The Biodiversity Protection Discount*

Golnaz Bahrami† — *Penn State University*
Matthew Gustafson‡ — *Penn State University*
Eva Steiner§ — *Penn State University*

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Abstract

Land use restrictions are the preferred policy tool to halt the dramatic decline in global biodiversity, but their economic costs are unknown. We compile a novel, nationwide, annual panel data set that tracks exposure to biodiversity protections, vacant land values, transactions, and land development on the individual parcel level. We estimate an average discount of 45% in the value of protected land in the U.S. This discount is driven by restrictions to development. It is larger in locations where developable land is more scarce and where political regimes are more committed to conservation. These economic costs should be weighed against the benefits of biodiversity to determine optimal conservation policy.

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JEL Classification: G1, Q24, R1, R3.

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†Department of Finance, Penn State Smeal College of Business. Email: gxb5298@psu.edu.
‡Department of Finance, Penn State Smeal College of Business. Email: mtg15@psu.edu.
§Department of Risk Management, Penn State Smeal College of Business. Email: ems6770@psu.edu.

1 Introduction

Researchers and policymakers are increasingly attentive to the negative economic consequences of the rapid deterioration in global biodiversity, which has led to a 69% decline in the abundance of monitored wildlife since 1970 (Cardinale et al., 2012; UN, 2022; WWF, 2022). A key driver behind this loss of biodiversity is changing land use patterns (Sala et al., 2000; Jaureguiberry et al., 2022). Thus, local land use restrictions have become the policy tool of choice to conserve biodiversity.[1] Today, such restrictions affect 8% of U.S. land. The vast majority of countries including the U.S. have pledged to protect 30% of global land and water by 2030.[2] Optimal policy design requires weighing the benefits of biodiversity conservation (see, e.g., Frank and Sudarshan, 2024) against the costs of regulatory interventions.[3] Yet, the literature lacks estimates of the costs associated with local land use restrictions for the protection of biodiversity. We provide the first large-scale, quasi-experimental estimate of the discount in the market value of vacant land that is subject to such restrictions.

Estimating the biodiversity protection discount is difficult for two main reasons. For one, we need to distinguish between the direct effects of land use restrictions on regulated land and any potentially offsetting external effects of these restrictions on unregulated land nearby (Turner et al., 2014). Additionally, we need to account for the possibly endogenous nature of land use restrictions whereby *ex-ante* less valuable land could be more likely to be regulated (McMillen and McDonald, 2002). We address these challenges by combining regression discontinuity (RD) analyses around protected area borders in the U.S. with difference-in-differences (DiD) estimations around newly formed biodiversity protected areas. As a baseline, we implement static RD analyses around protected area borders whose creation predates the start of our sample period. Then, we estimate dynamic RD-DiD analyses around new protected area borders that were established during our sample period. These analyses allow us to estimate the discontinuous shift in land values that occurs at the protected area border, to rule out any pre-existing differences in land values or other outcomes inside versus outside of protected area borders, and to trace the evolution of land values around these borders over time. We use the same empirical strategy to assess the effects of protected area policies on observed land development rates and to evaluate reduced development opportunities as a potential driver of the biodiversity protection discount.

[1] Buchanan and Tullock (1975) discuss the limitations of direct control measures such as land use restrictions. Keohane et al. (1998) rationalize such measures in the context of the U.S. political economy.

[2] See Kunming-Montreal Global Biodiversity Framework, signed by over 190 countries in December 2022.

[3] See, e.g., Weitzman (1992, 1993, 1998); Brock and Xepapadeas (2003); Harstad and Mideksa (2017); Harstad (2023); Heal and Pascual (2024) for a discussion of the economics of conservation.

To conduct our empirical analyses, we merge parcel-level data on vacant land values, transactions, and development outcomes between 2010 and 2020 from Corelogic with data on biodiversity protections from the USGS Protected Areas Database (PAD-US). The Corelogic database is compiled from county-level tax records and covers virtually all properties in the U.S. The PAD-US represents the official inventory of protected areas in the country. By combining these two data sources, we compile a unique, nationwide, annual panel data set that tracks exposure to biodiversity protections, vacant land values, transactions, and land development on the individual parcel level.

The main outcome of interest for our analyses is the value of vacant land from Corelogic. This value is derived from observed transactions, tax assessments, or appraisals based on recent sales of comparable properties. It represents Corelogic's best approximation of current market values. The key predictor in our tests is an indicator for properties located inside biodiversity-protected areas according to the PAD-US. We define protected areas as those with the highest conservation status, where permanent land use restrictions to prevent the conversion of natural land cover are in place.

Our baseline RD analyses within a 500 meter bandwidth around protected area borders indicate a 45% discount in the value of vacant land subject to biodiversity protections relative to the value of neighboring unprotected land. This estimate is robust to a variety of sub-sample tests, different bandwidths, and alternative specifications. The value effects we estimate are similar in magnitude to those of a 1.5 standard deviation increase in the land use restriction index examined in Turner et al. (2014). Our baseline RD design also allows us to estimate the external effects of protected area regulations on the values of unprotected land nearby. *Ex ante*, these external effects could be positive or negative. We find no evidence that proximity to protected area borders significantly affects the values of unprotected land nearby on average. This finding is consistent with the biodiversity protection discount being driven by the direct effects of these protections on the values of regulated properties.

Our dynamic RD analyses indicate near-zero effects of future biodiversity protections on the values of to-be-treated properties more than five years before protected area formation. We further estimate that a discount for to-be-treated properties first emerges several years prior to protected area formation. This estimate is consistent with anticipation effects reflecting the significant time typically required to establish protected areas in the U.S. The estimated effects approach the long-run 45% discount from our baseline analyses within five years of protected area formation, consistent with valuations in property markets responding to new information with some lag. A decomposition of the estimated biodiversity protection discount indicates that it is driven by a decline in the values of newly protected properties as opposed to an increase in those of unprotected control properties.

We can use our estimates of the biodiversity protection discount to quantify the economic costs of the underlying conservation policies. Notably, the average value per acre of control properties in our sample within 500 meters of protected area borders is $32,000. Applying this valuation to all protected land in this bandwidth yields a counterfactual aggregate value of $36 billion. Reducing this aggregate value by our 45% estimated biodiversity protection discount yields $16 billion. This result suggests that shifting protected area borders inward by 500 meters would result in a windfall gain of $16 billion. Under the assumption that this valuation can be applied to all the vacant land inside the protected areas in our sample, we estimate the economic costs of the protected areas in our sample to be $240 billion in lost land value. These cost estimates represent an important input into models estimating the value of biodiversity (Weitzman, 1993; Brock and Xepapadeas, 2003). However, a full welfare analysis may also need to include any supply effects of land use restrictions, as discussed in Turner et al. (2014).

