WIDE OPEN SPACES: ESTIMATING THE WILLINGNESS TO PAY FOR ADJACENT PRESERVED OPEN SPACE

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JOB MARKET PAPER

PRELIMINARY DRAFT: PLEASE DO NOTE CITE WITHOUT THE AUTHOR'S PERMISSION

Abstract. Each year, millions of dollars are spent on transitioning open space to protected status, yet we do not know the value that existing homeowners place on adjacency to these protected land parcels. Between 2000 and 2013, the Pennsylvania Game Commission acquired over 85,000 acres across the state of Pennsylvania, thereby providing a promise of future openness for adjacent homeowners. This paper exploits the timing and spatial variation of these acquisitions to identify the housing premium associated with open space preservation. Results suggest that preservation increases the average adjacent home value by between $21,420 and $27,370. I analyze various sources of this premium and conclude that it is driven by a preserved view and not new access to public land. Further, analysis comparing preservation of the land to continuing vacancy shows that preservation is tax-neutral for local governments.

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1. Introduction

Estimating the willingness to pay for housing amenities has been central to urban and regional economics for decades. Rosen's (1974) seminal paper proposing methods to measure willingness to pay through hedonic modeling inspired an influential literature on the valuation of amenities. One key amenity in this literature is open space, and institutions used to protect open space have attracted increasing attention from scholars and policy makers. Between 1980 and 2007, wildlife and wilderness areas increased by 23 percent (USDA, 2011), suggesting that a significant amount of open space has transitioned into protected status. This paper focuses on the institutions behind open space protections and the increased impact on nearby housing values resulting from an introduction of a guarantee for future openness using Pennsylvania Game Commission land acquisitions.

There are numerous institutions which facilitate open space usage definitions. Some examples of these institutions are community parks, state parks, zoning regulations, and wildlife conservation organizations. Each of these examples provide a guarantee that the owners of the land or government will not develop this land. Furthermore, these institutions differ by permanence and strength. For instance, owners of parcels can petition municipalities to change the land's zoning status to residential, and thereby removing the guarantee with relative ease. Converting a state park, which is owned by the public, into a residential area would require a significant amount of effort within the existing legal and political framework. The distinctions between open space institutions have received less attention in previous studies. Existing literature tends to conflate various institutions, such as parks and conservancies, making it difficult to assess how the market values a guarantee with credible permanence.[1]

[1] For instance, Shultz and King (2001) identify housing premiums between both parks and wildlife habitats while Irwin (2002) analyzes premiums for private cropland, private pasture, private forest, private land (of any type) in easement status, and military land. McConnell and Walls (2005) provide a comprehensive review of open space studies which includes the definition of the various open space institutions used in each study.

In this paper I utilize changes in boundaries of guaranteed open space generated by the Pennsylvania Game Commission, to measure the willingness to pay for a nearby parcel with preserved status. Using game land acquisitions has several key advantages over previous work on permanent open space, which has generated mixed results.[2] First, hundreds of these parcel conversions occurred across the state between 2000 and 2013. Previous studies have utilized existing open space boundaries or a single conversion event (Bucholtz et al., 2003). Using only a single event or existing open space introduces the possibility that unobserved variables may affect housing prices. Secondly, these acquisitions were unexpected by the general public. The PGC publicly unveils their purchases after a contract is signed stating that the PGC has the right to purchase the parcel for an agreed upon price. Further, these acquisitions are unusually permanent because the PGC is legally barred from selling parcels to private homeowners. This legal permanence provides one of the strongest institutional guarantees of future openness available. The final benefit of using PGC acquisitions is that the purchases are targets of opportunity, thereby reducing endogeneity that may be associated with other open space institutions. For instance, the location of parks, which are paid for and voted on by the public, may be located in desirable areas.This correlation complicates the identification of a causal effect of open space (Irwin and Bockstael, 2001; Irwin and Bockstael, 2004; McConnell and Walls, 2005).

Using geographical information software (GIS), I identify homes sales which are adjacent to a game land acquisition as well as home sales which are near the acquisition but not

[2] Johnston and Duke (2007) use a stated preference survey to analyze willingness to pay for land conversion via various channels. They find that respondents significantly prefer state contracts over trust purchases and contracts, state purchases, and conservation zoning. Irwin (2002)shows that converting pastureland to conservation or public land provides positive benefits to neighboring house values while converting to a forested landscape has a negative premium. Shultz and King (2001) suggests living closer to areas such as wildlife habitats and large natural resources are positive amenities while undeveloped, neighborhood, and district parks are associated with a negative effect on nearby homes,likely from excessive use and foot traffic.

directly adjacent for application in a difference-in-differences empirical framework. Comparing the increase in average home prices between these two groups before and after the acquisition occurred provides a housing premium estimate for living adjacent to protected open space. I find robust evidence of a housing premium for guaranteeing adjacent land remaining undeveloped on home values. In particular, the conversion of open space to game lands increases adjacent home values between 18 and 23 percent. For the mean home value of $119,000, this translates into an increase of $21,420 to $27,370 per home. This finding is robust to various definitions of adjacency. Then I examine possible channels driving this premium. Using two different approaches to disentangle the effect of a preserved view and the effect from newly accessible game lands, I find that the housing premium is being driven by the preserved view. Finally, I find no evidence of a premium on commercial land sales, further underscoring the value of guaranteed views for homeowners.

These findings have significant economic implications. The results of my study suggest that game land acquisitions between 2000 and 2013 have generated between $35,552,916 and $45,428,726 of home value gains from the conversion to preserved status. Furthermore, my analysis suggests these gains have arisen from the guarantee of open space and not from changes in allowable land use. These results suggest that there are large potential gains from simply clarifying land use definitions and developing institutions which can provide a credible guarantee against future development near residential areas. Lastly, the magnitude of the gains in home values provides support for keeping PGC land negotiations private in order to prevent speculation.

The paper proceeds as follows: the next section will present background on the Pennsylvania Game Commission and section 3 will detail data and adjacency definition. Section 4 will discuss the econometric specification and section 5 will provide a brief discussion of results. Section 6 will provide welfare and policy implications and section 7 concludes.

2. Pennsylvania Game Commission

In this section, I provide relative context the Pennsylvania Game Commission and describe the data on acquisitions I use. In the late 1800's, Pennsylvania's wildlife populations were ravaged by unregulated hunting, residential development, and pollution. Because of these

concerns, the state authorized the game commission to purchase land to be used for wildlife refuges and hunting preserves in 1919. Since this time, the PGC has been actively acquiring tracts of land across all of Pennsylvania. Game lands are public lands which are best known for providing hunting opportunities; however, the game lands also have walking trails and wildlife viewing areas that provide a usage for a broader audience than just hunters. These reasons suggest that game lands provide a positive amenity for those homeowners.

However, hunting for wild game is not without risks for hunters, people using the game lands for reasons other than hunting, and homeowners near the game lands.[3] This negative effect from the risks associated with having hunting activities close to a property would only lessen the likelihood of finding a housing premium associated with these acquisitions. Therefore, any effect found may be considered a premium which is the net effect of both the positive and negative amenity effect associated with the game lands.

Game lands are very common across Pennsylvania. There are existing game lands in 65 out of 67 counties, with Delaware and Philadelphia counties being the exception. Between 2000 and 2013, the PGC has acquired 386 different parcels totaling 85,182 acres. PGC land acquisitions are funded through mineral and oil revenue, hunting license revenue, and firearms sales. The lands the commissioners consider for purchase are scientifically examined for the benefit they can provide for wildlife management. This institution's lack of political influence sets it apart from other open space institutions such as parks and zoning ordinances. Zoning land for a specific use follows a political process and therefore not exogenously determined (Liu and Lynch, 2011; Adelaja et al., 2009; Pogodzinski and Sass, 1994). The PGC acquisitions placed a credible promise of open views in the future.[4] The PGC acquires tracts via three general channels: purchases, grants, and exchanges. The grants

[3]The hunter education program in Pennsylvania was implemented in 1959 and hunting related shooting incidents have declined by nearly 80 percent since then. In 2012 there were no firearm hunting fatalities and only 33 hunting accidents. (source: pgc.state.pa.us; Release #034-14)

[4] While there are instances of the PGC exchanging parcels, legally they can only trade land if the game commission has a substantial gain from the trade. This is usually reserved for when they are trading smaller isolated tracts for larger ones, or right-of-way roads for the public.

are given to the PGC usually from a person's estate and exchanges transfer the land to the PGC in exchange for something such as an access road or permission to run water or sewer pipelines under the game land.

