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Close, but not too close: Landmarks and their influence on housing values

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ABSTRACT

The college town of State College, PA, USA is home to The Pennsylvania State University (PSU) and its many facilities. Our initial research interest was to understand the influence of the newly developed Arboretum at Penn State (APSU) on nearby housing values in State College over time. Current sales transaction data were gathered and a pooled cross-sectional regression analysis approach utilized. Contrary to the literature, our findings suggest proximity to APSU, as well as three other nearby open spaces, had no significant influence on nearby homes. Further, proximity to PSU's main campus was negatively associated with housing values. Neither of these patterns varied over time.

To further explore these results, the study area was expanded beyond the neighborhoods most proximate to APSU to the balance of the borough. These results replicated our earlier findings, confirming that living close to PSU's campus is negatively associated with housing values community-wide. These findings disconfirm the common practical assumption that the State College market places a premium on proximity to the town's major employment center (PSU campus) and a significant local landmark (APSU). Housing markets in similar college towns may not reflect typical residential areas and may require alternative evaluation considerations.

1. Introduction

"Location, location, location" is a mantra often touted by real estate agents and homebuyers when discussing what ultimately influences the sales price of a home. Similarly, numerous studies have investigated the extent of environmental influences on housing values (e.g., Anderson, 2000; Irwin, 2002; Netusil, 2005). Consistently, researchers have found proximity to open space positively contributes to a home's value. Further, proximity to local landmarks and places historically important to the community has also been shown as being positively associated with housing values. However, few studies have examined these relationships over time as spaces change and local landmarks develop. That is, there has been little published material on how the evolution of a natural local landmark, rather than a historic landmark, influenced housing values. The present research sought to address this issue through an examination of housing values influences in the college town of State College, PA, USA.

State College is home to the Pennsylvania State University (PSU), the Commonwealth's land grant university, and its many facilities. Since 1999, PSU has been developing an open space at the edge of campus into what is now known as The Arboretum at Penn State (APSU). APSU shares boundaries with multiple neighborhoods and apartment complexes. Since its founding, APSU has slowly evolved from an open space into a community landmark.

The purpose of this research was to explore how proximity to an open space that was evolving into a local landmark affected housing prices in nearby neighborhoods over time. Based on the literature, it was hypothesized that homes closest to APSU would have higher sales values than homes further from APSU. It was also expected that as APSU evolved into a local landmark, homes nearest to it would experience a greater rate of increase in their value over time.

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2. Theory

2.1. Open space and residential values

There is considerable evidence that proximity to open space has a positive effect on the sales price of a single family home. For example, research has shown residential property has a higher-selling price the closer it is located to a park (Correll et al., 1978; Geoghegan, 2002). Lutzenhiser and Netusil (2001) also found homes located near a 'natural area park' had higher property values compared to those located further away. More specifically, they found homes experienced the largest rise in sale price when they were *very* close to an open space – within 1500 feet from a park. The positive influence of proximity to open space on housing prices has been replicated internationally in a variety of cultures, including for example, China (e.g., Biao et al., 2001), the Netherlands (e.g., Luttik, 2000), and Nigeria (e.g., Ajibola et al., 2012).

Many possible reasons for this relationship exist. For example, the preference for being near open space may reflect a benefit of well-planned residential areas. Land use planning, or utilizing urban activities in an allotted amount of physical space that is in the public's best interest, has been demonstrated to have a positive effect on residential values. For example, Ajibola et al. (2012) found residential property values increased in response to land usage planning. Their study demonstrated potential residents were more willing to purchase homes near areas being developed with consideration of the public's health, safety, and environmental quality.

Alternatively, it is possible that there are specific characteristics related to open spaces that may have varying levels of influence on housing values depending on the surrounding community. For example, Anderson and West (2002) found that in a city, large parks had considerably more positive influence on housing prices compared to smaller parks. Similarly, in low-income neighborhoods, where parks are typically scarce, a study in The Bronx, New York City, NY found that within five years of opening a small community garden, property values increased by 9.4% in the nearest surrounding neighborhoods (Voicu and Been, 2008). Further, Lutzenhiser and Netusil (2001) found proximity to all types of open spaces could boost home sales prices (e.g., golf courses, parks), but that proximity to natural area parks, like arboretums, were particularly influential.

Other studies found that potential buyers might favor the aesthetics of open spaces (Luttik, 2000). Houses in appealing, green settings (i.e., proximate to water bodies, open space, and attractive landscapes) sold for more than homes located in less attractive locations. Specifically, being within view of an open space (as compared to simply being close to it) could earn homes extra selling premiums.

Additionally, outside of the planning literature, there is a wide body of psychological and biophysical literature examining the psychological and health restorative benefits of exposure to green spaces which provides insight into reasons residents of urban areas are drawn to natural spaces. For example, urban residents express a desire for contact with nature, and this desire is often considered a strong emotional driver of suburbanization (Van den Berg et al., 2007). Green urban spaces have been found to both lower emotional stress (Van den Berg et al., 2014) as well as moderate the negative health effects of experiencing stress (Van den Berg et al., 2010).