The biodiversity protection discount we document aligns with the intuition that restricting land use reduces land values. However, it is somewhat surprising given prior evidence that biodiversity protections rarely have significant real effects (see, e.g., Grupp et al., 2023; Reynaert et al., 2024). Against this background, we examine the extent to which reductions in land development are a likely driver of the biodiversity protection discount. We measure land development using indicators for properties that switch classification from vacant land to, e.g., residential or non-residential property. We also examine other markers of development activity, such lot designations and access to sewers. Our baseline RD analyses indicate that biodiversity protections reduce the probability of development by 30%. We find qualitatively similar evidence across all development outcomes we study. Importantly, dynamic RD analyses again indicate no significant differences in the probability of to-be-treated land being developed more than five years prior to the formation of new protected areas.

We proceed by linking the evidence of reduced land development activity in protected areas to the estimated biodiversity protection discount. To establish this link, we condition our baseline RD analyses on measures of the extent of land development observed in protected areas. While development is rare in the typical protected area in our sample, the 90^{th} (95^{th}) percentile protected area sees 14% (53%) of vacant land developed over a given five-year period. Our analyses reveal a positive effect on protected land values of higher development rates in protected areas, offsetting the negative effect of biodiversity protections. These estimates indicate that the biodiversity protection discount is strongest in protected areas where development is most restricted. Our results suggest that reduced development opportunities are a key driver of the biodiversity protection discount.

We complete several heterogeneity tests that corroborate the evidence for restricted development opportunities as a key driver of the biodiversity protection discount. Specifically, we partition our sample based on several proxies for the scarcity of developable land in a location. The rationale underlying these tests is that the value effects of development restrictions should be larger in locations where developable land is more scarce. Consistent with this prior, we find that the biodiversity protection discount is largest in locations where land represents an above-median share of property values (see Davis et al., 2021) and where an above-median share of land is unavailable for development due to the local topography (see Lutz and Sand, 2023). Taken together, these results support our inference that reduced development opportunities drive the biodiversity protection discount.

Lastly, we explore the role of local political regimes in modulating the biodiversity protection discount. Prior work shows that Republicans are less concerned about environmental risks and less supportive of environmental policies (Dunlap and McCright, 2008; Konisky et al., 2008; Bernstein et al., 2022; Bisetti et al., 2022). Consistent with these findings, we estimate that the biodiversity protection discount is attenuated by 50% in counties with above-median Republican vote shares. Additional heterogeneity tests indicate that this attenuation is insensitive to conditioning on observed development rates in protected areas as a proxy for the enforcement of current regulations. These results suggest that the attenuation of the biodiversity protection discount in Republican-dominated counties is more likely driven by the belief that these protections are not permanent. Thus, restrictions to development opportunities and beliefs about political commitment to conservation efforts appear to be two important, but largely independent, drivers of the biodiversity protection discount.

Theoretical models of conservation require estimates of the costs of regulatory interventions to inform optimal policy design. Notably, Weitzman (1993) states: "If we knew the relative costs of specific projects [...] we would be well on our way to having an operational framework for selecting the most effective diversity-improving investment strategy from a global perspective." Weitzman (1998) develops a model of cost-effective biodiversity protection policies that takes the costs of such policies as an input. Our estimates of the biodiversity protection constitute a key component of these costs and thus facilitate optimal policy design. More recent theories of conservation seek to incorporate differing preferences over the scope of protection measures across political regimes (Harstad and Mideksa, 2017). Specifically, Harstad (2023) discusses how effective conservation requires repeated political commitment against threats of resource exploitation by lobbyists. We show that political regimes affect land owners' beliefs regarding local commitment to biodiversity protections. This finding underscores the importance of accounting for political regimes in models of conservation.

Our work also relates to the nascent literature on biodiversity finance (Karolyi and Tobin-de la Puente, 2023). Evidence is beginning to emerge on the pricing of biodiversity risk in equity and debt markets (see, e.g., Xin et al., 2023; Coqueret et al., 2024; Xiong, 2024).[4] Notably, Giglio et al. (2023) show that firms' exposure to physical and regulatory risks associated with biodiversity loss affects equity prices, while Chen et al. (2024) highlight the adverse effects of conservation policies on public financing costs. Garel et al. (2024) document that firms with a greater negative impact on biodiversity experience devaluations after environmental agreements proposing tighter biodiversity regulations. These results are consistent with the finding that regulatory uncertainty represents the most immediate climate-related risk investors perceive (Stroebel and Wurgler, 2021; Krueger et al., 2020). We extend this literature to the market for vacant land, which is arguably the asset class most directly impacted by common conservation policies. Although our work is more akin to traditional asset pricing studies in that we stop short of a welfare analysis, our estimates of the biodiversity protection discount are critical inputs into such analyses, including for instance Giglio et al. (2024) who model the costs and benefits to biodiversity conservation policy.

Viewed differently, our findings add to prior work on the effects of more general land use regulations on land values. For instance, Turner et al. (2014) document significant negative value effects of a land use restriction index that includes minimum lot sizes, permit waiting list times, and growth restrictions. More recently, Auffhammer et al. (2020) show how two specific endangered species protections affect land values. Our study extends this evidence to the topical and policy-relevant question of how the marginal current U.S. biodiversity restriction policy affects land values.

Our evidence that the biodiversity protection discount is driven in large part by reduced development opportunities is also novel and policy-relevant. This result, suggesting that the typical U.S. biodiversity protection is costly, may be viewed positively as biodiversity regulations have greater impact on environmental outcomes if they they target land that might otherwise be used for economic development (see, e.g., Grupp et al., 2023; Reynaert et al., 2024). No matter the interpretation, however, our estimates contribute to the body of work estimating the costs of global conservation (see, e.g., Deutz et al., 2020). Thus, our results inform the debate about trading off the economic value of land development with the ecological cost of reducing biodiversity (Giglio et al., 2024). Insight into this trade-off is especially important for attracting private capital towards financing biodiversity conservation and restoration efforts (Flammer et al., 2023).

