trails from trailhead coordinates.

The three aforementioned studies focus primarily on residential real estate values. Nicholls and Crompton employed a hedonic model and Asbere and Huffman employed a semi-logarithm to analyze actual residential real estate transaction data. Asbere and Huffman's usage of a dummy variable as an indicator of proximity to a trail is a method frequently used in previous studies. On the other hand, Parent and Hofe's study is unique in its usage of the Arc-GIS program to measure distance between individual residences and trailheads and thus accounted for spatial dependence between houses. Their study also differs from previous ones in its usage of housing appraisal data used from local property tax assessments rather than real estate transaction price data.

As evidenced in Table 1, existing research on the effect of trails on real estate prices is centered in the US. There are very few studies, however, on the effect of trails on Korean real estate prices. Although some related studies on green spaces' positive effect on housing desirability do exist, most of these studies focus on views of greenery. For example, Kim (2002) studied the effect of the green space ratio on nearby apartment prices. Je (1994), Park and Park (2004), Yang and Choei (2003), and Lee, Kim, and Son (2013) have studied the effect of park views on Korean housing prices. The effect of river views on Korean housing prices has been examined by Kang and Jung (2001), Choei and Yang (2002), Oh and Lee (2003), Song (2004) and Hwang, Lee, and Kim (2008).

In contrast, research into Olle trails' effect on real estate is hard to find, which reflects the fact that these trails have only been in existence for 10 years. Existing studies on Olle trails have analyzed trails from a tourism product perspective. Kang, Cho, Son, and Shin

(2012) surveyed and analyzed the satisfaction of Olle trail visitors, while Jeong, Park, and Roh (2010) studied the motivations of visitors to Jeju Olle trails. Other studies examine ways to encourage revisits to Olle trails in order to maximize tourism revenues (Hyeon, 2012).

The sole study concerned with researching the effect of Olle Trails on nearby real estate prices is by Lee and Jung (2014). Their study attempted to estimate the effect of Jeju Olle Course No. 7 on adjacent real estate prices by analyzing land prices, distance from trail, shape of plot, zoning classification, land category, and other factors. As their study utilized regression analysis, it is not possible to examine the effect of trails on high- and low-priced real estate separately. Their usage of assessed property values limits the study's ability to conclude whether the number of real estate transactions changed due to the creation of the trail.

The current study, however, uses actual prices from housing sales data instead of assessed property values or appraisal prices. This study uses quantile regression instead of regression analysis in order to obtain more specific and descriptive results. The paper seeks to extend this research to Jeju Island in South Korea by estimating the effects of Olle trails on nearby land prices.

The magnitude of such effects can shed light on the degree to which people in both South Korea and the US value access to nature as a tourism resource. Such research will aid local governments in making concrete projections of benefits from the development of trails and will serve as a foundation for policy-making.

In order to move beyond previous research in this area, the current study will use the quantile regression method for examining the effect of trails on residential real estate and land prices. Quantile regression allows differentiation of high- and low-priced real estate. While it is largely accepted that trails generally exert a positive effect on real estate prices, their effect on high- vs. low-priced real estate may differ. This approach allows for a more multifaceted understanding of the issue under study.

Extent of spatial analysis and method

Jeju Olle Trails consist of a set of 21 trails following the coastline of Jeju Island (see Figure 1). Olle Trails are located primarily in rural areas. As tourists started to arrive en masse, the exposure of local properties greatly increased along with the probability of real estate transactions. The creation of the trails increased the degree of openness and utility of local properties as well as the land comprising the trail itself.

This study also focuses on Jeju Olle Trail, Course No. 7 and the surrounding area. As seen in Figure 2, this course is located on the southern coast of Jeju Island.

Olle Course No. 7 was selected for analysis because it is the most popular of the 21 Olle courses in Jeju and attracts the most visitors. It takes a long time to create economic value from trails. Jeju Olle Trails, which have existed for a decade, were the first of their kind in Korea. It takes a long time for the economic value of trails to be reflected in the market for land. Nevertheless, as the most popular trail among the 21 Olle trails in Jeju Island, course No. 7 has asserted its economic value most rapidly. Course No. 7 was selected for this study because it is most likely among the trails to exert an influence on actual land sale prices for nearby real estate. The three towns of Beop-hwa-dong, Hogeun-dong, and Seoho-dong border course No. 7.

Beop-hwa-dong (region1) has the highest density of housing and frequency of real estate transactions among the 3 towns. In 2013, Beop-hwa-dong recorded 42 real estate

Figure 1. Jeju olle Trails.