The positive psychological and physiological effects of exposure to green spaces in urban environments are not limited to only the most "wild" of natural urban spaces. Manicured gardens and parks are similarly effective in promoting health and well-being (Van den Berg et al., 2014). There is some evidence to suggest that the larger the green space, the more restorative the space might be (Van den Berg et al., 2010). Beyond mere square footage, evidence also exists that urban residents' perceptions of and emotional attachment to these natural spaces are likely key to understanding their preferences for green spaces. For example, Zhang et al. (2015) examined two cities with similar amounts of usable green space, sociodemographics (including socioeconomic status), and housing conditions. The two cities only differed in the (subjectively) perceived and (objectively) measured accessibility of the green spaces. While residents of the two cities showed similar physical health levels, respondents with greater access to green spaces emotionally valued these spaces more. They also reported better mental health overall. These results suggest it is not only the availability of urban green spaces that is appealing, but also access to those spaces that may be important in understanding the premium home-buyers place on proximity to open space.

2.2. Landmarks and residential values

Emotional connection to specific places may help explain other similar patterns of home-buying in which urban residents pay premium prices for their homes. Being within close proximity to local landmarks has also been shown to consistently and positively influence housing prices. Lazrak et al. (2011) found homes sold in preserved historic neighborhoods experienced a 26.4% premium in sales price. Further, across multiple cities, similar studies found designation of a historic landmark (Noonan, 2007) or district (Ijla, 1994) caused homes within that district or near the landmark to experience faster rates of increased value.

The benefits of landmarks on housing values can be particularly influential for certain types of homes and markets. For example, in an analysis of the housing market of Baton Rouge, LA, USA also home to a large land grant university, Zahirovic-Herbert (2012) found historic preservation positively affected a home's value, and that these effects were particularly beneficial for lower-end properties. This reflected the fact that buyers of lower-end homes, compared to higher-end home buyers, tended to be more concerned with the features of a house than its size.

3. Study 1: materials and methods

3.1. Selection of the study area

It was hypothesized that the homes in State College, PA, most affected by APSU's evolution as a local landmark would be those within walking distance to it. Walking distance has conventionally been considered by researchers to be one-quarter mile (Duany and Plater-Zuberk, 1992; Song and Knaap, 2003). Consequently, the spatial scope of the study area included the neighborhoods closest to APSU: East College Heights, West College Heights, and Overlook Heights (See Fig. 1).

3.2. Selection of the study time frame

APSU has slowly evolved as a local landmark over the past 15 years. This open space was previously undeveloped land, freely open to the public for recreation, and occasionally used by University faculty for conducting botanic and landscape experiments. In 1999, the University Board of Trustees officially integrated APSU into the "University Park Campus Master Plan" (The Arboretum at Penn State [APSU], 2014). The first tree of APSU was dedicated in 2005. Construction of the main attraction at APSU, the H.O. Smith Botanic Gardens, was completed in 2009 and officially dedicated in 2010. A second attraction, the Childhood's Gate Children's Garden, opened in 2013.

The years for analysis were determined by three criteria: (1) to coincide as closely as possible with the most significant steps in

Fig. 1. Study area boundary, key neighborhoods, and surrounding open spaces.

APSU's evolution as a local landmark; (2) to coincide with demographic data available from Centre County local government[1]; and (3) to examine time periods that were distributed as evenly as possible over the 15-year APSU history. As a result, sales transaction data were requested for the years 2000, 2005, 2010, and the first 9 months of 2014 (this study began in September 2014).

3.3. Description of data

The scope of this study limited our data gathering and processing to the use of spatial data made available through Centre County, PA, government (Centre County Pennsylvania, n.d.), and the Pennsylvania Spatial Data Access (Access Data, n.d.). Our study benefits immensely from the availability of sales transaction data provided by Centre County Association of Realtors MLS (CCAR, 2014). Actual sales data, as opposed to government assessment data, is a better reflection of market decisions (Anderson, 2000) and thus significantly improves the quality of our analysis.

Based on available data from CCAR (2014), we defined home structure in terms of year of sale, number of bedrooms, number of bathrooms, and above ground square footage. Neighborhood structure was defined by a sociodemographic composition of metrics obtained from the United State Census Bureau, including median income, education (percent of high school graduates or above and percent of bachelor degrees or above), and population density.

3.4. Spatial analysis methodology

Environmental influences were defined by a locational analysis that assigned a code representing the straight line distance to the nearest land use type for each individual home in the study area. Land uses in the locational analysis included: agriculture, forest, open space, commercial, mixed-use, public (including Penn State University), and industrial properties. Land uses of critical interest adjacent to the study area were separated from the general data set for individual analysis. These areas contained APSU, Sunset Park, the Blue Course Golf Course, and Radio Park Elementary School. The approximate location of each property's home was identified by calculating the center of each amorphic property.

Single family housing data selected for inclusion in the hedonic analysis was visually verified using ArcMap GIS software. Residential sales and socioeconomic and data were geographically located by joining this data to the Centre County land use data. The resulting points were overlaid onto a map of residential land use classifications, which included single family, mobile home, multifamily, two-four family (duplex), and urban forest. Urban forest areas represented tree crown cover generally located in-between residential properties. All single family coded properties that appeared to be located outside of single family land use areas were subsequently verified using a combination of ESRI aerial maps and Google Streetview imagery. Basic architectural features, such as the presence of more than one driveway or main entrance, or associated multi-address mailboxes, assisted in delineating single family from multifamily housing.

The verification process removed 13 properties from the data set. Each conflict was clearly not a single-family property or was unable to be verified. Further, although each property was within the bounds of the Borough of State College, it was located outside

[1] State College is located within Centre County, PA.