The PGC land acquisition purchasing process is unique because of the lack of public information. The real estate commissioner meets with landowners who are interested in selling their parcel to the PGC and decides if the parcel is of interest to the Game Commission. The landowner and commissioner will then decide on a price for the parcel and a legally binding contract will be signed. Only after this process will the purchase decisions be put to a vote at a public meeting where the Board of Commissioners are present. The parcels that are put up for a vote are unanimously favored for purchase and the outcome of the vote is published in the Pennsylvania Game News. Because of these "behind the scenes" negotiations, the acquisitions are largely unanticipated by the general public.

3. Data and Adjacency Definition

3.1. **Data.** The PGC data used is comprised of acquisitions which occurred between 2000 and 2013. There are 386 of these parcels across 55 of the 67 counties in Pennsylvania, the remaining counties did not have an acquisition during this time frame. Number of acquisitions, average acreage, and standard deviation by county and by year are provided below in tables 1 and 2. The average parcel the PGC acquires is 220 acres. The number of parcels acquired across counties range from 1 to 47 in this time period. As these tables show, there is ample game land acquisition activity across both time and space.

I use the PGC data to identify single-family-home parcels which sold within four years before or after an acquisition. The dataset of housing parcels has been compiled using online parcel searches as well as independent digitizing for rural counties. Independent digitizing involved acquiring separate assessment data, sales history, and GIS parcel maps for an individual county and then merging them together. Figure 9 shows an example assessment card from Clearfield County that was digitized independently. The housing observations in my sample is from across all of Pennsylvania, with exceptions for areas which did not have

GIS maps or the relevant data was stored with a third party vendor and not able to be accessed. Figure 3 shows the data in my sample, as well as counties which are unable to be used because of lack of game land acquisition or lack of data availability. The counties with available housing data encompass 150 of the PGC acquisitions, which is 39 percent of the available acquisitions.

3.2. **Treatment.** Parcels that are directly adjacent to a game land acquisition are considered to be treated. Those parcels which are not directly adjacent to the acquisition are defined as control parcels. One shortcoming of the data is that not all homes are provided as a shape, some are provided as a single point which doesn't allow for exact identification of adjacent properties. To identify these properties I use GIS analysis. First, I use the subset of counties which I have parcel shapes for and then assign them a coordinate for the centroid of each parcel. I identify which of these parcels are adjacent and then calculate the distance from the game land using the centroid as the endpoint. Using this analysis I found that the centroid of 95% of adjacent parcels are within 463 meters of the acquisition. Therefore, if I set the adjacency cutoff at 450 meters, I can be 95% confident that I have properly accounted for all adjacent parcels. I explore alternate adjacency definitions in section 5.5.

4. Econometric Approach

4.1. **Baseline Econometric Specification.** In this section I will discuss the baseline econometric model used as well as alternative specifications used for robustness checks. I begin with a simple illustrative example. Consider two identical homes, A and B, in two different areas, both of which have open space beside them. The homeowners have no control over how the open space is developed adjacent to their property. One day, home A receives a notice that the Pennsylvania Game Commission owns the parcel adjacent to her home. Now, the capitalization of this promise of future preserved status and new public land is the only difference in the house price between homes A and B. Therefore, the identifying

assumption is that in the absence of the acquisition, the adjacent homes would have experienced similar changes in housing value compared to homes which are slightly further away. Figure 5 shows the trends in housing values between the treatment homes, in the upper panel, and the control homes in the lower panel. The houses between 450 and 5,000 meters on the acquisitions show no trend, while the treatment group shows a similar lack of trend prior to the nearest game land acquisition (time = 0). After the acquisition, the treatment group experiences an increase in housing values while the control group does not show an increase in house values.

Given the varying time of each acquisition as well as their spatial dispersion, I propose applying a difference-in-differences estimator. I use the following equation:

$$\ln(price)_i = \beta_1 treat_i + \beta_2 post_i + \beta_3 treat_i \times post_i + \alpha_1 \mathbf{X}_i + \xi_{yq\,gl}$$

where

$treat_i$ *is parcel being closer than* 450 *meters to a new acquisition*

$post_i$ *is an indicator for a sale that occurred after the nearest acquisition*

$\mathbf{X_i}$ *is a vector of a parcel's characteristics*

$\xi_{yq\,gl}$ *is the set of relevant fixed effects*

The coefficient of interest, β_3 describes the treatment effect of being adjacent to new game land acquisitions. Given that most people consider game lands as a positive amenity, I would expect that the coefficient will be positive.

4.1. **Baseline Econometric Specification.** The baseline specification aggregates two different effects: a preserved view and new access. This subsection and the following one provide different specifications to disentangle these two effects. Providing new public open space carries with it a guarantee of access. Once the land is owned by the PGC, it becomes open to the public for their use. Therefore, any increases in housing values may be from

the benefit of having more public land to use. In order to address this, I identified PGC acquisitions which are independent of existing game lands. Those which are new independent game lands have an effect from both new open space usage, since there were no public lands around previously, as well as a preserved open view. Those acquisitions which are additions to existing game lands already have access to public land because there are existing game lands nearby to use, so the main effect from the acquisitions which are additions should be the guarantee of a view. The additions to existing game lands represent only a three percent increase to the game land acreage. See figure 6 for a visual representation of the additions and independent game lands definitions.

I modify the baseline econometric specification by adding an indicator variable, $new\,gl$. The $new\,gl$ indicator is equal to one only after the acquisition of a new independent game land happens. The coefficient on this term reports the differential pre-acquisition premium between control parcels located near an independent game land acquisition and those near an addition to existing game lands. The triple interaction term, $treat_i \times post_i \times new\,gl_i$, represents the increased premium that houses adjacent to independent game lands experience compared to homes adjacent to a game land addition acquisition. The hypothesis to test on the coefficient of interest (which I refer to as β_5), is:$H_o : \beta_5 = 0$ and $H_a : \beta_5 \neq 0$. If I can not reject the null hypothesis and the coefficient on β_5 is insignificant, then this implies that the effect is not being driven by the new access. However, if I reject the null hypothesis and there is a significant effect from having more usable open space, then this would suggest that the premium in the baseline specification is partially attributed to the new access.

4.3. **Preserved View.** Homeowners may enjoy new access to public land, or they may value a preserved view. To identify a potential preserved view effect I identify the parcels which are on the "first row" of houses beside an acquisition which have been referred to as "adjacent." These parcels will have the effect from a preserved view and a new access after the game land acquisition. Secondly, I identify the houses which are "second row" houses, that I refer to as "nearby." These houses would already have a first row house in front of them, but they are quite close to the game lands. Therefore, they have the benefit of new access, but they do not have the guarantee of a future unobstructed view. See figure 7 for

a visual representation of the first and second-row of homes definitions. I again modify the baseline econometric specification with an additional indicator, *nearby*, which represents the homes that are nearby, but not directly adjacent to a game land acquisition. The houses which I referred to as treatment parcels previously I now identify with an indicator variable, *adjacent*. The coefficient on the *adjacent* indicator I refer to as $\beta_{adjacent}$ and the coefficient on the *nearby* indicator is β_{nearby}. I can decompose the two coefficients of interest as: $\beta_{adjacent} = \beta_{view} + \beta_{access}$ and $\beta_{nearby} = \beta_{access}$. The hypothesis to test will be $H_o : \beta_{adjacent} = \beta_{nearby}$ and $H_a : \beta_{adjacent} \neq \beta_{nearby}$. If I fail to reject the null hypothesis then this implies that the increase in housing value can be attributed to a premium for a preserved view. Rejecting the null hypothesis suggests that the premium aggregates the premium for a preserved view and newly accessible public land.