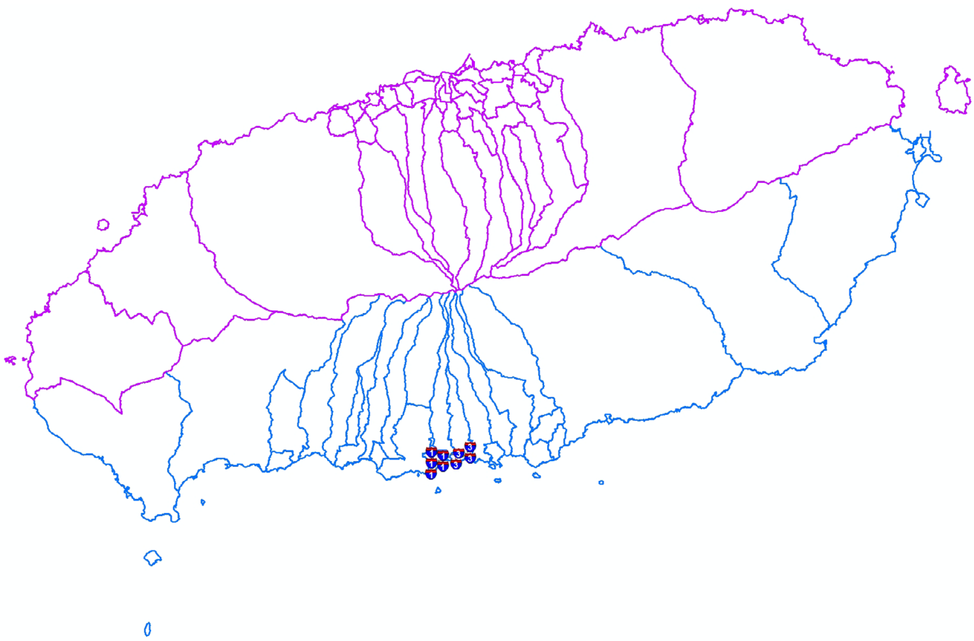

Figure 2. Olle Course No. 7.

transactions. Hogeun-dong (region 2) has more farmland but less housing than Beop-hwa-dong and is generally less developed. In 2013, Hogeun-dong recorded 33 real estate transactions. Compared to regions 1 and 2, Seoho-dong (region 3) has the fewest adjacencies with the Olle trail. In 2013, region 3 recorded 7 real estate transactions.

The most important variable in this study is the distance of each plot of land from the Olle trail. Defining this variable was quite tricky. Quantitative measurement of trail benefits is essential in analyzing their impact, yet there is a dearth of related research. This study uses a GIS approach and a quantile regression model to analyze the economic benefits of trails. The proximity of the land to trails is the most deterministic variable in the quantitative model for estimating the prices of land located near trails. As trails are not single points, but rather long lines, calculating the distance from a trail to a plot of land is not a simple undertaking. After specifying positions at regular intervals along the trail, geographical coordinates are calculated for each position. Finally, the distance from each position to each plot can be measured.

American studies of trails generally calculate the distance from each plot of land to a single point, the trail entrance. Once the geographic coordinates of the trail entrance and the plots of land are obtained, it is easy to calculate the Euclidean distance from the trail entrance. That approach is much simpler than that used in the current study, which follows multiple points along a trail.

Trails in the US are largely located within forests and mountainous areas located far from residential areas. In this case, it is logically unproblematic for the trailhead to serve as the point from which distance to a land plot is measured. Local market participants consider the distance of a property to a trailhead to be more salient than the property's proximity to the trail as a whole. This is due to the characteristics of trails in the US: upon entering a trail, there are generally few exit points or settlements along the way. Jeju Olle Trails, however, do not have singular entrance points and weave through numerous villages, allowing visitors to enter and exit the trail at multiple points. Olle Trails pass by houses of local residents; thus, properties along the trail have the potential to increase in value due to their close proximity to the trail. If the distance from a trailhead to a land plot were treated as a variable, the effect of proximity to an Olle Trail on real estate prices would tend to be underestimated.