Table 1
Stepwise regression coefficients on the cube-root of housing sale price (Study 1).

Variable	Unstandardized Beta	S.E.	Standardized Beta	t	p-value
Intercept	40.20	2.56		15.69	<0.001
Above Ground sqft	0.01	0.001	0.42	7.85	<0.001
Year sold	3.36	0.45	0.37	7.51	<0.001
Distance to Commercial Businesses	0.004	0.001	0.25	4.88	<0.001
No. Bedrooms	2.45	0.62	0.20	3.99	<0.001
Distance to PSU campus	−0.001	0.000	−0.19	−3.81	<0.001

$R^2 = 0.83$, R^2-adj = 0.69.

the scope of the study area. While data was necessarily removed due to either not having been sold within the scope of the study or falling outside of a single family classification, the study captured multiple data points from each neighborhood area in State College. As a result, the data set was not biased towards one neighborhood of the study area.

Other attributes of the homes obtained from the CCAR (2014) dataset included who inhabited the home prior to sale: Vacant = 1, Tenant = 2, Owner = 3, Other = 4, New = 5. It also included the type of housing structure (i.e., single family homes, duplex, and condominium).

4. Study 1: results

4.1. Aggregation of data

Over the course of 14 years, 164 properties were sold within the study area. The dataset was collected in a pooled cross-section fashion. This reflected the fact that all of the variables were collected over all four years, but each sample was independent from the other since no individual home was represented in more than one year. Thirteen homes were resold at least once during the study period. To assure independence of samples, all 13 homes were removed from the analyses to create a final sample size of 151. To assess whether the data could be pooled across all four years, the variance for each year was examined relative to the year's mean. All four years had comparable standard deviations, accounting for the increasing mean across years, suggesting the data could be aggregated (see Appendix A; Kessler and Greenberg, 1981).

4.2. Transformation of non-normal data

Exploratory data analyses revealed that sales transaction data were positively skewed, $S = 0.92$, $se = 0.20$. A follow-up Kolmogorov-Smirnov test confirmed the data's non-normality, $KS(148) = 0.12$, $p < 0.001$. A cube-root transformation of the data adequately reduced the skew, $S = 0.32$, $se = 0.20$, and produced a normally distributed dataset, $KS(148) = 0.06$, $p > 0.20$. As a result, the cube-root of the sale price was used for subsequent regression analyses.[2]

4.3. Descriptive analyses

Of the 151 homes sold in the target study area between 2000 and 2014, one was a half- duplex, two were full duplexes, and one was a condominium. The remainder were single family houses (n = 148, 97.4%). Fifty (33.8%) of the homes sold were in the Overlook Heights neighborhood, 72 (48.6%) were in East College Heights, and 26 (17.6%) were in West College Heights. Prior to sale, 93 (62.8%) residences were occupied by the owner of the home, 11 (7.4%) were occupied by a tenant, 31 (20.9%) were vacant, 3 (2.0%) were new at the time of sale, and 10 (6.7%) were classified as "other" or were unclassified.

In order to test the hypothesis that proximity to APSU would positively predict housing values in the closest neighborhoods, as well as identify other predictors of housing values within the study scope, stepwise regression analyses were conducted. The regression model included square footage above ground, year of sale, number of bedrooms, number of bathrooms, distance to APSU, distance to PSU campus, distance to commercial businesses, and distances to three other open spaces adjacent to the study area (a golf course, a small neighborhood park, and a large open field behind an elementary school). In order to investigate the hypothesis that distance to APSU would have an increasing positive influence on nearby residences over time as it evolved into a local landmark, an interaction term of year sold and distance to the APSU was included in the model.

Contrary to predictions, distance to APSU was not a significant predictor of housing value; nor were distances to the three other open spaces (see Table 1). There was also no significant interaction between year sold and proximity to APSU on housing prices, suggesting this null relation did not change over time.

Importantly and unexpectedly, distance to the largest landmark in the city, PSU's campus, was negatively related to housing values. As proximity to campus increased, housing values decreased. Follow-up regression analyses found no significant interactions between proximity to campus and year or neighborhood. This suggested the closer one's home to campus, the less its worth, and this relationship was consistent across time and all three neighborhoods examined.

On the other hand, above ground square footage, number of bedrooms, year sold, and proximity to commercial businesses were, as expected, positively associated with housing value. With increases in size of house and proximity to commercial businesses, housing values climbed; moreover, higher sales prices were also associated with more recent sales. Unexpectedly, the number of bathrooms was not a significant predictor of sale price.[3]

5. Study 1: discussion

5.1. Predictors of residential value

As expected, features related to the size of house, such as above ground square footage and number of bedrooms, were positively associated with housing values in the three neighborhoods closest to APSU. Larger homes tended to sell for more money. Additionally, proximity to commercial businesses and year sold were also positively associated with housing prices. The more recently a home

[2] In similar studies, a natural log transformation of sale price was typically utilized to achieve normality. To ensure consistency with the literature's standard methodology, after running all analyses, the regression models were replicated for both S1 and S2 using a natural log transformation. All results replicated with a natural log transformation of sale price for both studies 1 and 2.

[3] This may have been a product of low variance for this measure. An analysis of the frequencies of the number of bathrooms in Study 1 showed a range from 1 to 5 bathrooms. However, only three (2%) homes in our sample had four or more bathrooms. Most of our sample (59%) were two-bathroom homes.