5. Results

5.1. **Baseline Results.** Table 3 begins by showing a baseline regression which controls for age, square footage, lot size and number of bedrooms. The only fixed effects present in column 1 are year and county fixed effects, separately. The coefficient of interest, β_3 which corresponds to the variable treatment by post, shows that there is an 18.6% increase in a house's value resulting from the game land acquisition. Column 2 strengthens the specification by controlling for year by quarter fixed effects in addition to county fixed effects. The year by quarter fixed effects control for the inherent differences across seasons. Some of these homes may sell for a higher price in the fall when hunting season is approaching. The effect if still significant at the 5% level and the magnitude of the premium increases to 19.2%.

One concern with using only county fixed effects to control for geography is that there may be many game lands located in a given county. There may be systematic differences across game lands within the same county which would not be controlled for when using only county fixed effects. In this study, the relevant market control would be separate game lands. Therefore, column 3 shows results when controlling for year fixed effects as well as game land

fixed effects. Since all of the game lands in my study are housed completely within a given county, county fixed effects are redundant and therefore omitted. The resulting premium increases slightly to 20%. Column 4 is the same specification as column 3, except there are year by quarter fixed effects. Column 4 shows a 20% increase in a home's value after the game land acquisition.

Columns 5 and 6 in table 3 report the results from two specifications with the most comprehensive set of fixed effects. One concern is that some markets have inherently different traits changing across time compared with another market nearby. For instance, homes located near a game land that releases higher than average number of pheasants may experience a higher premium in the fall than other game lands. Using year by quarter by county fixed effects (column 5) and year by quarter by game land fixed effect (column 6) controls for trends across time that can also vary between game lands. My findings are robust to these controls, with the results showing a significant 21% and 23% increase in a home's value after acquisition, respectively.

5.2. **Newly Accessible Public Land Discussion.** The premium associated with these acquisitions may be a new access effect or a preserved view effect. When the game land acquires a parcel they are providing a guarantee that they will not develop this land. In addition, this land that used to be private and inaccessible now becomes available for public use. Therefore, the additional benefit to a person's home reported in table 3 is, potentially, the sum of the benefits from access as well as the guarantee.

Using the model presented in section 4.2, I have identified the game lands which are new, independent game land parcels and those which are additions to existing game lands. Additions to existing game lands would have the guaranteed view effect since the home would have already had proximity to public land prior to the acquisition[5]. However, new independent game lands would have both new guaranteed access and guarantee of future openness. Looking at the potential difference in the effect between these two groups will allow me to discover if the premium is being driven by new access to the land.

[5]Additions to existing game lands represent a 3% increase on average.

If this effect of a guaranteed view is being inflated by a separate access effect that is not being controlled for, I would see the estimate of β_5 being positive and significantly different than zero. The results are shown in table 4. The results use the same progression of fixed effects as I described from table 3 and I find that the coefficient of interest, β_5, is insignificant in every specification. This implies that there is not a different effect from game lands which introduce both public use and a future guaranteed view versus the effect from game lands which provide an additional guaranteed view. Therefore, the effect I found previously can likely not be attributed to an effect from the newly accessible land.

5.3. **Preserved View Discussion.** To further investigate the preserved view effect I consider homes in the first row of houses that would be getting a guarantee and access versus those in the second row which would only receive an access effect and not a guarantee effect since there is already a house in front of them. I create a variable which identifies houses which are considered adjacent, less than 450 meters, and those that are "nearby" and are between 450 and 900 meters. The omitted category are those which are more than 900 meters.

The coefficient of interest is β_4, which reports the effect on adjacent homes. Table 5 reports the results using the same progression of fixed effects from table 3. The increase in adjacent home values resulting from the acquisition ranges from 18.4% in column 1 to 23% in column 6 These results are strikingly similar to the premiums reported in table 3.

If the effect reflected an access premium, I would expect the coefficient of β_5, to be positive and significantly different than zero. The results are reported in table 5. There is no significant premium on homes that are near to a game land acquisition, but not directly adjacent. Therefore, there does not appear to be a new access effect that is driving the results from my baseline analysis. I have shown two different approaches which suggests that the effect I am finding is related to the benefit of a preserved view.

5.4. **Unobserved Factors - Robustness Discussion.** I have attributed the premium found in this study to the game land acquisition. However, if there is another policy that

happens at the same time as the acquisition that affects housing values, then the premium I have identified would be biased by this policy. To perform a falsification test, I will analyze parcels whose sales should not be influenced by the acquisition. Commercial buildings in rural areas are purchased for their value to the business, not for the value of the vacant adjacent parcel. It is unlikely that a mechanic shop would be purchased at a higher value after the PGC acquires the land adjacent to their building. Therefore, this falsification exercise will test for unobserved treatments that may be affecting housing values. I use the same econometric model detailed in section 4.1, where the coefficient of interest is β_4 which reports the effect from the game land acquisition. If the premium I found in the previous results were being influenced solely by the game land acquisition, I would expect to find an insignificant effect on β_4. However, if there is a significant premium from the acquisitions, the assumption of treatment being only from the acquisitions would be invalid. It would suggest that there was another unobserved factor affecting the adjacent homes at the same time each of the acquisitions occurred.

I identified sales surrounding game land acquisitions which have a use code of commercial or industrial. I used a study distance of 5,000 meters and identified the parcels that were within the treatment distance of 450 meters. The resulting regressions are shown in table 7. Controls for lot size and square footage are present in each specification. The columns follow the same fixed effects progression as detailed in table 3. The results show that there is an insignificant premium from the acquisition, which strengthens the hypothesis that the significant results are being driven by the acquisition and not another unobserved treatment.

5.5. **Adjacency - Robustness Discussion.** The cutoff of 450 meters, for determining adjacency, was determined using available parcel shapes. In this section I provide analysis of my results using various treatment cutoffs in order to demonstrate the robustness of the premium. Figure 8 shows the resulting premium and 95% confidence interval for various treatment cutoffs. The regression used to determine these effects use year-by-quarter-by-game-land fixed effects in addition to linear, quadratic, and cubic controls for age, lot size, square footage, and number of bedrooms. The cutoff for control parcels remains 5,000 meters.

The figure begins with a treatment cutoff of 350 meters and increases the treatment cutoff by increments of 25 meters. The coefficient is significant and almost 20 percent using this treatment distance. As the treatment cutoff increases, the effect becomes insignificant after 500 meters, which is consistent with decaying premiums as distance to the amenity increases. The figure shows that the effect I find is robust to using various treatment cutoff distances around the predetermined 450 meter cutoff.

6. Placing the Effect in Context

Welfare implications of these conversions are very important to the Commissioners of the PGC as well as county planners. In this section I will interpret and provide some back-of-the-envelope calculations to provide a basic welfare analysis. I will consider both the positive housing tax base implications as well as the negative effect from removing these parcels from the current tax base.

Before the acquisition, the vacant land was owned privately and the county collected taxes on the vacant land. After the acquisition, the county receives less tax revenue because these parcels are held under a tax-exempt entity. One scenario to consider is that these parcels would have continued to be vacant if the PGC had not purchased them. Using a range of vacant land tax per acre of \$5 to \$20[6], I estimate that the decrease in tax revenue from these acquisitions is between \$425,910 and \$2,129,550 per year.

Another scenario, which is slightly outside of the scope of this paper, is that all of this vacant area would be converted to houses. The average home adjacent to the acquisition in my sample is valued at \$119,600 and is located on a 2.2 acre parcel. Therefore, the acquisitions could have been converted into approximately 38,720 houses. The increase in county tax revenue from these houses for the average county would be \$62,566,400.[7] On net, the county would lose the vacant land revenue calculated above and gain the revenue from the new houses. Therefore, the overall increase in tax revenue from building these new homes would be between \$61,714,580 and \$60,010,940 per year.

[6]Using Howard Hanna's estimated taxes on their listings, I found the range of vacant land tax rates per acre across Pennsylvania to range from \$5 per acre to \$20 per acre. Some municipalities may charge more or less. Also, there are various homestead/ farmstead and Clean and Green exemptions that homeowners can claim in order to further decrease their vacant land tax bill.

[7]The average 2015 county millage rate in Pennsylvania is \$13.5106 per \$1,000. The maximum millage rate is \$57.42 in Lackawanna County and the minimum is \$2.338 in Cumberland County.