In order to determine land sale prices in regions 1, 2, and 3, land deeds were analyzed. In Korea, the actual sales price is not revealed to the general public. Although the Korean Government provides actual sales price data on the web, prices are not mapped to lots or land parcels. Among residential properties, lot numbers are only provided for apartments. Other real estate – land, commercial space, offices, single housing, etc. – is not assigned lot numbers. In the absence of lot numbers, geographic coordinates cannot easily be generated for land plots. In order to use GIS, first collation and analysis of real estate property deeds was required. Based on the information in land deeds, it was possible to generate geographic coordinates for each plot. With the coordinates for each plot of land and coordinates along the path of the trail, it was possible to calculate a variable representing the "distance from Olle course No. 7".

Data and variables

Land sale price is set as the dependent value. Besides distance from the Olle trail, explanatory variables affecting land prices were also considered in the model. Control variables used in the model include Region, Zoning type, Current Land Use, Land Shape, and Road Access.

Olle course No. 7 can be divided into three "Regions." These 3 regions have legal boundaries and are analogous to what would be called "towns" in the US. In other words, regions in this study are administrative districts. Beop-hwa-dong, Hogeun-dong, and Seoho-dong were assigned to the dummy variables region 1, region 2, and region 3, respectively, so that regional differences could be reflected in the model.

The next variable affecting land prices is "Zoning Type," and it describes the legal regulations limiting how land can be used. Because usage regulations are legally binding, land

Table 2. Summary of variables.

Variable		Description
Distance from trail	Trail	Distance from trail
Region type	Region 1	Beophwa-dong: 1, other areas: 0
	Region 2	Seoho-dong: 1, other areas: 0
	Region 3	Hogeun-dong: region3 is Ref. variable in the model
Zoning type	Zoning_residential	Residential zone: 1 other zones: 0
	Zoning_green	Green zone: 1 other zones: 0
	Zoning_etc	Green preservation zone: 1, other zones: 0 zoning_etcis treated as a Ref. variable in the model
Current land use	Land category_site	Residential land: 1, other categories: 0
	Land category_farm	Agricultural land (w/wo municipal water): 1, other categories: 0
	Land category_orchard	Orchard: 1, other categories: 0
Land shape	Land shape_rectangular	Rectangular: 1 other shapes: 0
Road access	Road access_narrow	Access road width 8–12 m: 1, other widths: 0
	Road access_main	Access road width >12 m: other widths: 0
	Road access_zero	No easement: 1, other roads: 0

prices vary depending on zoning type. In residential zones, buildings in excess of three stories cannot be built, and in green zones (aka regulated green zones), buildings may not be constructed without permission. Even if special permission is granted, the 1st story floor space must not exceed 20% of the total size of the plot. In commercial zones, the 1st story floor space can use up to 90% of the total size of the plot and buildings up to 20 stories are allowed. Thanks to these advantages, land in commercial zones fetches the highest prices, followed by land in residential zones and land in green zones. The three regions examined in this study do not contain any commercial zones but they do contain residential and green zones. A distinction is made between green zones and re-regulated green zone variables.

The variable "current land use" denotes how a land plot is actually being used. Land can be used for building housing, producing crops or operating an orchard, for example. Although both "zoning type" and "current land use" describe how land is being used they are distinct from a legal standpoint as one is enforceable while the other is not. Although the land owner cannot change "zoning type" for a particular zone, they may change "current land use" for their plot of land.

The next variable in the model is land shape. Land shape affects how efficiently land can be used. Square lots can be most effectively utilized, but because trapezoidal, triangular, and irregularly shaped lots leave some land unused, land price for the latter is relatively lower.

The width of roads adjacent to lots is another variable that can affect land price. Wider roads exert a more positive influence on land price. Roads greater than 12 m in width are denoted as "main," roads from 8 to 12 m in width are denoted as "narrow," and plots without road access are denoted as "zero."

Table 2 shows a comprehensive overview of the variables appearing in the current study.

A quantile regression model is used to estimate the effect of trail proximity on nearby land prices. Regression models have the advantage of capturing the difference in effects of trail proximity on low-priced land and on high-priced land.

The empirical model

The current study utilizes quantile regression to analyze the impact of trails on land price and can separate the impact of trails between high-priced and low-cost land. Quantile regression enables the use of one model with the entire data-set, dealing with Heckman's (1979) warning about sample selection bias.