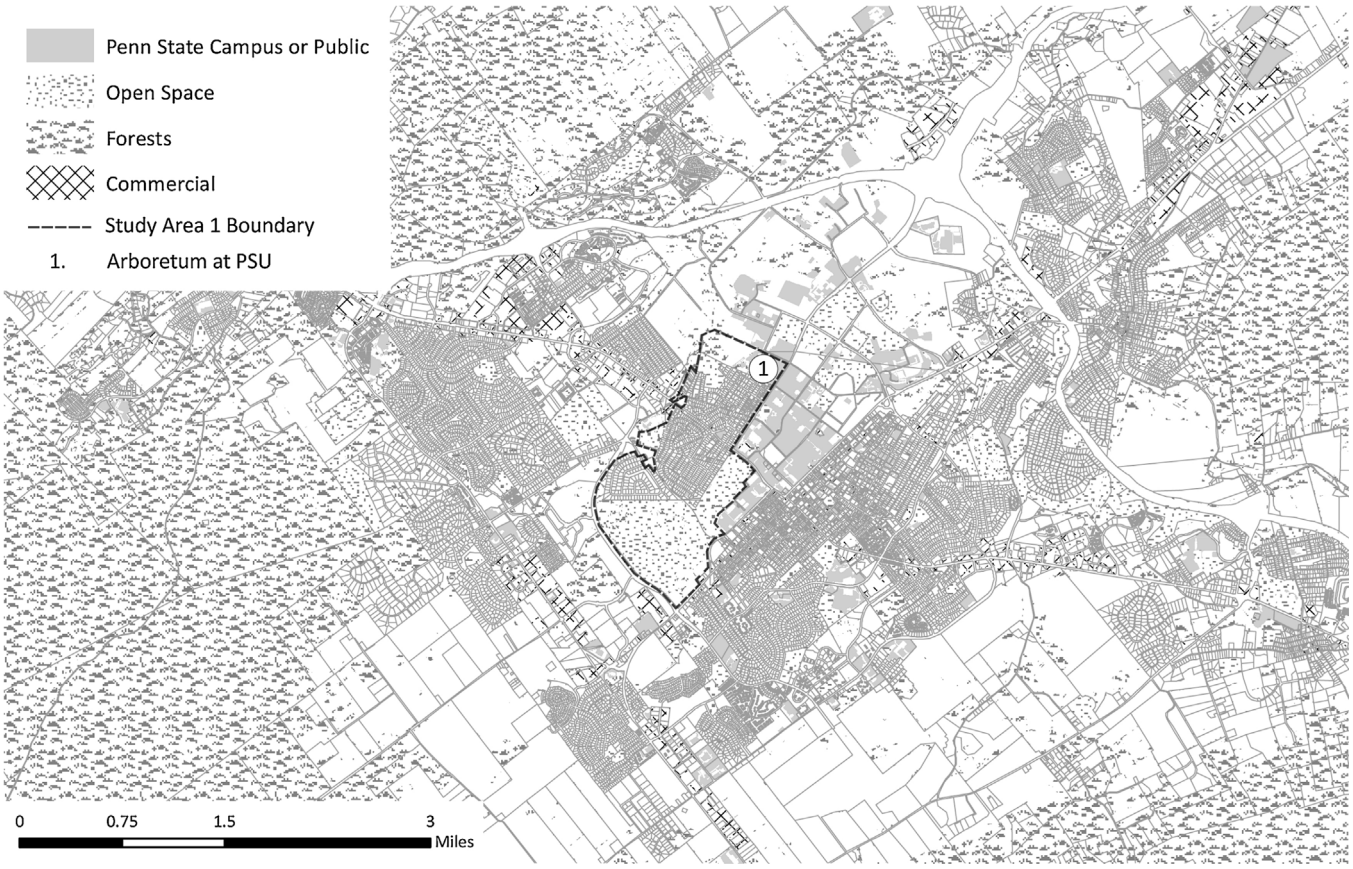

Fig. 2. Expanded study area boundary, APSU location, and surrounding context.

was sold and the closer it was to commercial businesses, the more the home tended to be worth.

Contrary to our hypotheses, proximity to open space was not a significant predictor of residential sales price. This effect did not change over time as APSU evolved from a preserved open space to a local landmark. Additionally, proximity to three other open spaces was also not predictive of housing values. This may be because people value open space for different reasons (Swim et al., 2014), and the qualities APSU provide in this college town may reflect an already "saturated market." For example, APSU is a place designed to promote environmental exploration and education. It is located in a borough that has lots of green spaces and was built around a university. Further, State College is nestled in Pennsylvania's Appalachian Mountains, with state parks, wilderness preserves, and hunting and recreation grounds only a short car ride away in nearly every direction (see Fig. 2 for a map of State College and the surrounding green spaces). This lack of unique qualities (e.g., a chance to be in nature, educational space) may explain, in part, why housing prices were not reflecting an increased local valuing of that space.

Also unexpectedly, proximity to the city's main employment center, PSU's campus, was negatively associated with residential sales prices. The closer a home to campus, the less it was worth. This finding went against conventional practical wisdom in State College. Among residents, it was commonly believed the most expensive homes were the ones that lied at the edge of campus (specifically, in East and West College Heights). Consequently, this finding suggested something that might be practically meaningful for residents of nearby communities.