[4] Existing evidence also documents impacts on other markets, such as those for labor (Ferris and Frank, 2021) and resource extraction rights (Bošković and Nøstbakken, 2017).

2 Biodiversity-Protected Areas in the U.S.

In this section, we describe the formation of biodiversity-protected areas in the U.S. Panel A of Figure 1 presents the current distribution of protected areas based on the USGS Protected Areas Database (PAD-US). The data show that protected areas cover 8% of the country's total area, in line with global average levels of protection (Jenkins et al., 2015).

[Insert Figure 1 about here.]

An intuitive driver of protected area formation is the presence of imperiled species. Panel B of Figure 1 depicts the distribution of imperiled biodiversity based on high-resolution habitat suitability analyses for over 2,200 endangered species by Hamilton et al. (2022). These analyses indicate that over 50% of the imperiled species studied are likely to occur inside biodiversity-protected areas, suggesting that at least some protected areas help conserve critical habitats. However, Hamilton et al. (2022) also show that areas of unprotected biodiversity importance cover 6% of the contiguous U.S., implying that existing biodiversity protections are insufficient. Moreover, Jenkins et al. (2015) find that many existing protected areas in the U.S. are not well suited for biodiversity conservation, indicating a mismatch between established protections and areas of high biodiversity importance.

This mismatch suggests that factors other than the presence of imperiled biodiversity may influence the formation of protected areas. One such factor is the ownership structure of the land, which affects the process by which protected areas can be created.[5] On publicly owned land, the formation of protected areas typically involves legislative action on the federal, state, or local level of government. Examples include Congress or State governments passing laws to establish National or State Parks, and local municipalities enacting zoning laws to create areas dedicated to biodiversity protection within their jurisdictions. However, 65% of unprotected biodiversity-relevant areas lie on private land (Clancy et al., 2020; Hamilton et al., 2022). A key tool for establishing biodiversity protections on private land is the conservation easement, often granted in return for tax benefits.[6] Such financial incentives are unlikely to affect our estimation of the biodiversity protection discount so long as the land values we observe are accurate. However, we do not observe the flow of any financial inducements to land owners. While an interesting question for future research, who pays for any biodiversity discount is not of first-order importance to estimating the presence of this discount.

[5] See taxonomy of biodiversity-protected areas in the U.S. as outlined by the USGS, accessed 09/25/2024.

[6] Conservation easements are voluntary, legally binding agreements between land owners and government agencies or private conservation organizations whereby the land owner commits to limiting land development or certain types of land use.

In sum, the presence of imperiled species represents an intuitive driver of protected area formation. However, the creation of protected areas typically involves some degree of government intervention. Thus, political regimes may also influence the extent of protected areas. Further, the need to negotiate conservation easements with private land owners suggests that public land ownership may further contribute to the extent of protected areas. To characterize the extent of current biodiversity protections in the U.S., we estimate a set of state-level regressions. Specifically, we regress the total protected area share in a state on measures of imperiled biodiversity, accounting for historical democratic vote shares and the share of publicly managed land. Table 1 presents the results. The estimates reported indicate that the extent of protected areas is positively correlated with the presence of imperiled species, but state-level political leanings are insignificant. While our estimates do not rule out political influences on conservation efforts, especially on the local level where referendums and ballot initiatives are common, they suggest that existing protections are at least associated with the presence of imperiled biodiversity. Consistent with our prior, we also find that the share of public land in a state is positively correlated with the extent of protected areas in that state.

[Insert Table 1 about here.]

The timeline for establishing biodiversity-protected areas in the U.S. varies but often takes many years.[7] For National Parks, Congress directs the Department of the Interior through legislation to undertake location analyses at proposed sites. These analyses are followed by the design of management plans, including public and expert consultations, culminating in Congress designating a new protected area. For instance, the New River Gorge was designated as a National River in 1978 before being established as a National Park in 2020 through the Consolidated Appropriations Act.[8] The process for establishing new state parks is typically somewhat shorter and more localized. For instance, the Kodachrome Basin State Park, Utah, was first studied by the National Geographic Society in 1948 and designated as a state park in 1962.[9] The timeline for creating conservation easements tends to be shorter than that for national or state parks but can vary depending on the complexity of the land ownership and negotiations with the owner.[10] The significant amount of time that is commonly involved in creating protected areas in the U.S. suggests that there may be anticipation effects of impending protected area formation on land values prior to the regulations taking effect. Importantly, we will be able to estimate the extent of such anticipation effects in our empirical analyses.

[7]See National Park Service System Plan (2017), accessed 09/26/2024.

[8]See New River Gorge is Now a National Park and Preserve, accessed 09/26/2024.

[9]See Kodachrome Basin State Park, accessed 09/26/2024.

[10]See U.S. Fish and Wildlife Service, Conservation Easement Handbook (2022).

3 Data Sources and Sample Construction

The principal data sets used in this study are sourced from Corelogic and the U.S. Geological Survey. Below, we describe each of these data sources in turn, outline how we construct the samples for our empirical analyses, and provide descriptive statistics on these samples.

3.1 Data Sources

Corelogic Property Data. Corelogic is a leading commercial data provider focused on the U.S. property market. The Corelogic database is compiled from county-level tax records and covers virtually all properties in the U.S. From this database, we obtain two data sets, namely, the Historical Property data set and the Owner Transfer data set.

The Historical Property data set contains detailed records on property characteristics. These characteristics include unique property identifiers (denoted as CLIP), land size in acres, county FIPS codes, and the spatial coordinates for the centroid of each property. They also include the calculated value of the property and the source of that information (e.g., appraisal or transaction). Further, Corelogic captures point-in-time indicators for land use and property type codes. We track changes in these codes to infer land development (e.g., a change from vacant land to residential or commercial property). Corelogic updates the records on property characteristics based on available county-level tax rolls at regular, usually annual, intervals. These updates are current as of the date on which the local tax assessor certifies the data refresh for a county. We observe historical characteristics for properties of all types based on updates certified between 2010 and 2020. We focus on properties whose records indicate that they are classified as vacant land at some point during that period. We carry forward the historical property characteristics for these properties until a more recent update becomes available. We thus construct a property-by-year panel data set over the 2010–2020 period.