Quantile regression is particularly suited as an alternative for the method of least squares when dealing with strongly heterogeneous data-sets. This is the case for land price data, which exhibits great variability. Quantile regression can control heteroskedasticity in data as well as analyze functional relationships between variables along various points of the probability distribution (Brian and Barry, 2003). Judge, Hill, Griffiths, Lütkepohl, and Lee (1988) described the minimization problem for quantile regression as follows (Dimelis & Louri, 2002):

$$\min_b \sum |e_i|\theta_i = \sum |y_i - x_i\beta|\theta_i$$
$$\theta_i = \begin{cases} 2q \quad , & \text{if } e_i > 0 \\ 2(1-q), & \text{if } e_i < 0 \end{cases} \tag{1}$$

In Equation (1), β is a coefficient and vector of kx_1 when there are k explanatory variables. There are a total of k explanatory variables x_i. The error term is e_i and q is a quantile larger than zero but less one. Quantiles from 0.1 to 0.9 were examined in this study.

The quantile regression method has existed for over 200 years, but was not commonly used due to its complexity as an estimation method. Koenker and Bassett (1978), however, used a linear programming algorithm to solve the minimization problem for quantile regression, thus spurring its active usage. The interior point and simplex methods can be employed in finding solutions to linear programming problems. After calculating estimates for the quantile regression coefficients, a hypothesis test is conducted on those estimates. Because linear programming is a non-parametric method that doesn't assume any distribution, the standard deviation must be estimated asymptotically as per the bootstrapping method specified by Gould (1992). The bootstrapping method estimates the standard deviation by using the sample data as an approximating distribution.

The model used in this analysis is as follows:

$$\log(Y_i) = \alpha + \beta_1(\text{trail} + \sum \beta_{2i} X_{ii} + e_i \tag{2}$$

Here i takes values from one to n, where n is the total number of observations (in this study $n = 196$). Y represents the real estate transaction price. The remaining factors that can affect land price are treated as explanatory variables named X and j represents the number of explanatory variables unrelated to trails.

Estimation results

Results are summarized in Table 3. When testing the suitability on an OLS model, the R-squared statistic is the standard for comparison; but in the case of quantile regression, the pseudo R-squared statistic serves as the standard. As Table 3 indicates, the goodness of fit for the OLS is above 10%. Taking the cross-sectional data into account, the OLS model is deemed appropriate. In the case of OLS, the variables "land category_site" and "road access_main" are significant; other variables are insignificant. An analysis of the variable "land category_site" reveals a coefficient greater than zero. This suggests that when the land

Table 3. Results of analysis: OLS and quantile regression.