My paper has shown that there is a significant increase in adjacent home values. There are approximately 4.3 home parcels surrounding the average game land acquisition. The increase in home value for an average home adjacent to the acquisition ranges from $21,528 to $27,508. Therefore, the increase in each home value would contribute between $291 and $372 per year to the tax base. Therefore, each acquisition increased tax revenue by between $1,251 and $1,598. Aggregating these numbers for all 386 acquisitions, the acquisitions added between $482,762 and $616,867. Considering only the scenario where the land remained vacant if the PGC did not purchase it, the resulting decline in tax revenue from privately held vacant land is significantly offset by the increase in home values from the surrounding residential houses, rendering the acquisitions tax neutral for local government tax revenue.

7. Conclusion

Valuing open space has been an important focus of research by economists for many years. This paper aims to extend the literature by identifying the effect of changing expectations on open space. Using Pennsylvania Game Commission land holdings provides many benefits, one being that the organization has an extensive and long-standing game land system with legal restrictions placed on them to forbid sales of existing game lands to private buyers. Further, the PGC has been consistently acquiring land throughout the past decade and this dynamic boundary allows for a clean identification of treatment.

Results suggest that housing values are positively impacted by the addition of a guarantee on the adjacent open land by 23 percent. This is economically important because changing an area's future status from ambiguous to protected provide benefits through an indirect result of increased house values in addition to the direct benefits from conservation and habitat protection. This can boost tax revenue as well as provide an empirical basis to champion open space protection.

It is imperative to contemplate the policy implications of this preservation. Local governments are be concerned with the reduction in housing supply resulting from preserving open space while conservancies such as the PGC are focused on protecting various animal species.

My paper looks at the spillover benefits from preserving this land and I provide a back-of-the-envelope calculation that can speak to the costs and benefits of this institutional change. From a benefit perspective, I considered houses that are affected and the increase in housing value that the homeowners experience resulting from the acquisition. The average home sale in my study is $119,600 and, on average, there are 4.3 residential parcels surrounding a game land acquisition. Each acquisition added $118,284 to the aggregate housing stock. Using a millage rate of $13.51 per $1,000 results in the average home providing $372 in additional property tax revenue, and the acquisition itself adding $1,598 to the tax base.[8] I showed that, under the assumptions that the land would remain vacant if the PGC had not purchased it, the preservation is tax-neutral for local governments.

Future research should continue to look at spillover effects from preserving open space. These acquisitions provide a recreational opportunity for the public and this incentive may lead to other economic benefits in tourism, merchandise, and service sectors of the local economy. There are many interesting avenues of further analysis on housing markets associated with preserved open space. Other research has shown that policies such as greenbelts can lead to an increased hazard rate of development. One research question may look at development patterns such as the types of housing built or the amount of housing investment that landowners choose before and after a preservation acquisition.

Overall, I have shown that introducing a guarantee on adjacent land has a significantly positive effect on existing homes and that this effect is coming from the preserved view of the adjacent homeowners and not a new access effect. This increase in the value of rural homes is an important issue that local and state governments should consider when deeming parcels as protected.

[8]See previous footnote for average millage rate detail. This rate does not include school, library, or municipal millage rates.

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Table 1

Summary Statistics of 2000-2013 Acquisitions by County			
County Name	Count	Mean (Acres)	StdDev
ADAMS	3	15.9	14.0
ARMSTRONG	5	108.5	98.7
BEAVER	3	97.3	81.0
BEDFORD	2	122.8	71.6
BERKS	6	20.2	16.6
BLAIR	4	383.5	683.2
BRADFORD	4	34.3	13.7
BUCKS	2	25.1	22.2
BUTLER	2	15.3	10.5
CAMBRIA	11	70.3	125.4
CAMERON	1	1104.3	N/A
CARBON	6	136.1	185.6
CENTRE	15	341.6	624.6
CLARION	7	1000.6	1615.8
CLEARFIELD	11	1361.3	2540.1
CLINTON	4	827.7	1579.6
COLUMBIA	1	1176.6	N/A
CRAWFORD	1	95.1	N/A
CUMBERLAND	3	49.2	80.0
DAUPHIN	5	21.8	15.4
ELK	47	236.8	800.9
ERIE	12	98.8	78.4
FAYETTE	5	143.4	88.8
FRANKLIN	1	60.5	N/A
GREENE	9	49.4	47.4
HUNTINGDON	15	373.7	575.0
INDIANA	46	131.4	179.9
JEFFERSON	5	49.9	77.9

Summary Statistics of 2000-2013 Acquisitions by County			
County Name	Count	Mean (Acres)	StdDev
JUNIATA	4	311.4	577.0
LACKAWANNA	11	112.3	192.8
LANCASTER	1	113.2	N/A
LAWRENCE	4	70.9	100.4
LEBANON	5	62.9	72.6
LEHIGH	2	4.3	4.6
LUZERNE	4	150.2	295.1
LYCOMING	3	41.7	57.4
MCKEAN	17	85.6	136.0
MERCER	5	4.8	9.1
MONROE	4	389.2	479.0
NORTHAMPTON	22	10.7	13.1
NORTHUMBERLAND	7	117.6	210.5
PERRY	4	54.9	35.6
POTTER	1	7.0	N/A
SCHUYLKILL	9	499.4	528.9
SOMERSET	10	105.4	104.1
SULLIVAN	1	30.2	N/A
SUSQUEHANNA	2	44.9	62.7
TIOGA	1	25.7	N/A
UNION	1	416.4	N/A
VENANGO	1	541.4	N/A
WARREN	7	72.8	33.0
WASHINGTON	14	377.2	930.4
WESTMORELAND	7	143.4	267.3
WYOMING	1	151.5	N/A
YORK	2	129.7	162.3
Grand Total	386	220.7	677.3

Table 2

Summary Statistics of 2000-2013 Acquisitions by Year			
Year	Count	Mean (Acres)	StdDev
2000	43	255.4	453.2
2001	35	245.6	620.0
2002	26	244.0	615.2
2003	57	114.7	289.5
2004	22	296.9	730.3
2005	22	211.7	332.5
2006	17	181.1	234.8
2007	23	72.1	194.0
2008	22	361.2	1086.6
2009	30	118.4	242.2
2010	18	347.3	1058.4
2011	24	441.6	1745.2
2012	43	184.1	383.3
2013	4	132.5	161.7
Grand Total	386	220.7	677.3

TABLE 3. Housing Premium from PGC Acquisition

Dependent Variable: Log Price	(1)	(2)	(3)	(4)	(5)	(6)
Adjacent Indicator	-0.160***	-0.167***	-0.0834	-0.0917*	-0.0969*	-0.110*
	(0.054)	(0.054)	(0.054)	(0.054)	(0.056)	(0.058)
Post Acquisition Indicator	0.0583***	0.0539***	0.0710***	0.0626***	0.0407	0.0404
	(0.013)	(0.013)	(0.017)	(0.017)	(0.026)	(0.030)
Adjacent X Post	0.186**	0.193**	0.199**	0.204**	0.215**	0.233**
	(0.092)	(0.092)	(0.091)	(0.091)	(0.096)	(0.101)
Observations	10,536	10,536	10,536	10,536	10,536	10,536
R-squared	0.457	0.464	0.484	0.49	0.54	0.549
Year FE's	X	X	X	X	X	X
Year by Quarter FE's		X		X	X	X
County FE's	X	X			X	
Game Land FE's			X	X		X
Year by Quarter by County FE's					X	
Year by Quarter by Game Land FE's						X

Notes: Treatment parcels are those within 450 meters of an acquisition. Control parcels are those between 450 and 5000 meters. Linear, quadratic, and cubic controls for square footage, lot size, age, and number of bedrooms are present.