The Owner Transfer data set contains transaction-level records including information on completion dates, transaction prices, as well as the identities of buyers and sellers. From this data set, we extract transactions of vacant land completed between 2010 and 2020. We drop pending records, retain only arms-length transactions, and focus on transactions recorded in regular deeds (i.e., not foreclosures or quit claims). We also drop properties that sold multiple times in the same year to avoid observations associated with land flipping. We merge these transaction records with the property characteristics panel described above using Corelogic's property identifiers (CLIP) and the completion year observed in the transaction records.

U.S. Geological Survey Protected Areas Data. The USGS Protected Areas Database (PAD-US) contains a set of state-level shape files describing the spatial boundaries and institutional characteristics of the biodiversity-protected areas in the U.S. We use PAD-US version 4.0, released in 2024. A review of the major changes between different versions of the PAD-US suggests that they mainly reflect improvements to the quality and quantity of information collected, rather than large-scale changes in the boundaries of existing protected areas. Such changes would introduce measurement error into our estimations, but this error would strictly attenuate any evidence of the biodiversity protection discount. Protected area characteristics in the PAD-US include the Gap Analysis Project (GAP) status of the protected area, the mechanism under which a protected area was established, the type of agency managing the area, the year in which the protected area was established, and the size of the area in acres. The GAP status is a measure of the conservation level of each area. Areas with GAP status 1 and 2 have permanent and legally enforceable protection from conversion of natural land cover, which restricts development in 95% of their total area.[11] In areas with GAP status 3, extractive uses are permitted, such as logging, mining, and recreational uses. Areas with GAP status 4 have no known mandate for biodiversity protection. We focus our analyses on protected areas with GAP status 1 and 2.

We merge the PAD-US protected areas data with the property characteristics panel based on the parcel-level coordinates included in the Corelogic data outlined above. For each parcel, we define an indicator that takes the value of one if the parcel-level coordinates are located within the boundaries of a protected area, and zero otherwise. For parcels located in any protected areas, we record the GAP status of the area containing the parcel. We then compute the distance from each set of parcel-level coordinates to the nearest protected area border. For parcels located inside a protected area with GAP status 1 or 2, this variable measures the distance to the nearest border of the protected area containing the parcel. For all other parcels, this variable measures the distance to the nearest border of a protected areas with GAP status 1 or 2 in the same state. For parcels located inside a protected area with GAP status 1 or 2 (all other parcels), we further merge in key characteristics of the area containing the parcel (of the nearest protected area with GAP status 1 or 2). The resulting data set allows us to determine whether a given property from the Corelogic characteristics panel is located in a protected area. It also allows us to observe the characteristics of the area containing the parcel (the nearest protected area with GAP status 1 or 2, respectively).

[11] In areas with GAP status 1, natural disturbance events like wildfires or native insect outbreaks are permitted to proceed without intervention. By contrast, such events are suppressed in areas with GAP status 2.

3.2 Sample Construction

We construct two samples based on the merged USGS-Corelogic property characteristics panel described above. First, we extract a double cross-section of vacant land observed in 2010 and 2015. We focus on land located within 500 meters of a protected area border, based on the distance between the centroid of the parcel and the nearest protected area border. To avoid measurement errors in the classification of land as located inside or outside protected area borders, we drop parcels within 31.8 meters of these borders. This threshold value represents the closest distance that the centroid of a square one-acre property can be to a protected area border without crossing that border. We further focus on land located around protected areas that were established before 2006. That is, we focus our analyses on protected areas that have been in place for at least five years prior to the first observation year in our sample. We drop observations with missing data on size and land smaller than 0.25 acres.

In this sample, we define *Treated* as an indicator that takes the value of one if the land is located inside a protected area with GAP status 1 or 2, and zero if it is not located in any protected area. *Value/Acre* is the calculated land value per acre (in $'000). For land observed in 2010 (2015), that is the average over the 2010–2014 period (the 2015–2019 period), winsorized at the 1st and 99th percentiles. *Acres* is the size of the land in 2010 (2015). *Developed* is an indicator that takes the value of one if a property is classified as vacant land in 2010 (2015) but is no longer classified as such by 2014 (2019). We define analogous development indicators for residential land (land use codes 460 and 465), namely, *Res. Dev.*, an indicator for residential development, *Res. Lot*, an indicator for land classified as a residential lot rather than acreage, and *Sewer*, an indicator for land with a sewer system present (sewer codes commercial, private, public, or septic). *Sold* is an indicator that takes the value of one if a property observed in 2010 (2015) appears in the transaction sample by 2014 (2019). *Distance* is the distance from the centroid of the parcel to the nearest protected area border in KM. We use the double cross-section of vacant land observed in 2010 and 2015 for our baseline regression discontinuity analyses of land values around existing protected areas.

We also construct an annual panel of vacant land observed between 2010 and 2020. In contrast to the double cross-section, we now focus on land located in the vicinity of protected areas that were established between 2010 and 2020. The other sample selection criteria follow those from the double cross-section. Variable definitions also follow those from the double cross-section, except we use annual, point-in-time observations. We use this annual panel in dynamic regression discontinuity analyses of land values around protected area borders newly created over the 2010–2020 period.

We further construct a sample of treated and control transactions of vacant land completed in the U.S. over the 2010–2020 period. Sample selection criteria and variable definitions again follow those from the double cross-section, except deal information is observed as of the time of the transaction and property characteristics are observed as of the year prior to the transaction. We focus on transactions completed after the nearest protected area (the protected area containing the parcel, respectively) was established. This transaction sample allows us to draw inferences about the biodiversity protection discount based on observed market prices for vacant land sold.

3.3 Descriptive Statistics

Table 2 presents summary statistics for the treated and control properties in the vacant land samples used in this study.[12] Panel A shows these statistics for the double cross-section of vacant land observed in the U.S. in 2010 and 2015. The statistics reported indicate that the mean value per acre for treated properties is lower than that for control properties ($20,840 versus $54,190). Treated properties are, on average, larger than control properties, less likely to be developed, and less likely to be sold. Panel B shows descriptive statistics for the annual panel of vacant land, computed over the time period after protected area borders are established. These statistics show similar trends to those in the double cross-section. The descriptive evidence presented here suggests that biodiversity protections have significant effects on property values, development outcomes, and other characteristics.

[Insert Table 2 about here.]