				Quantile regression											
	OLS			Quantile = 0.1			Quantile = 0.2			Quantile = 0.3			Quantile = 0.4		
Variables	Beta	Std.e	*p*	Beta	Std.e	*p*	Beta	Std.e	*p*	Beta	Std.e	*p*	Beta	Std.e	*p*
C	11.866	.430	.000	10.642	.633	.000	10.776	.520	.000	11.147	.504	.000	11.282	.496	.000
Trail	.000	.000	.331	.001	.001	.253	.000	.000	.418	.000	.000	.554	.000	.000	.993
Region 1	.176	.246	.475	.271	.270	.316	.505*	.270	.063	.445*	.256	.084	.355	.224	.115
Region 2	−.285	.262	.278	−.336	.286	.243	−.177	.321	.582	−.111	.263	.672	−.216	.258	.403
Zoning_residential	−.077	.307	.802	−.162	.415	.697	−.147	.336	.662	−.162	.294	.582	−.160	.328	.626
Zoning_green	−.232	.281	.412	−.324	.573	.572	−.209	.408	.609	−.161	.316	.610	−.059	.350	.865
Current land use_site	.458*	.262	.082	.152	.247	.538	.262	.262	.319	.151	.217	.488	.221	.240	.358
Current land use _farm	.213	.221	.338	−.080	.264	.763	−.035	.265	.894	−.201	.198	.312	−.031	.223	.891
Current land use _orchard	.147	.282	.602	−.101	.293	.731	−.107	.369	.772	.048	.233	.837	.192	.254	.452
Land shape_rectangler	−.539	.342	.117	.151	.327	.646	−.224	.293	.444	−.360	.253	.157	−.669*	.307	.031
Road access_narrow	.200	.175	.254	.225	.192	.243	.278	.181	.126	.359*	.170	.036	.452*	.180	.013
Road access_main	1.126*	.224	.000	1.387*	.247	.000	1.448*	.227	.000	1.367*	.165	.000	1.215*	.192	.000
Y2012	−.054	.180	.766	.261	.337	.439	.078	.190	.684	−.051	.182	.779	−.073	.187	.697
Y2013	−.126	.172	.466	−.047	.505	.926	−.014	.253	.957	−.021	.181	.908	−.064	.186	.731
R-squared		.271													
Adjusted R-squared		.219													
Pseudo R-squared				.292				.279			.246			.222	
		quantile = 0.5			quantile = 0.6			quantile = 0.7			quantile = 0.8			quantile = 0.9	
C	11.873	.456	.000	11.912	.413	.000	12.275	.434	.000	12.441	.450	.000	12.659	.435	.000
Trail	.000	.000	.635	.000	.000	.578	−.001*	.000	.071	−.001*	.000	.053	−.001*	.000	.070
Region 1	.304	.266	.255	.239	.262	.362	.138	.349	.693	.062	.396	.875	−.043	.354	.903
Region 2	.117	.244	.632	.230	.241	.341	−.117	.298	.696	−.117	.331	.723	−.369	.362	.310
Zoning_residential	−.378	.379	.319	−.132	.306	.666	−.137	.333	.681	−.021	.349	.952	.567	.565	.316
Zoning_green	−.451	.326	.168	−.210	.257	.414	.027	.268	.921	−.081	.279	.772	.150	.298	.614
Land category_site	.141	.273	.608	.150	.285	.599	.419	.339	.217	.780*	.409	.058	.805	.692	.246
Land category_farm	.026	.239	.913	.105	.243	.667	.219	.239	.361	.275	.247	.268	.178	.238	.456
Land category_orchard	.147	.266	.582	−.102	.257	.693	.095	.330	.773	.097	.331	.771	.187	.328	.569
Land shape_rectangler	−.919*	.391	.020	−1.113*	.505	.029	−.749	.486	.125	−.821*	.441	.064	−1.040*	.406	.011
Road access_narrow	.404	.256	.117	.177	.223	.428	.088	.218	.688	.053	.219	.809	.274	.225	.225
Road access_main	1.093*	.292	.000	.851*	.250	.001	.568*	.268	.035	.516*	.292	.079	.650*	.334	.053
Y2012	.049	.199	.806	.139	.175	.427	−.032	.201	.875	.027	.216	.901	−.287	.257	.266
Y2013	−.087	.183	.637	−.061	.175	.726	.044	.215	.840	.039	.206	.849	−.038	.265	.886
R-squared															
Adjusted *R*-squared															
Pseudo *R*-squared		.180			.156			.134			.144			.196	

*Significant at the 90% level of confidence.

Table 4. Quantile regression coefficient estimates by Quantile.

Quantile	0.9	0.8	0.7
Coefficient	−0.000614	−0.00055	−0.00054

Table 5. Price impact of distance from an Olle Trail (transaction price units : ₩10,000).

Category	Min	Max	Average
A. Rate decrease per 100 m	−0.000614	−0.000614	−0.000614
B. Land price per m^2(land price/m^2)	8.15	17.17	12.06
C. Trail (unit: m)	100	1000	384.69
D. = A × B × C	0.50041	10.54238	2.848568
Total price decrease	0.5	10	2.8

category is residential, the plot has a higher price than other land categories. Also, when a plot is connected to a major road ("road access_main"), the coefficient is greater than zero. Such plots exhibit higher land prices than plots connected to alleyways ("road access_narrow) or without ("road access_zero").

In the quantile regression, the only significant variable affecting the bottom and top 10% of land prices (quantiles 0.10–0.90) was "road access_main." Thus, the width of access roads exerted the greatest influence on land prices for both high- and low-priced land. Plot shape had no effect on prices for the bottom 30% of plots by price, but exerted a noticeable effect on land prices above this threshold. But once the price quantile reached 70%, plot shape ceased to influence land prices.

The effect of the trail variable on land prices behaves consistently, allowing some conclusions to be drawn. Under the OLS method, the trail variable was not significant at the 10% level. Conversely, the quantile regression shows no significance for this variable up to the 60% level, but becomes significant from the 70% level and up. This suggests that plots in the bottom 70% of land prices are not affected by trails.

Previous studies on the economic effects of trails have examined whether the trail exerts a direct influence on land prices. The quantile regression used here, however, shows that the effect of trails differs between high- and low-priced land.

The dependent variable used in the model was not log-scaled. The distances from land plots to Olle Trails were scaled logarithmically; therefore, a log-linear model was used. The top 30% of land prices had a coefficient of −0.00054, which can be interpreted thus: for every 100 m in distance from an Olle Trail, land price falls 0.054%. For the top 10% of land prices, the coefficient is −0.000614, implying land prices fall by 0.061% for every 100 m from an Olle Trail. Table 4 provides basic statistics for the variables used in the study. The statistics show that the average distance from an Olle Trail is 384.69 m. The closest plot was 100 m from a trail; the furthest was 1000 m.