TABLE 4. Differences in Housing Premium from PGC Acquisition: Independent versus Additions

Dependent Variable: Log Price	(1)	(2)	(3)	(4)	(5)	(6)
Adjacent Indicator	-0.166***	-0.176***	-0.0627	-0.0747	-0.0834	-0.0952
	(0.057)	(0.057)	(0.057)	(0.057)	(0.059)	(0.061)
Post Acquisition Indicator	0.0739***	0.0680***	0.0686***	0.0598***	0.0492*	0.0526*
	(0.016)	(0.016)	(0.018)	(0.018)	(0.027)	(0.031)
Independent Gameland Acquisition Indicator	0.0769***	0.0767***	0.209*	0.191*	0.126	0.405**
	(0.025)	(0.025)	(0.108)	(0.108)	(0.151)	(0.197)
Adjacent X Post	0.237**	0.245**	0.265**	0.271**	0.321***	0.342***
	(0.110)	(0.110)	(0.108)	(0.108)	(0.118)	(0.124)
Adjacent X Independent Gameland	0.062	0.0892	-0.178	-0.145	-0.128	-0.127
	(0.174)	(0.174)	(0.173)	(0.172)	(0.175)	(0.192)
Post X Independent Gameland	-0.0598**	-0.0557**	0.0252	0.026	-0.0756	-0.118
	(0.026)	(0.027)	(0.028)	(0.028)	(0.059)	(0.138)
Adjacent X Post X Independent Gameland	-0.185	-0.207	-0.069	-0.0915	-0.167	-0.183
	(0.234)	(0.234)	(0.230)	(0.230)	(0.237)	(0.256)
Observations	10,536	10,536	10,536	10,536	10,536	10,536
R-squared	0.458	0.464	0.485	0.490	0.541	0.549
Year FE's	X	X	X	X	X	X
Year by Quarter FE's		X		X	X	X
County FE's	X	X			X	
Game Land FE's			X	X		X
Year by Quarter by County FE's					X	
Year by Quarter by Game Land FE's						X

Notes: Treatment parcels are those within 450 meters of an acquisition. Control parcels are those between 450 and 5000 meters. Linear, quadratic, and cubic controls for square footage, lot size, age, and number of bedrooms are present.

TABLE 5. Housing Premium from PGC Acquisitions: Adjacent versus Nearby

Dependent Variable: Log Price	(1)	(2)	(3)	(4)	(5)	(6)
Adjacent Indicator	-0.160***	-0.167***	-0.0813	-0.0895*	-0.0937*	-0.106*
	(0.054)	(0.054)	(0.054)	(0.054)	(0.056)	(0.058)
Near, But Not Adjacent Indicator	0.00306	0.00557	0.047	0.0494	0.0533	0.0611
	(0.050)	(0.049)	(0.049)	(0.049)	(0.051)	(0.053)
Post Acquisition Indicator	0.0605***	0.0564***	0.0723***	0.0641***	0.0438*	0.0427
	(0.013)	(0.013)	(0.017)	(0.017)	(0.026)	(0.030)
Adjacent X Post	0.184**	0.191**	0.197**	0.202**	0.211**	0.230**
	(0.092)	(0.092)	(0.091)	(0.091)	(0.096)	(0.101)
Near X Post	-0.0869	-0.095	-0.0628	-0.0696	-0.074	-0.0643
	(0.072)	(0.072)	(0.070)	(0.071)	(0.074)	(0.079)
Observations	10,536	10,536	10,536	10,536	10,536	10,536
R-squared	0.457	0.464	0.484	0.490	0.540	0.549
Year FE's	X	X	X	X	X	X
Year by Quarter FE's		X		X	X	X
County FE's	X	X			X	
Game Land FE's			X	X		X
Year by Quarter by County FE's					X	
Year by Quarter by Game Land FE's						X

Notes: Adjacent parcels are those within 450 meters of an acquisition Second row parcels are those between 450 and 900. Control parcels are those between 900 and 5000 meters. Linear, quadratic, and cubic controls for square footage, lot size, age, and number of bedrooms are present.

TABLE 6. Housing Premium from PGC Acquisition: Parcel Size Distribution

Dependent Variable: Log Price	(1)	(2)	(3)	(4)	(5)	(6)
Adjacent Indicator	-0.316***	-0.317***	-0.185**	-0.187**	-0.179**	-0.182**
	(0.0733)	(0.0733)	(0.0727)	(0.0727)	(0.0764)	(0.0795)
Post Acquisition Indicator	0.0625***	0.0574***	0.0540***	0.0445**	0.0452	0.0371
	(0.0150)	(0.0150)	(0.0182)	(0.0183)	(0.0279)	(0.0310)
Adjacent X Post	-0.00808	-0.0436	0.108	0.0629	4.31e-05	0.00386
	(0.123)	(0.123)	(0.122)	(0.122)	(0.129)	(0.136)
Adjacent X Post X Above Median Parcel Size	0.229**	0.243***	0.325***	0.332***	0.374***	0.381***
	(0.0931)	(0.0930)	(0.0928)	(0.0927)	(0.101)	(0.108)
Observations	10,536	10,536	10,536	10,536	10,536	10,536
R-squared	0.468	0.474	0.492	0.498	0.548	0.556
Year FE's	X	X	X	X	X	X
Year by Quarter FE's		X		X	X	X
County FE's	X	X			X	
Game Land FE's			X	X		X
Year by Quarter by County FE's					X	
Year by Quarter by Game Land FE's						X

Notes: Adjacent parcels are those within 450 meters of an acquisition. Control parcels are those between 450 and 5000 meters. Linear, quadratic, and cubic controls for square footage and lot size are present.

TABLE 7. Falsification Analysis: Commercial Sales

Dependent Variable: Log Price	(1)	(2)	(3)	(4)	(5)	(6)
Adjacent Indicator	0.358	0.249	0.474	0.420	0.583	0.384
	(0.595)	(0.603)	(0.597)	(0.605)	(0.802)	(0.953)
Post Acquisition Indicator	0.268**	0.245**	0.115	0.0804	0.0113	0.373
	(0.118)	(0.120)	(0.149)	(0.153)	(0.309)	(0.363)
Adjacent X Post	-1.023	-0.735	-1.196	-0.981	-1.511	-1.744
	(1.076)	(1.084)	(1.074)	(1.081)	(1.218)	(1.530)
Observations	1,326	1,326	1,326	1,326	1,326	1,326
R-squared	0.190	0.212	0.218	0.245	0.409	0.431
Year FE's	X	X	X	X	X	X
Year by Quarter FE's		X		X	X	X
County FE's	X	X			X	
Game Land FE's			X	X		X
Year by Quarter by County FE's					X	
Year by Quarter by Game Land FE's						X

Notes: Parcels of interest are commercial or industrial buildings. Treatment parcels are those within 450 meters of an acquisition. Control parcels are those between 450 and 5000 meters. Linear, quadratic, and cubic controls for square footage and lot size are present.