Table 3 presents summary statistics for the protected areas in our vacant land samples. Recall that the protected areas in the double cross-section are selected to have been created in or before 2005. By contrast, the protected areas in the annual panel are selected to have been created after 2010. Panel A (Panel B) presents descriptive statistics for the protected areas represented in the double cross-section (annual panel). The median protected area in the double cross-section contains 62 treated observations in a given year, is classified as GAP status 2, was established in 1992, and is nearly 3,000 acres in size. The median protected area in the annual panel contains 14 treated observations in a given year, is also classified as GAP status 2, was established in 2016, and is approximately 200 acres in size. See Appendix Table A.1 for the top-10 protected areas in our samples.

[Insert Table 3 about here.]

[12] Appendix Figure A.1 presents the breakdown of the sources of information for the land values in the Corelogic database. Additional descriptive statistics are reported in Appendix Figures A.2 and A.3.

Figure 2 presents a more detailed breakdown of the treated observations in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. Panel A shows that 21% (79%, respectively) of treated properties are located in protected areas with GAP status 1 (GAP status 2). Panel B indicates that the treated properties are mostly in protected areas established under fee ownership (65%). Panel C indicates that nearly half of the treated properties (44%) are located in protected areas managed by federal agencies. Panel D shows that 71% (29%, respectively) of treated properties are located in metropolitan areas (non-metropolitan areas).

[Insert Figure 2 about here.]

4 Identification Strategy

The main identification challenge we face resembles that in the broader literature on the value effects of land use regulations (Quigley and Rosenthal, 2005, see, e.g.,). For one, biodiversity protections may have direct effects on the values of regulated land and (potentially offsetting) external effects on the values of unregulated land nearby (Turner et al., 2014). Biodiversity protections may also be endogenously determined as a function of land values.[13] Simply put, land in protected areas may differ from land outside of such areas in ways that affect land values but are unobservable to researchers.

To address this identification challenge, we employ two types of regression discontinuity analyses (see, e.g. Hahn et al., 2001; Greenstone and Gayer, 2009). As a baseline, we compare the values of properties located within a narrow bandwidth around pre-existing protected area borders that are observed at the same time. These static RD analyses allow us to separate direct and external effects of biodiversity protections on the values of regulated and neighboring unprotected land. The close spatial matching at the center of this comparison helps us to ensure that treated and control properties are in locations of comparable quality. For instance, they should be equally exposed to environmental factors, which have been shown to affect property prices, including air quality, exposure to flood risk, and proximity to landfills (see Hite et al., 2001; Chay and Greenstone, 2005; Bernstein et al., 2019; Baldauf et al., 2020; Addoum et al., 2024). Second, we estimate dynamic RD analyses to trace land values around new protected area borders that are created during our sample period (see, e.g. Grembi et al., 2016, for a similar approach). These combined RD-DiD analyses allow us to rule out alternative explanations involving *ex-ante* selection effects that could bias our estimates.

[13] See, e.g., Siegan (1972), Ohls et al. (1974), Fischel (1990), Pogodzinski and Sass (1991), McMillen and McDonald (2002), and Ihlanfeldt (2007).

4.1 Baseline Regression Discontinuity Analyses

In our baseline RD analyses, we compare land values in the immediate vicinity of pre-existing protected area borders. Our goal is to isolate any discontinuous shift in land values when crossing a protected area border after accounting for a property's distance from that border. We implement our analyses using a Poisson pseudo-ML model to account for the skewness in the distribution of land values (see Appendix Figure B.1 and Cohn et al., 2022). Specifically, we estimate regressions of the following form in the double cross-section of vacant land observed in the U.S. in 2010 and 2015:

$$\begin{aligned} \mathit{Value/Acre}_{i,t} = \beta_0 + \beta_1 \mathit{Treated}_{i,t} + \beta_2 \mathit{Distance}_{i,t} + \beta_3 \mathit{Treated}_{i,t} \times \mathit{Distance}_{i,t} \\ + \beta_4 \mathit{Acres}_{i,t} + \beta_5 \mathit{Treated}_{i,t} \times \mathit{Acres}_{i,t} + \gamma_{a,t} + \epsilon_{i,t} \end{aligned} \quad (1)$$

where *Value/Acre* is the land value per acre of property i observed in year t in \$'000. For properties observed in 2010, that value is the average calculated value per acre over the 2010–2014 period. For properties observed in 2015, that value is the average calculated value per acre over the 2015–2019 period. *Treated* is an indicator that takes the value of one if the vacant land is located inside a protected area with GAP status 1 or 2, and zero if it is not located in any protected area. *Distance* is the distance from the centroid of the vacant land to the nearest protected area border. For treated properties, this variable measures the distance to the nearest border of the protected area containing the property. For control properties, this variable measures the distance to the nearest border of the surrounding protected areas with GAP status 1 or 2 in the same state. Given the differences in the average size of treated and control properties in the double cross-section (see Panel A of Table 2), we include covariates for property size (*Acres*) and the interaction between property size and the treatment indicator (*Treated*). *Acres* is the size of the vacant land in acres in 2010 (respectively, 2015). Thus, β_1 captures the effect of biodiversity protections on small properties located directly by the protected area border. We include protected area-by-year fixed effects (γ) in our estimations. These structures ensure that our treatment effect is identified based on variation in land values near the same protected area border, in the same year. Standard errors are clustered by protected area.

In alternative specifications, we augment Eq. (1) with higher-order polynomial controls for *Distance* and interactions between these controls and the *Treated* indicator (see, e.g., Cattaneo and Titiunik, 2022). For robustness, we also estimate Eq. (1) using using different bandwidths ranging from 100 meters to 500 meters from protected area borders and in the sub-sample of vacant land transactions described in Section 3.