It was possible that as APSU grew, it was seen less by the community as a landmark of State College, PA, and more as part of PSU's campus, particularly as it is developed from a natural green space into manicured gardens. If true, this would suggest our hypothesis that APSU was developing as a local landmark in the community was invalid, and the space was not being increasingly valued by the larger community over time. Such an explanation is less likely, however, because proximity to PSU campus was negatively associated with housing values. If APSU's development was perceived by the surrounding community as merely an extension of PSU's campus, then the relationship should have reflected a negative association with proximity to APSU and housing values that strengthened over time. It is possible that both effects may be occurring simultaneously – that residents of State College were allured by proximity to the APSU and yet saw the close proximity to PSU's campus as a negative selling point. Therefore, the premium residents would normally be willing to pay for being closer to APSU might be undermined by their wish to be further from campus. Further, access to natural landscapes surrounding State College may have minimized the desirability of APSU.

The lack of influence of open space on housing sales prices could also have reflected an important characteristic unique to college towns and other mixed-density residential areas. Proximity to green space has been found to be a significant predictor of housing values in urban areas, but not suburban areas (Anderson and West, 2002). This suggests that despite the higher population density of some college towns (like State College), areas with single family homes may reflect more of a suburban real estate market than a traditional city real estate market. However, it was unclear from the current data whether or not the more densely populated areas of State College (i.e., student housing areas) would indicate a pattern similar to the real estate value boost typically found in homes closer to open space in more traditional urban real estate markets. It is suggested that future researchers examine college towns and other areas (like boroughs) that have both qualities of urban and

suburban residential settings to better understand what predicts single family housing values in these types of residential areas.

By design, we initially wanted to limit the scope of the study to examine only the neighborhoods closest to APSU to get a detailed and nuanced look at its possible influence on housing prices over time. However, the unexpected negative relation between proximity to PSU's campus and housing prices could have implications for the rest of the borough, as PSU's campus takes up a large amount of State College's real estate. In order to further explore this practically important and unexpected effect, we expanded the scope of our study to the balance of State College.

6. Study 2: materials and methods of expanded study area

6.1. Selection of expanded study area

In order to further explore the unexpected findings, particularly the relationship between proximity to PSU campus and housing values, we expanded the spatial scope of the study area to include the balance of the borough of State College, PA (See Fig. 2). Because many of downtown State College's properties include high-rise apartments, and other rental structures not representative of most of the residential housing in State College, only properties sold as single family homes were included in the analyses. Additionally, an examination of the raw data indicated many of the transactions that occurred within the same building occurred on the same day. For example, 114 residences classified as "single family" homes were purchased at the same address on the same day. This suggested one buyer purchased all of the residential units associated with that property. In order to avoid counting these types of purchases more than once, only the first listing at each address was used in the analyses.

6.2. Data description

Additionally, due to the larger scope of the expanded study area, we attempted to overcome early limitations and supplemented our data analysis with the inclusion of sociodemographic data. Sociodemographic data was applied at the census tract scale, due to the availability of data and discrepancies between the Decennial Census (Bureau, n.d.) and the American Community Survey (Bureau, n.d.). Only the years 2000 and 2010 were available for State College. The variables included in this analysis were median income, percentage of the population with a bachelor's degree, and population density (number of people per square acre).

The sampling strategy used to collect the sociodemographic data was different than that used to collect environmental and housing characteristics, resulting in two data sets with different assumptions, scales, and timeframes. Sociodemographic data were only collected during two of the four years at the census tract scale; the residential data was available for all four years at the individual housing level. Additionally, all homes within a census tract had data for both 2000 and 2010; the residential data are four cross-sectional samples pooled across all four years with any duplications in data removed to maintain independence.

Subsequently, separate regression models were employed for the different data sets (cf., Song and Knaap, 2003). The first examined proximity to landmarks and characteristics of the homes over the four study years at the individual home level. The second model examined sociodemographic predictors of housing prices for the two years available at the census tract level. Unfortunately, employing separate analyses limited our ability to draw direct comparisons across regression models. Nevertheless, examining sociodemographic data provided a richer understanding of what may predict housing values in college towns. Beyond these corrections, the methods and variables employed in the original study area were replicated in the expanded study area.

7. Study 2: results of expanded study area

7.1. Aggregation of data

Using the same approach to ensure independence of samples across years, all homes sold more than once during the study period were removed from analyses (n = 124). The final study sample size was 1277. The means and standard deviations across all four years were checked to ensure pooling of data was appropriate. On the basis of this analysis, it was concluded that the variance for each of the four years were comparable, relative to the mean sales prices (see Appendix A). As a result, the data was pooled across all four years.

7.2. Transformation of data

The sales dataset was positively skewed, $S = 1.56$, $se = 0.07$, and Kolmogorov-Smirnov normality tests confirmed it was significantly non-normal, $KS(1277) = 0.13$, $p < 0.001$.We applied a cube-root transformation to satisfactorily reduce the positive skew, $S = 0.68$, $se = 0.07$. However, the Kolmogorov-Smirnov normality test still indicated the data were non-normal, $KS(1277) = 0.07$, $p < 0.001$. An examination of the Q–Q Plot for the cube-root of the sale price suggested the data may be normal and that the significant Kolmogorov-Smirnov statistic may be the result of the large sample size.[4] As a result, and in order to remain consistent with the methodological approach utilized in Study 1, analyses proceeded using a cube-root transformation.