FIGURE 1

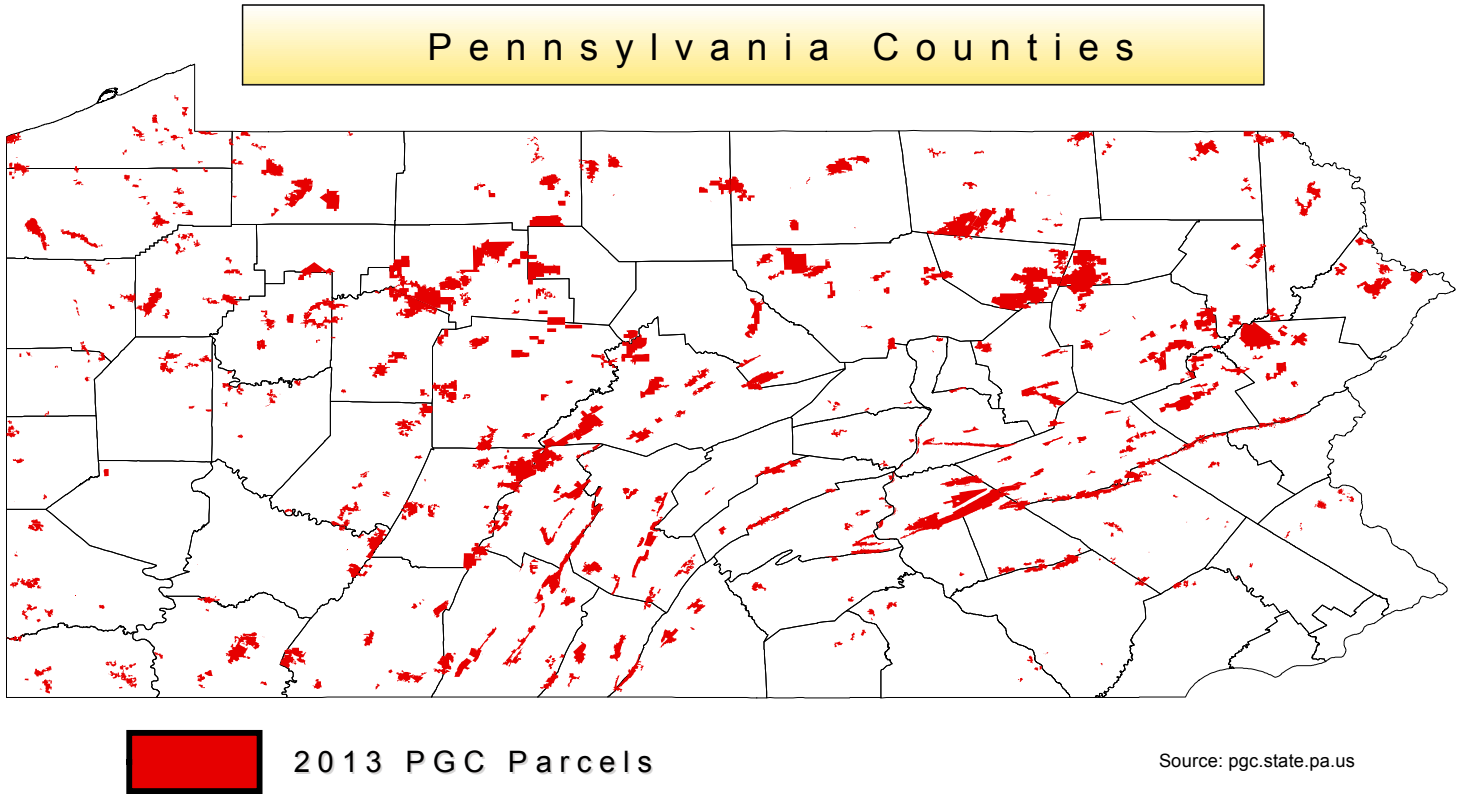

Pennsylvania Counties
2013 PGC Parcels
Source: pgc.state.pa.us

FIGURE 2

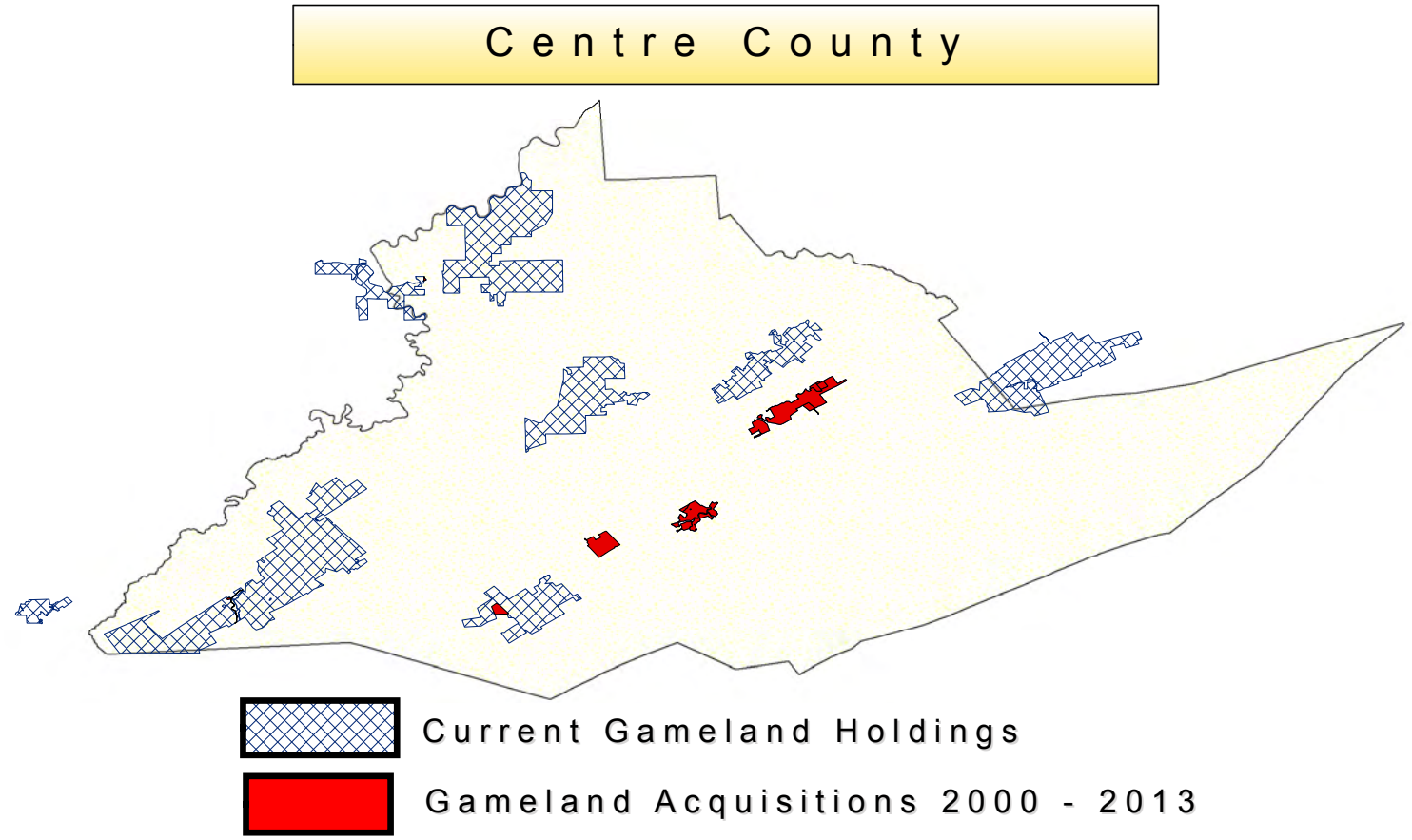

Centre County
Current Gameland Holdings
Gameland Acquisitions 2000 - 2013

FIGURE 3

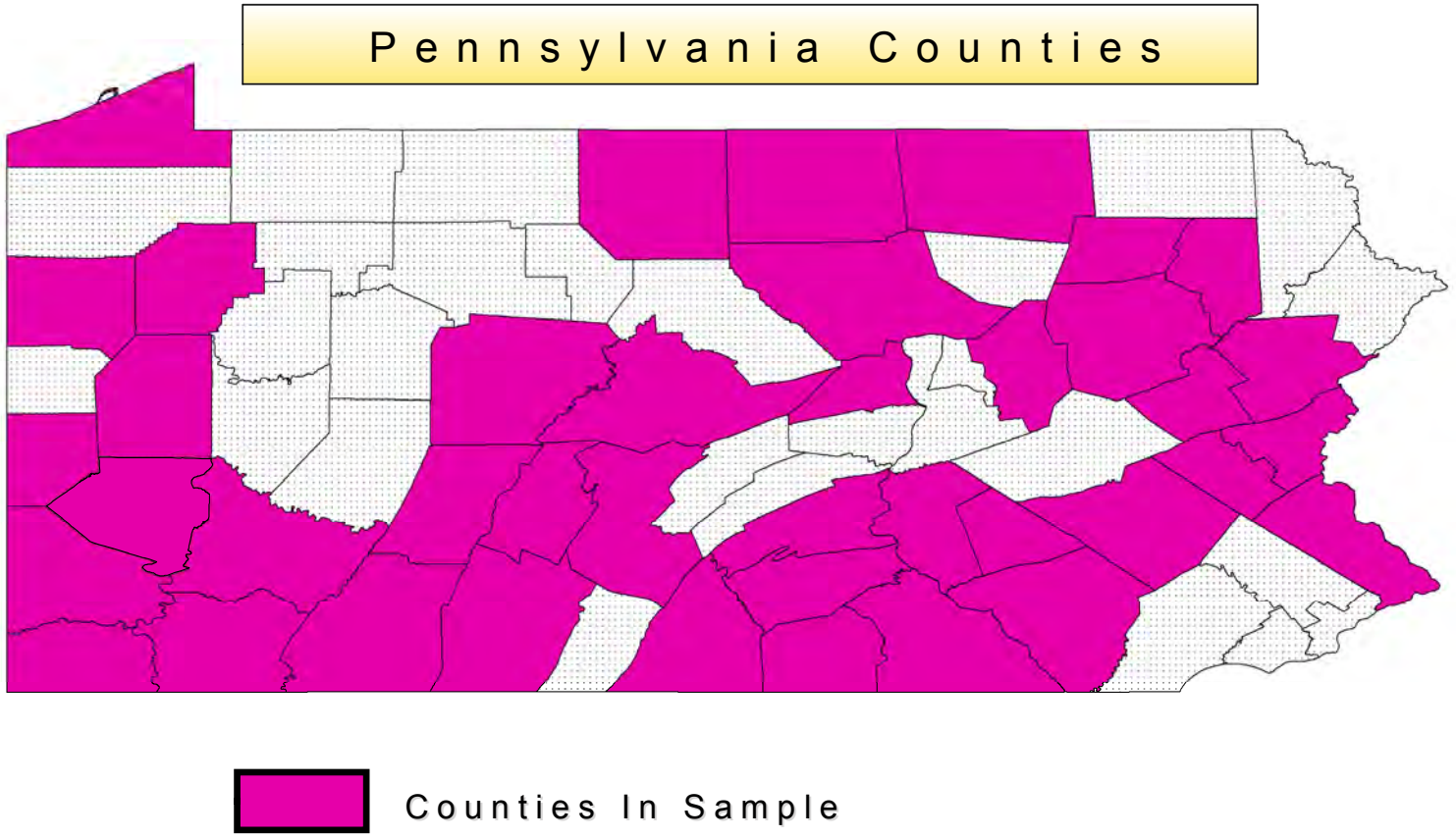
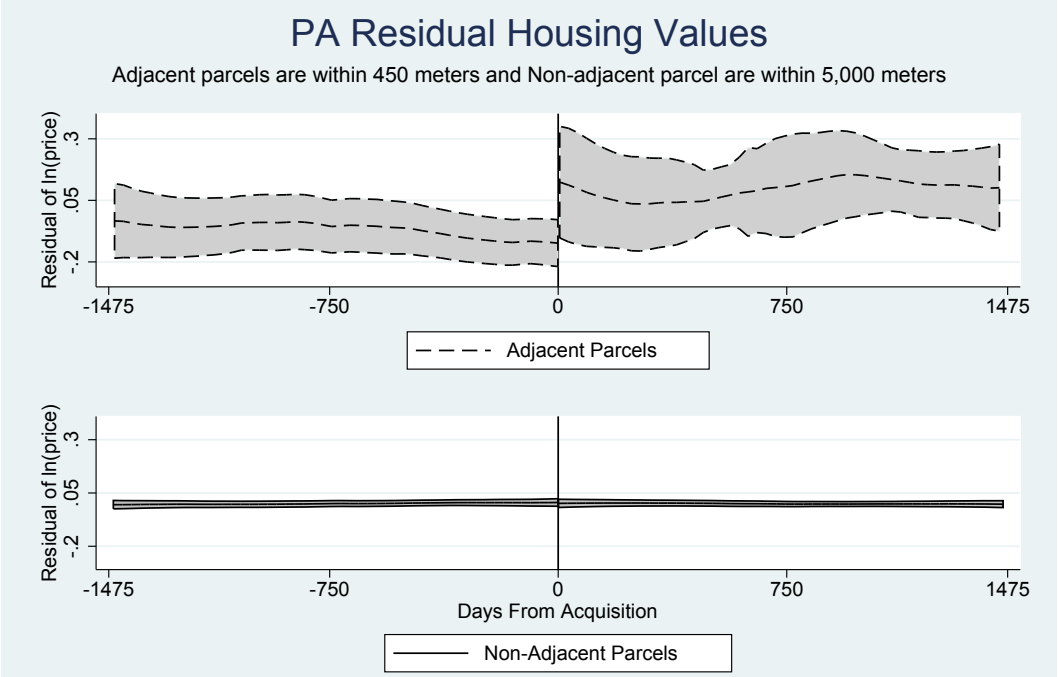


FIGURE 4. Realty Listing in Centre County, Pennsylvania

FIGURE 5. Trends in Housing Values



Sales are normalized to reflect nearest acquisition date and the relevant time period is within 4 years. Controls for year-quarter-gameland, age, lotsize, square feet, and number of bedrooms are present