4.2 Dynamic Regression Discontinuity Analyses

In our baseline analyses described above, we restrict the sample to properties around the borders of protected areas that have been in place since at least 2005. This framework does not allow us to test the assumption of continuity in property characteristics at the protected area border, as any differences in characteristics may be a result of the biodiversity protections that we study. To assess the extent to which to-be-treated and to-be-control properties discontinuously differ at the border of a yet unformed protected area, we employ dynamic regression discontinuity analyses. Specifically, we estimate regressions of the following form in the annual panel of vacant land around newly established protected areas observed between 2010 and 2020:

$$\begin{aligned} \mathit{Value/Acre}_{i,t} &= \beta_0 + \beta_1 \mathit{Treated}_{i,t} + \beta_2 \mathit{Treated} \times \mathit{4\text{-}0\ Yrs.\ Pre}_{i,t} \\ &+ \beta_3 \mathit{Treated} \times \mathit{1\text{-}5\ Yrs.\ Post}_{i,t} + \beta_4 \mathit{Covariates}_{i,t} + \gamma_{a,t} + \epsilon_{i,t} \end{aligned} \tag{2}$$

where all variables and notation are as in Eq. (1), except that *Treated* is an indicator that takes the value of one for vacant land that is treated in future, that is, land located where a protected area with GAP status 1 or 2 is later established. *4-0 Yrs. Pre* is an indicator that takes the value of one at times between four and zero years before the formation of the nearest protected area. *1-5 Yrs. Post* is an indicator that takes the value of one at times between one and five years after the formation of the nearest protected area. We further include interactions between *Treated* and indicators for the number of years before or after the protected area is created. Thus, the coefficient on the *Treated* indicator captures the differential value of to-be-treated properties five and more years before the formation of the protected area, while the interaction terms indicate how this differential changes over time. Covariates for *Distance* and *Acres* as well as fixed effects for protected area-by-year are included as in Eq. (1). Standard errors are clustered by protected area.[14]

Note that Eq. (2) is different from a staggered difference-in-differences analysis. The inclusion of protected area-by-year fixed effects creates homogeneous cohorts with a single treatment date. However, given the lengthy procedures for establishing protected areas in the U.S. (see Section 2), each protected area treatment will likely be anticipated in advance to varying degrees. Lastly, each protected area in our sample contributes observations for different time periods relative to its formation (see Appendix Figure C.1 for the distribution of observations in our sample by event year).

[14] In unreported regressions, we include interaction terms between the timing indicators from Eq. (2) and all covariates. These alternative estimations produce very similar results to those reported in the text.

4.3 Illustration and Validation of Regression Discontinuity Design

We illustrate the regression discontinuity design outlined above by plotting the locations of example properties from our estimation samples. We focus on properties in California as it is in the top-three most frequently observed states in our baseline and dynamic regression discontinuity samples. Figure 3 presents the resulting maps. Panel A (Panel B) illustrates examples of treated and control properties around the borders of a protected area in our baseline (dynamic) regression discontinuity sample. In both panels, the light green shading around the protected area border indicates a 500 meter bandwidth. The red (black) markers indicate the locations of treated (control) properties within this bandwidth. The close spatial matching of treated and control properties around protected area borders illustrates the strength of the RD empirical design which is its focus on comparing land values in the immediate vicinity of these borders, and observed at the same time.

[Insert Figure 3 about here.]

One important requirement for the validity of the RD design is that property characteristics do not change discontinuously at the border. To test this assumption, we estimate Eq. (1) in the annual panel of vacant land observed in the U.S. between 2010 and 2020. We repeat this estimation for each of the variables included in our study and restrict the regression sample to the period at least five years prior to the formation of a given protected area. The results reported in Table 4 show that there is no discontinuity in land values, property sizes, or development markers at the borders before the protected areas are established.

[Insert Table 4 about here.]

Another key requirement for the validity of the RD design is that there is no deliberate manipulation of properties being selected into protected areas at the border. As we show in Section 2, the extent of protected areas in place is driven by the presence of imperiled biodiversity rather than, for instance, local political preferences. However, to test this assumption behind our RD design more formally, we implement the threshold manipulation test proposed in Cattaneo et al. (2020). The results depicted in Figure 4 show that there is no significant difference in the density of properties' distance from protected area borders at these borders in the first year after the protected areas are established. We fail to reject the null hypothesis of no discontinuity at the border (robust p-value 0.75).

[Insert Figure 4 about here.]

5 Biodiversity Protections and Land Values

In this section, we present the results from estimating the effects of biodiversity protections on land values based on the identification strategy outlined above. Critically, the effects we document constitute—to our knowledge—the first estimates of the biodiversity protection discount on the level of individual asset values derived from quasi-experimental methods in the literature. Our estimates help inform the debate about the economic effects of land use restrictions for the protection of biodiversity and provide insight into the trade-offs accompanying such policies.

5.1 Results from Baseline Regression Discontinuity Analyses

Table 5 presents the results from estimating Eq. (1) across the treated and control properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. The dependent variable is the calculated value per acre of vacant land in $'000. All estimations tabulated include protected area-by-year fixed effects. The results shown across the different columns of Table 5 vary by estimation bandwidth around protected area borders and by the set of (higher-order polynomial) control variables for the distance between a property and the nearest protected area border. Due to these control variables, the estimates on the *Treated* indicator represent the discontinuous change in land values when crossing protected area borders.

[Insert Table 5 about here.]

The estimates reported in column 1 indicate a 45% discount in the value of vacant land subject to biodiversity protections relative to that of unprotected control properties. This estimate is derived from a specification with a 0.5 KM bandwidth around protected area borders and up to cubic controls for distance from the border. The estimates in column 2 indicate a comparable discount of 48% when accounting for linear distance controls instead. The results reported in column 3 further corroborate the estimated discount when limiting the estimation to a narrower bandwidth of 0.2 KM around protected area borders. Notably, the estimated discounts are somewhat smaller than, but similar to, the approximately 60% unconditional difference in average land values per acre reported in Table 2. As a point of reference, the land value discounts we document are similar in magnitude to those of a 1.5 standard deviation increase in a land use restriction index analyzed in Turner et al. (2014), which aggregates local development restrictions such as permit waiting times, growth restrictions, or minimum lot size requirements.

The coefficient estimates on *Distance* in columns 2 and 3 capture the external effects of land use restrictions on the values of neighboring unregulated land, e.g., due to changes in upkeep or development of restricted land (Turner et al., 2014). We find little evidence of such external effects on average. Taking the largest coefficient of 0.26 in column 3 and multiplying it by 0.2 KM suggests a 13% value increase for a control property at the far end of the estimation bandwidth compared to one right at the border. Thus, such external effects seem small relative to the shift in land values at the border.

5.2 Robustness Tests for Baseline Analyses

We conduct several additional tests to ensure that our findings are not driven by specific empirical design choices or undesired features of the institutional setting. First, we examine the robustness of our estimates to variation in bandwidth restrictions between 100 and 500 meters from protected area borders. The patterns depicted in Figure 5 show that, despite large increases in the number of observations as the bandwidth expands, the coefficient estimates on the *Treated* indicators are similar to those from our baseline regressions (see Table 5) and corroborate our main inferences.