7.3. Descriptive analyses

Of the 1277 single family stand-alone properties sold in the borough of State College between 2000 and 2014, 833 (65.2%) residences were occupied by the owner of the home prior to sale, 51 (4.0%) were occupied by a tenant, 212 (16.6%) were vacant, 85 (6.7%) were new at the time of sale, and 21 (1.6%) were classified as "other" (see Appendix A).

7.4. Regression analyses

To determine if distance to PSU was negatively associated with housing value across the entire borough, a multiple regression was run with all of the significant predictors identified in the initial study: above ground square footage, year sold, number of bedrooms, proximity to PSU campus, and proximity to commercial businesses. Because so many of the predictors of value were related to the size of the home, number of bathrooms was also included in the regression model, even though it was not found to be a significant predictor in the initial study.

The results of the initial study were replicated by the expanded area. Proximity to PSU campus was again found to be a significant negative predictor of housing value, controlling for other predictors of housing value found (see Table 2). As proximity to campus increased, the value of the home decreased. Follow-up regression analyses found no significant interactions between proximity to campus and year. This suggested the closer one's home to campus, the less its worth, and this relationship was consistent across the 14-year timeframe of this study.

[4] A Kolmogorov-Smirnov normality test of a natural log transformation of sales price remained significant ($KS(1227) = 0.042$, $p < 0.001$).

Table 2
Multiple regression coefficients on the cube-root of housing sale price (Study 2).

Variable	Unstandardized Beta	S.E.	Standardized Beta	t	p-value
Intercept	40.51	0.77		52.45	<0.001
Above Ground Sqft	0.005	0.000	0.50	25.44	<0.001
Year sold	2.73	0.14	0.33	19.97	<0.001
No. Bedrooms	1.12	0.23	0.10	4.90	<0.001
No. Bathrooms	2.58	0.24	0.22	10.85	<0.001
Distance to Commercial Businesses	<0.001	<0.001	0.04	2.32	0.02
Distance to PSU campus	<0.001	<0.001	−0.13	−7.52	<0.001

R^2 = 0.81, R^2-adj = 0.66.

Table 3
Multiple regression coefficients on the cube-root of housing sale price (Study 2; 2000 and 2010).

Variable	Unstandardized Beta	S.E.	Standardized Beta	t	p-value
Intercept	54.30	1.96		27.72	<0.001
Median Income 2000	<0.001	<0.001	0.04	0.65	0.52
% Population with bachelor's degree 2000	**−0.037**	**0.08**	**−0.39**	**−4.66**	**<0.001**
Population Density 2000	0.88	0.86	0.49	1.02	0.31
Median Income 2010	**<0.001**	**<0.001**	**0.16**	**3.63**	**<0.001**
% Population with bachelor's degree 2010	**0.34**	**0.07**	**0.37**	**4.88**	**<0.001**
Population Density 2010	−0.54	0.82	−0.33	−0.67	0.51

R^2 = 0.22, R^2-adj = 0.04.
Note: Bold highlights significant effects.

As expected, all other predictors were found to be significantly and positively associated with housing value. As expected, but in contrast to the findings of the initial study, the number of bathrooms was positively associated with sales price in the larger dataset. As the size of the house, number of bedrooms, number of bathrooms, and proximity to commercial businesses increased, the value of the home also increased.

In order to examine the relationships between median income, education level, and population density on single-family home sales prices, a multiple linear regression model was run including all three variables for both the years 2000 and 2010. Including the two years in the same model for each measure allowed us to control for the year 2000 levels of these measures and observe any change in these variables as predictors across the 10-year time period (Binning et al., 2015).

A number of unexpected results were found (see Table 3). In the year 2000, median income at the census tract level was not a significant predictor of sales price. However, in 2010, controlling for year 2000 levels of SES, median income was significantly and positively associated with residential sales price. Also unexpectedly, in the year 2000, percentage of people with a bachelor's degree was negatively associated with residential sales price, but in 2010 (controlling for 2000 levels), it was positively associated with sales price. Population density was not a significant predictor of sales price in either year.

8. Study 2: revisited discussion

8.1. Campus as a predictor of single family residential value

The expanded study area replicated the results of the initial study. Specifically, it was found that across the entire borough of State College, PA, the closer a house was to PSU's campus, the less it was worth. This suggested that contrary to the casual assumptions of living close to the borough's major economic and employment center, proximity to PSU's campus is not typically considered a valued benefit.

Song and Knaap (2003) found a similar, but inconsistent pattern in their examination of predictors of housing values. In their study, the major employment centers overlapped considerably with the major commercial districts and so both negative and positive relations to housing values were found, respectively, despite how difficult it was for them to geographically disentangle the two centers. In State College, the campus has relatively clearly defined boundaries (though there is some overlap with buildings in the downtown region). Additionally, commercial areas were also relatively distinct and clear from overlap with campus. As a result, our study replicated their findings and further clarified this pattern: proximity to the borough's major employment center (PSU campus) was negatively associated with housing values and proximity to commercial districts was positively associated with housing values.