Using the values presented above, the calculated change in land prices caused by distance from an Olle Trail is shown in Table 5.

Multiplying the three quantities given in column 1, the magnitude of price decrease by distance can be calculated. The values range from 5000 to 100,000 KRW per square meter, with an average decrease of 28,000 KRW for every 100 m from a trail. If land price decreases by 5000 KRW for every 100 m from a trail, the converse also holds true. Namely, land that is 100 m closer to a trail will see a potential increase in price of 5000 KRW per square meter).

Summary and conclusion

This study uses regression and quantile regression analysis to examine the effect of Olle trails on nearby land prices. Although linear regression analysis does not find any significant effects, quantile regression proves to be more useful in identifying significant Olle trail factors affecting land prices. Linear regression is not well suited for analyzing data-sets with outliers, but quantile regression is able to control the effects of outliers and thereby overcome the former method's shortcomings.

The current study uses actual real estate sales data instead of assessed property values and can be seen as a further development upon Lee and Jung (2014), which was the first study of Olle trails' effect on real estate prices. Compared to assessed property values, sales data more accurately reflects Olle trails' economic value because buyers are participants in the land price discovery process.

This study finds that Olle trails exert a positive influence on nearby land prices, with a greater effect for plots with higher proximity. This is evidence of Olle trails' economic value and can provide justification for local government support of such trails. In addition, the results indicate that Olle trails only exert a significant effect on land plots in the top 30th percentile of land prices. In other words, plots in the top 30% of land prices are affected by the presence of trails, but the plots in the bottom 70% are not.

Buyers' preference for Olle trail accessibility is capitalized in land sales prices. This preference manifests more strongly in expensive plots of land. It can be assumed that buyers of expensive plots are in a higher income class than other buyers. It is not surprising that preference for environmental goods like trails and open spaces is more prominent among the high-income class as such goods are an extravagance for those in lower income classes. Trails can be seen as a kind of environmental good. In Korea, environmental goods are still viewed as luxuries rather than necessities. As previously mentioned, high-income buyers are more willing to pay for environmental goods than are low-income buyers, which is why buyers of expensive plots offer a premium for Olle trail accessibility. The finding that trails only exert a significant positive effect on plots in the top 30th percentile can be interpreted through the phenomenon described above. [3]

The present study only examines Olle course No. 7 out of 21 total trails, but in the future this study will be extended to the other trails so that comparisons between courses can be made. Each of the 21 Olle courses are unique. Course No. 7 happens to be located in a predominantly residential and agricultural area, but some of the courses straddle commercial areas. It is hoped that further studies on Olle trails will enable useful comparisons between trails and provide evidence of the need to allocate resources for their further development and conservation. If it is found that Olle trails exert a positive influence on commercial zones, owners of commercial real estate could be induced to share the costs of trail conservation.

Notes

1. The Jeju Olle Trails were developed by the private sector, not the local government. Jeju Olle Trails registered as the corporate entitiy "Jeju Olle, Inc." in September 2007 as the first scenic system of organized trails built on Jeju Island. The first trail opened to the public in September 2007. Jeju Olle, Inc. is unique among similar development projects in South Korea as it is a private rather than public undertaking. Jeju Olle, Inc. first conducted a field

study of suitable sites for constructing trails and made efforts to inform local residents about the proposed developments. The cooperation of local residents was necessary due to trails cutting through the centers of villages. The final step involved enlisting as a corporation with the Jeju Provincial Government, and municipal administrators form villages. Since then, 21 trails have been developed and continue to draw many visitors.

2. During the IMF financial crisis (1997–2000) in Korea, Jeju Island briefly exhibited higher growth rates in land prices than Seoul. This is largely due to the devaluation of the Korean won which made it too expensive for Koreans to travel abroad. Rather, the number of domestic tourists travelling to Jeju rose, increasing liquidity and subsequently real estate prices in Jeju.
3. A similar study by Jung and Bae (2004) examining the effect of skyline views on apartment prices found that the value of skyline views varies by region. For example, skyline views for expensive real estate exerted a greater influence on apartment prices than did skyline views for inexpensive real estate. This may be due to the high-income class' greater willingness to pay for environmental goods such as skyline views .

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