[Insert Figure 5 about here.]

Second, we re-estimate Eq. (1) in a regular OLS model replacing the dependent variable with the natural logarithm of the value per acre. The corresponding regression results are shown in columns 1 and 2 of Table 6. We also re-estimate Eq. (1) with protected area-by-year-by-land use fixed effects to account for heterogeneous treatment effects depending on land use (see columns 3 and 4). We further re-estimate Eq. (1) weighting sample observations by the inverse of the number of observations in a given protected area so as not to over-emphasize the estimation results from areas with a large number of properties around them (see columns 5 and 6). Further, we replicate our baseline estimation in the sub-sample of vacant land transactions using the transaction price per acre as the dependent variable (see columns 7 and 8). Given the smaller size of the transaction sample, we include county-by-year-by-land use fixed effects in these estimations.[15] In sum, the estimates from all our robustness tests are fully consistent with our main inferences.[16]

[Insert Table 6 about here.]

[15] The results reported in Appendix Table D.1 show that biodiversity protections significantly reduce the liquidity of vacant land within protected area borders.

[16] Unreported tests additionally indicate that the size of a protected area has little effect on our findings, which are qualitatively similar after excluding the 10% largest or smallest protected areas measured either by the number of properties in our sample or by the total acreage of the area.

5.3 Results from Dynamic Regression Discontinuity Analyses

We dig deeper into the evidence for a biodiversity protection discount in the market for vacant land using dynamic regression discontinuity analyses around protected area borders that are newly established during our sample period. Table 7 presents the results from estimating the dynamic regression discontinuity model from Eq. (2) in the annual panel of vacant land observed in the U.S. between 2010 and 2020. The dependent variable is the value per acre of vacant land. The results shown across the different columns of Table 7 vary by the sets of fixed effects included in the estimations. All estimations tabulated are for a 0.5 KM bandwidth around protected area borders and include up to third-order polynomial controls for a property's distance to the nearest protected area border.

[Insert Table 7 about here.]

Across all three columns of Table 7, the coefficient estimate on the *Treated* indicator is statistically insignificant. The economic magnitude of the estimated effects is also small, ranging from 4% to 8% depending on the specification. Thus, our estimates indicate no significant differences in the values of to-be-treated properties in the five to nine years prior to a protected area's formation. This finding provides some comfort that protected areas are not created on *ex-ante* less valuable land.

The coefficient estimates on the interaction terms between the *Treated* indicator and the *4-0 Years Pre* indicator reported in Table 7 indicate that a significant discount for to-be-treated properties emerges four years prior to the formation of a protected area. The economic magnitude of the estimated effects is also significant, ranging from 19% to 21% depending on the specification. Recall that the process for establishing new protected areas typically takes several years (see Section 2). Thus, the evidence we present for land values beginning to trend down as the treatment date approaches is consistent with significant anticipation effects among land owners.

Importantly, the coefficient estimates on the interaction terms between the *Treated* indicator and the *1-5 Years Post* indicator reported in Table 7 indicate a statistically significant discount for treated properties after a protected area is formed. The economic magnitude of the estimated effects is highly significant, reaching between 34% and 38% depending on the specification. These estimates are consistent with a significant biodiversity protection discount in the market for vacant land.

In sum, the evidence presented in Table 7 indicates no significant discount for to-be-treated properties several years prior to protected area formation. However, a notable discount emerges as adoption approaches and rises sharply after protected areas are established. These data patterns are consistent with a causal effect of biodiversity protections on the value of vacant land.

Note that the estimation results reported in column 1 of Table 7 include protected area-by-year interacted fixed effects. Thus, the coefficient estimates in column 1 capture the extent to which a relative value wedge appears between treated and control properties. By contrast, the estimates shown in columns 2 and 3 do not include such interacted fixed effects. Therefore, the results reported in these columns allow us to attribute the observed value wedge to reductions in the values of treated properties versus uplifts in the values of control properties. Notably, the estimates in column 2 suggest that, after the including separate fixed effects for protected area and observation year, virtually the entire discount is driven by declines in treated property values.

Figure 6 presents year-by-year estimates derived from the estimation results shown in Table 7. In each panel, the horizontal axis represents event time relative to protected area formation, and the vertical axis indicates the value differential at a given event time relative to an untreated property nine years before protected area formation. The estimates depicted in Panel A (respectively, Panel B) are derived from the estimations reported in column 1 (column 2) of Table 7.

[Insert Figure 6 about here.]

Panel A shows that the estimated value difference between to-be-protected properties and control properties remains almost exactly zero until about two years before protected area formation. By five years after protected area formation, the estimated value difference is very similar to the 45% long-run discount that we report in Table 5. The dynamics of treated property values presented in Panel B closely match those of the overall value wedge illustrated in Panel A. In contrast, we find virtually no change in the values of control properties in the fifteen years surrounding protected area formation.

In sum, the data patterns depicted in Figure 6 are consistent with (1) investors, assessors, and land owners updating their beliefs regarding the introduction of protected areas as the treatment date approaches, and (2) calculated land values updating with a lag as new appraisals and comparable sales data become available. By contrast, the evidence presented fails to support an alternative explanation whereby the biodiversity protection discount is driven by *ex-ante* lower land values inside protected areas. In particular, omitted variables would have to explain why property values just inside to-be-protected area borders decline by almost 50% around protected area formation. Thus, while we cannot rule out omitted variables contributing to the observed discount to some degree, a causal effect of biodiversity protections on land values is likely the predominant driver of our results.

5.4 Discussion

The estimation results presented above can be used to inform discussions about the economic costs of biodiversity protections. Specifically, we can quantify the impact of biodiversity protections on aggregate land values in the U.S. using counterfactual valuations derived from our estimation results.

First, we focus on the value of land in our sample within 500 meters of protected area borders. The average value per acre of *unprotected* land in this selection is $32,000. In the absence of any biodiversity protection discount, *protected* land in this selection should have the same value per acre. Applying $32,000 per acre to the 1.9 million acres of protected land in this selection yields a counterfactual aggregate value of $36 billion. Reducing this aggregate value by our 45% estimated biodiversity protection discount yields $16 billion. This result suggests that shifting protected area borders inward by 500 meters would result in a windfall gain of $16 billion. However, this estimate is likely low as it is restricted to the protected land in our sample within 500 meters of protected area borders.