It is unclear precisely why this negative relationship with proximity to employment centers exists. It is considered common knowledge in State College that the most expensive homes are those closest to campus, yet examining sales data from 2000 to 2014, our study revealed the opposite pattern is occurring. We posit two possible explanations. First, there may be underlying friction between actors of different social grouping – namely faculty, employees, students, and local residents not affiliated with PSU. Conceivably, PSU's sizable employee base want to live close, but not too close, to their place of work. With a student body of more than 46,000, it is possible that people employed by the university are trying to avoid parts of the borough perceived as being student-centric. Perhaps where the university ends and where residents perceive the borough of State College to begin is not clearly marked by the physical boundaries of campus, but rather areas where residents perceived they could live without interruption from PSU's substantial student body.

Additionally, among community researchers in State College, a noted divide between the "locals" and the people associated with the university (routinely referred to locally as the "town vs. gown" conflict) exists. Unfortunately, there currently is little data to reflect this dynamic in State College. However, if such a divide does exist, it could explain both the negative association with proximity to campus and the lack of influence of APSU on nearby housing values. Any negative sentiments toward the university could be reflected in the value of the homes closest to campus. Further, rifts between the residents of State College and the university community may cause residents to perceive they have less access to APSU, which would negate the positive emotional effects and sense of connection the green space would otherwise provide (Zhang et al., 2015).

Second, broad housing growth and land use trends in the townships surrounding State College suggest that there are valued opportunities to access open space outside of State College. US Census data (2000, 2010, and 2014) illustrates how the adjacent townships of College, Ferguson, and Patton had constructed new households at an average rate of 2.6% per year between 2000 and 2014. By comparison State College experienced new growth at a rate of less than 1% per year. During that period nearly five times the number of new households were constructed in adjacent townships (see Table 4). Rises in median home value offer evidence to support the value of this new growth. Between 2010 and 2014, the median home value in State College and Patton Township increased by 16.9% and 19.5%, respectively, compared to significantly lower increases in College and Ferguson townships (0.2% and 8.5%, see Table 5).

State College contains limited natural open space – just 5% according to the National Land Use Database (2001–2011). It has drastically reduced those spaces by 66% since 2001 while increasing medium density development. More than 80% of Patton Township is classified as natural open space, though natural lands appear to be gradually yielding to low-density residential development (see Table 6). These statistics describe two different trends – State College is slowly urbanizing at the expense of its natural lands, while Patton Township is gradually suburbanizing in response to people's desire to live near natural lands. Increases in median home values in both areas suggested both trends were valued by residents.

Notably, State College and Patton are a short drive apart. A resident of one has easy access to the urban or natural amenities of the other. The dynamic relationships between State College and its surrounding townships may help explain why open space was not significantly valued and why the PSU campus was negatively valued – open space can be easily and cheaply accessed from elsewhere in the region and the benefits of living near campus did not appear to outweigh the perks of living in a more natural but easily accessed area.

Table 4
Comparison of Adjacent Township No. of Households (2000–2014).

	State College	College	Ferguson	Patton
2000	12,488	3213	5699	4974
2010	13,362	4202	7226	6901
2014	13,574	3957	7779	7053
Percent change	9%	23%	36%	42%

Table 5
Comparison of Adjacent Township Median Home Value (in dollars, 2000–2014).

	State College	College	Ferguson	Patton
2010	$ 237,900	$ 223,400	$ 226,500	$ 198,300
2014	$ 278,100	$ 223,900	$ 245,700	$ 237,000
Percent change	16.9%	0.2%	8.5%	19.5%

Table 6
Comparison of Adjacent Township Land Cover Type (2001–2011).

	State College	College	Ferguson	Patton
Developed Open Space[a] (2001)	28.3%	13.1%	8.2%	11.8%
Percent change	−8.7%	6.0%	8.0%	17.6%
Natural Open Space (2001)	5.1%	66.1%	85.6%	80.4%
Percent change	−66.6%	−24.1%	−4.7%	−16.3%

[a] Commonly includes large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.

8.2. Sociodemographic predictors of residential value

The addition of sociodemographic factors to the expanded study area also produced some unexpected effects. Likely these aberrant effects were related to inconsistencies in the availability of socioeconomic data across temporal and physical scales. Unexpectedly, population density was not related to the value of a home. The education level of the surrounding area appeared to be both positively and negatively associated with a home's sales price depending on the year. These unanticipated findings likely reflected important limitations in the sociodemographic data, all of which would overestimate the homogeneity of the population examined. Nestled in a valley, the borough of State College is geographically compact. Despite a sizable population, there are few census tracts in State College, and as a result, the sociodemographic analyses did not contain enough nuances to accurately reflect the demographics of its different neighborhoods. In addition to the larger geographic scale of data collection, the time scale was limited to only two years during the study period, further depreciating our ability to model a nuanced and accurate representation of population and changes in sociodemographics over time. Further, the inconsistent effects in higher education may indicate a possible ceiling effect. College towns with large research universities employ disproportionate numbers of people with advanced degrees, which could deflate variance in the regression model, creating unstable effects.

9. General conclusions

The purpose of this study was to investigate the influence of proximity to APSU on nearby single family housing values in State College, PA, USA over time (Study 1). The initial approach taken by the investigators was based on the existing literature, suggesting proximity to this permanently protected open space would increase the value of homes in the neighborhoods closest to it (Anderson, 2000; Irwin, 2002; Netusil, 2005). It was hypothesized this effect would grow stronger over time as APSU developed from a public open space to a landmark, representing a place to explore and learn about nature.