FIGURE 6. Independent versus Addition Acquisitions

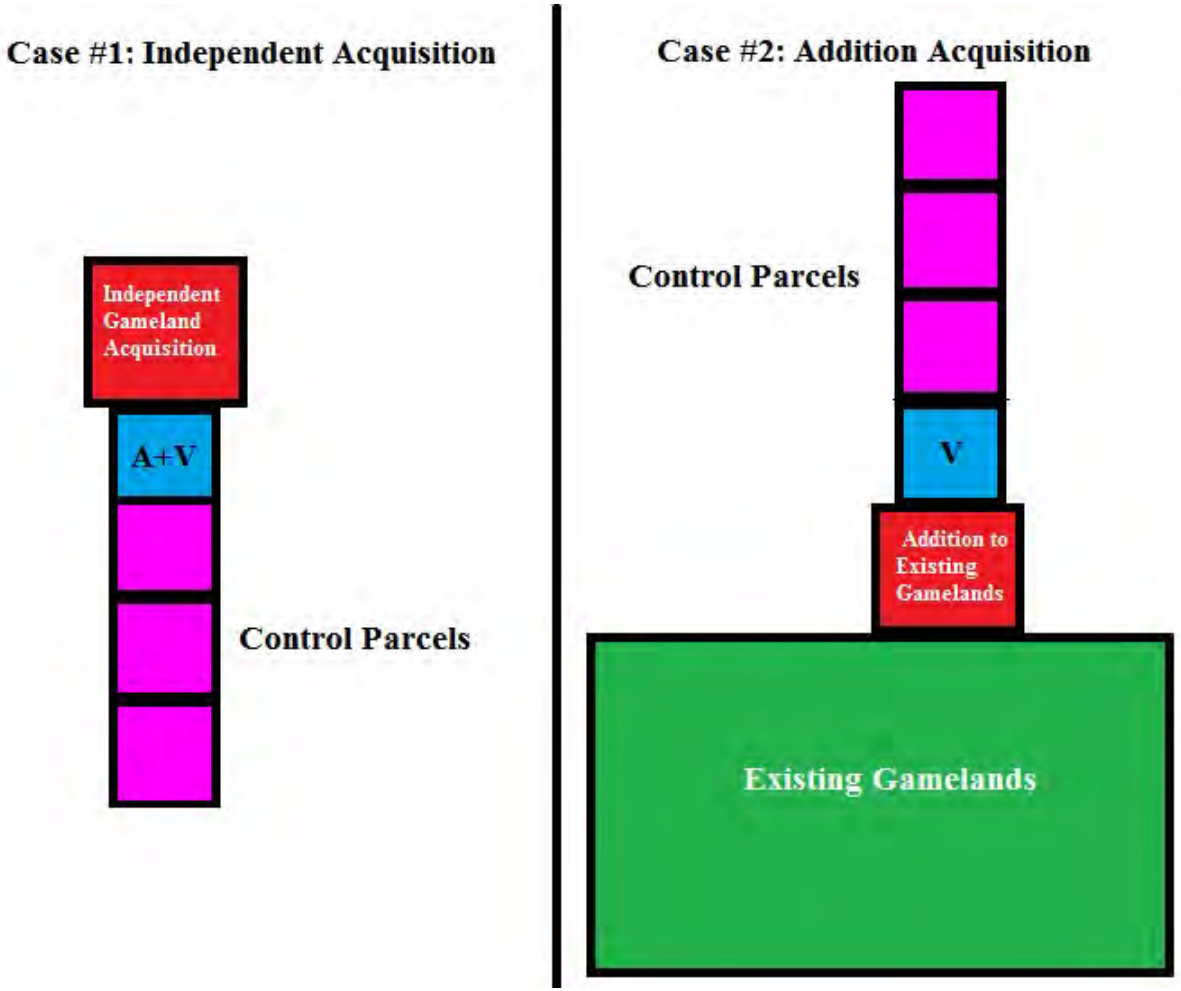


FIGURE 7. Adjacent versus Nearby Homes

FIGURE 8. Various Treatment Cutoffs

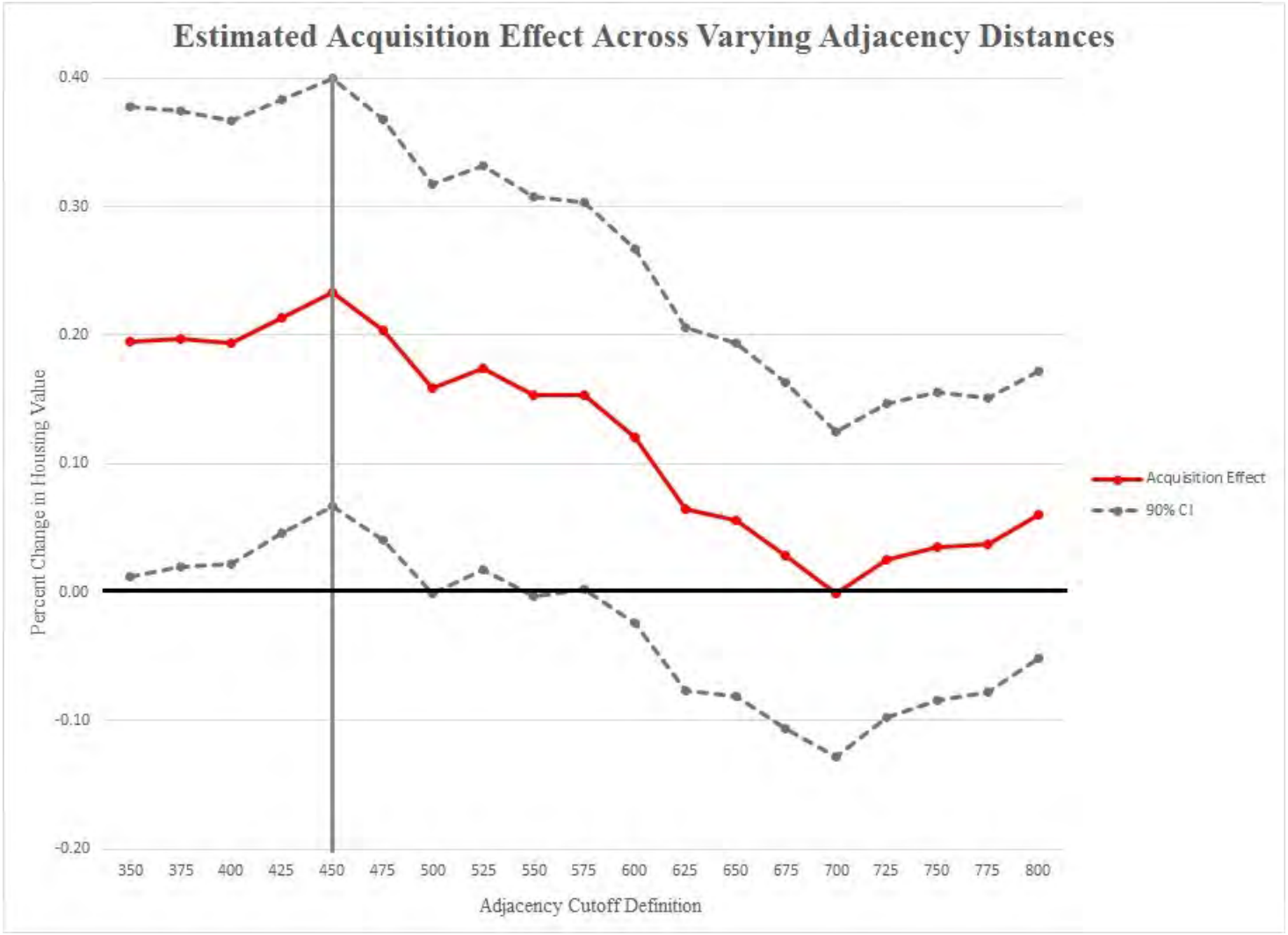


FIGURE 9. Assessment Card: Clearfield County

02/20/15 10:42:19 AM RESIDENTIAL PROPERTY RECORD CARD CLEARFIELD COUNTY, PA EFFECTIVE DATE OF VALUE: 4/01/2000

10915 TREASURE LAKE RD Control #: 128081832 Map #: 1280C02002001150021 ZONING: PRD CLASS: R STATE CLASS: CARD #: 1 OF 1

CURRENT OWNER/ADDRESS
KIRK, SAMUEL J & SHARON L

636 TREASURE LAKE
DUBOIS PA 15801

NBHD ID: 38.00
LIVING UNITS: 1
ROUTING NO:

DEED BOOK: 2009
DEED PAGE: 07361
DEED DATE: 20090529
GROSS SIZE TYPE:

LAND DATA: TYPE SIZE
WATERFRONT 82 x 181
0 x 0
0 x 0
0
0
0
0.000
0.000
0.000
0.000
0.000
0.000
TOTAL ACRES: 0.000
GROSS SIZE: 0.000

INFLUENCE FACTORS	%	LAND VALUE
TOPOGRAPHY	-60	10,190
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
TOTAL LAND VALUE:		10,200
GROSS TYPE/VALUE:		0

- ASSESSMENT INFORMATION -

	PRIOR	CURRENT
LAND	10,200	10,200
C & G LAND	0	0
BUILDING	119,100	119,100
TOTAL	129,300	129,300
ASSESSED	0	32,325

VALUE FLAG: 2 OVERRIDE

19870224 012
19900508 SLH
0

SALES DATA:

Date	Type	Price	Valid	Date	#	Amount	Purpose
20090601	LAND + BLDG	402,655	A	0		0	
20060822	LAND + BLDG	400,000	A	0		0	
19981201	LAND + BLDG	222,500	A	0		0	

PERMIT DATA:

DWELLING DATA:

Style: CONVENTIONAL
Walls: FRAME/EQUAL Story Ht. 1.0

Total Rooms: 8 Bedrooms: 3

Basement: FULL
Attic: NONE
Full Baths: 2 Add'l Fixtures: 0
Half Baths: 1 Total Fixtures: 10
Heating: BASIC
Heating System: WARM AIR
Type: ELECTRIC
Fin. Bsmt. Living Area: 0 X 0
Basement Rec Room Area: 0 X 0
WB / Metal Fireplaces: 1 / 0
Basement Garage (# Cars) 1
Special Feature:
Ground Flr Area: 3186
Quality Grade: B- CDU: GD

Year Built: 1988 Condition: AVERAGE

COST APPROACH COMPUTATIONS

Base Price	94,080
Plumbing	2000
Additions	8200
Unfin. Area	0
Basement	0
Attic	0
Heat/AC Adj.	0
FBLA	0
Rec Rm	0
Fireplace	2,000
Bsmt. Gar.	800
SUBTOTAL	107,080
Grade Factor	1.17
C & D factor	0
TOTAL RCN	$125,280
% Good	0.95
Market Adj.	0
TOTAL RCNLD	$119,000

OUTBUILDING DATA

Type	Qty	Yr	Size1	Size2	Grd	Cond	Value
	0	0	0	0			$0
	0	0	0	0			$0
	0	0	0	0			$0
	0	0	0	0			$0
	0	0	0	0			$0
	0	0	0	0			$0
	0	0	0	0			$0

Misc OBY Desc:
Total OBY Value = $0

NOTES:
H & L 115 SECTION 2

ADDITION DATA:

	Lower Level	First Floor	Second Floor	Third Floor	Area	Value
A	Wood Deck				320	1800
B		Opn Frm Prch			80	1000
C		Frame Garage			576	5400
D					0	000
E					0	000
F					0	000
G					0	000
H					0	000
I					0	000
J					0	000
K					0	000
L					0	000
M					0	000