Contrary to what has been demonstrated over large scales in the literature, our findings suggest proximity to APSU had no significant influence on the homes nearest it. These results were replicated in the same neighborhoods with three other nearby open spaces: a golf course, a small neighborhood park, and a large undeveloped field behind an elementary school.

Our analyses found proximity to an even more substantial landmark in the city, PSU's main campus, was negatively associated with housing values, even when controlling for other factors such as year sold, above ground square footage, number of bedrooms, and proximity to commercial businesses. Together, these five predictors accounted for 69% of a home's value in the study area. The results were consistent across scales, confirming that living close to PSU's campus was negatively associated with housing value citywide. Additionally, in Study 2 proximity to commercial space was a positive predictor of housing values as were home size and year of sale. These six predictors accounted for 66% of a residence's sale value. Homes that were either new or occupied by the owner prior to sale sold for more than vacant homes or those occupied by tenants. In sum, homes in State College that were the most expensive were large, close to commercial businesses, and far from campus.

We offer several suggestions to explain our unexpected findings. At the smallest scale of analysis, State College may be saturated with small scale open spaces, which minimizes the effect of individual spaces. At larger scales, it is possible that social friction between the PSU campus (and APSU by proxy) and State College Borough is limiting its perceived value by non-PSU affiliated actors. We also

posit that regional growth trends suggest that the benefits of open space are easily accessed in adjacent townships, without significantly impacting the benefits of living close, but not too close, to the PSU campus. Regardless of the underlying cause, this finding suggests that college towns likely represent unique social and physical compositions and do not have the same drivers of residential values as traditional urban areas.

These findings are both practically and theoretically important. The negative relation between proximity to PSU's campus and home's sales value disconfirmed the common knowledge among realtors and planners in State College that the most expensive homes were closest to campus. Instead, these findings suggested "living close to campus" may be the selling point for the borough of State College itself compared to other nearby towns. But for those within borough limits, the more desirable properties were those furthest from campus. This negative association with the public university's campus implied that the relationships between college towns and the colleges they support are much more complex than they appear on the surface. Researchers need to do a better job theoretically defining what makes a "college town" the type of place to live that it is. To start, we propose that key defining features of a college town may be the proportion of the population employed by the university, the proportion of the square footage of the town occupied by the university, and the perceived access community members feel they have to university facilities. These potentially unique features, and more, must be further investigated to ensure economic models adequately capture the buying decisions of thousands of people in higher density, stable, high turn-over real estate markets.

Further we encourage researchers to consider the lens through which they study a phenomenon. Our study provided evidence that both the geographic and temporal scales of analysis were critical decisions which impacted how we could interpret our results. While this may be a familiar concept to those who focus on spatially oriented research, we offer it as a reminder to consider the impact of the regional trends on microcosms.

Decisions related to temporal scale nested in varying spatial contexts can be equally influential in understanding and interpreting data. To better understand our unexpected effects, we further expanded spatial scale and compared development patterns in State College to its neighboring townships over time. The information gleaned from this ad hoc analysis further underscores the richness of data provided by examining changes in development and its consequences for property values longitudinally.

Many planners and environmentalists see mixed-density and higher density housing as crucial to environmentally sustainable development because they strike a compromise between larger living spaces and easy access to nature with the environmental and economic efficiency of high density settlements. Despite this, much of the research on the benefits of residential proximity to open and green spaces thus far has been conducted in urban areas. Our results suggest housing markets in college towns, especially those in considerably less urban areas, will not necessarily behave like cities and, therefore, more research is needed such areas.

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Appendix A.

Tables 7–10

Table 7
Means and standard deviations for price sold by year (Study 1; in USD, rounded to the nearest dollar).

Year	Mean_	SD_
2000	181,449	85,681
2005	294,746	120,724
2010	320,987	138,283
2014	339,289	135,951

Table 8
Means and standard deviations for attributes of homes sold and the residents in the study scope (Study 1; 2000–2014).

Attribute	Mean_	SD_
Above Ground Sq. Footage	1,880.4	897.3
No. Bedrooms	3.5	0.8
No. Bathrooms	1.9	0.7
Distance to the APSU (ft.)	3,220.7	1,574.6
Distance to PSU campus (ft.)	2,222.6	1,625.6
Distance to Commercial Businesses (ft.)	1,115.2	628.1
Median Income (USD)	$80,969	11,481
% Graduated High School	97.9	0.2
% Graduated College	77.7	8.1
Population Density (No. people/sq. acre)	5.1	0.8

Table 9
Means and standard deviations for price sold by year (Study 2; in USD, rounded to the nearest dollar).

Year	Mean_	SD_
2000	173,996	78,125
2005	247,748	110,273
2010	274,907	107,961
2014	287,844	117,443

Table 10
Means and standard deviations for attributes of homes sold and the residents in the city of State College, PA (Study 2; 2000–2014).

Attribute	Mean	SD
Above Ground Sq. Footage	1,825.5	882.6
No. Bedrooms	3.5	0.8
No. Bathrooms	2.1	0.7
Distance to PSU campus (ft.)	8,189.2	4,469.9
Distance to Commercial Businesses (ft.)	1,452.8	1,039.3
Median Income (USD)	$58,760	16,429
% Graduated High School	96.2	1.7
% Graduated College	62.6	9.2
Population Density (No. people/sq. acre)	3.7	5.2

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