Under the assumption that the $32,000 valuation can be applied to all land inside the protected areas in our sample, we can expand our calculations. The total amount of land inside these protected areas is 47 million acres. Applying $32,000 per acre to this total yields a counterfactual aggregate value of $533 billion. Discounting this aggregate value by 45% suggests that the economic cost of the protected areas in our sample totals $240 billion in lost land value in aggregate.

The biodiversity protection discount we estimate represents an important input for assessing the welfare implications of conservation policies. A large theoretical literature discusses various ways to estimate the benefits to biodiversity. For example, Brock and Xepapadeas (2003) proposes a dynamic welfare measure that extends the more traditional benefit-cost and genetic distance / phylogenic tree approaches used in studies such as Weitzman (1992, 1993). The effective use of either of these approaches requires an estimate of the costs to biodiversity protections. Weitzman (1993) explicitly states the importance of measuring the costs of biodiversity protections in the cost-benefit approach, where our cost estimates should be embedded in the Bellman equation used to estimate the dynamic value of biodiversity. Like Turner et al. (2014), our econometric technique does not allow us to identify overall supply effects. Turner et al. (2014) assume that such supply effects are not relevant to welfare analyses. The large discounts we observe are consistent with this assumption, since they suggest that protected land has features that are not easily replicated elsewhere in the local economy. In the following section, we examine this conjecture more directly by studying whether the biodiversity protection discount is driven by a reduction in land development opportunities.

6 Development and the Biodiversity Protection Discount

The value of vacant land is driven by the present value of future cash flows, which are often generated from development. Since biodiversity protections restrict land use, reduced development opportunities represent an intuitive potential driver of the discount we document. However, Grupp et al. (2023) find that biodiversity protections have little effect on land development overall (see also Joppa and Pfaff, 2009). Further, it is unclear whether the biodiversity protections in our study alter development outcomes over the course of our sample period. Conservation efforts are typically implemented over many decades (see, e.g., Pimm et al., 2014). For instance, the Post-2020 Global Biodiversity Framework Working Group highlights conservation goals for 2050 and beyond (Tsioumani, 2020). Long-run conservation goals may not materially affect development in the short term. Especially given evidence of very low long-run discount rates (see, e.g., Giglio et al., 2015), it is possible that reduced development opportunities far in the future, rather than development outcomes that we can observe during our sample period, are the primary driver of the discount we document.

We study the link between the biodiversity protection discount and observed development in two main ways. First, we test whether these protections reduce the observed likelihood of development. Then, we test whether the biodiversity protection discount is modulated by the extent of land development that is observed inside protected areas.

6.1 Effects of Biodiversity Protections on Development

To assess the effect of biodiversity protections on the likelihood of development, we estimate Eq. (1) as a linear probability model in our double cross-section. We replace the dependent variable with *Developed*, an indicator that takes the value of one if a property classified as vacant land in 2010 (respectively, 2015) is no longer classified as such by 2014 (respectively, 2019). Table 8 presents the results.

[Insert Table 8 about here.]

The estimates reported in columns 1 through 3 indicate that biodiversity protections significantly reduce the probability of land development. Depending on the specification, we find a 3.1 to 3.6 percentage point decline in the likelihood of development. These estimates correspond to an approximately 30% reduction in development rates relative to the unconditional mean of this variable. Our findings imply that the presence of biodiversity-protected areas has real effects on land use and observed land development patterns.

We corroborate the evidence for the effects of biodiversity protections on observed development by assessing additional indicators of development activity. In these analyses, we focus on residential land since residential development accounts for nearly two-thirds of the total development we observe. Residential land in our sample is any property with land use code 460 or 465. Column 4 of Table 8 shows that biodiversity protections predict a 4.3 percentage point (or c. 38%) decline in the probability of residential land being developed. Columns 5 and 6 show that this development reduction manifests in other key indicators, such as a reduced probability of land being classified as a residential lot (as opposed to acreage) and the presence of a sewer system. These findings support the inference that the biodiversity-protected areas in the double cross-section, all of which have been created in or before 2005, impact observed development rates during the 2010–2020 sample period.

We also replicate our dynamic regression discontinuity analyses for the development indicators shown in Table 8. To that end, we re-estimate the regression specification from Eq. (2) as a linear probability model in the annual panel of vacant land observed in the U.S. between 2010 and 2020. These analyses allow us to assess the evidence for pre-existing differences in land development rates prior to the creation of protected areas. They further allow us to document any immediate impact of newly created protected areas on observed development rates. Table 9 presents the results.

[Insert Table 9 about here.]

The estimates reported across the four columns in Table 9 indicate consistent patterns in observed development rates around the introduction of new protected areas. First, we find no evidence for significant differences in annual development rates between to-be-treated properties and control properties more than five years prior to the introduction of new protected areas. Second, we detect reduced development rates for to-be-treated land in the five years preceding the introduction of new protected areas, consistent with the anticipation effects from the value analyses reported in Table 7. These effects are statistically and economically significant for the development of residential land (see columns 2 through 4). Further, the estimates reported indicate a sharp drop in observed development rates in the five years following the introduction of new protected areas. Again, these effects are statistically and economically significant for residential development. The dynamic estimation results presented here are fully consistent with the observed land value patterns reported in Section 5.3. In sum, the findings discussed in this section indicate that biodiversity protections have immediate economic effects on development rates of vacant land in the U.S.

6.2 Linking the Biodiversity Protection Discount to Development

The results presented in Tables 8 and 9 suggest that reduced development is an important mechanism through which biodiversity protections affect land values. We further examine the merits of this explanation by constructing two variables that reflect the extent of development around protected area borders. We define *Treated Development* as the mean rate of development inside the nearest protected area within 500 meters of the area border over the 2010–2014 period and over the 2015–2019 period, respectively. Analogously, we define *Control Development* as the corresponding mean rate of development outside the nearest protected area within 500 meters of the area border.[17]

If the biodiversity protection discount is driven by reduced current development opportunities, then we expect this discount to be attenuated in areas that experience relatively more development. To test this conjecture, we again estimate Eq. (1) across the treated and control properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. However, we augment the regression specifications with interaction terms between *Treated* and *Treated Development* as well as *Treated* and *Control Development*. Table Table 10 presents the results.

[Insert Table 10 about here.]

The estimates reported across the columns of Table 10 indicate that the interaction terms between *Treated* and *Treated Development* are associated with higher land values. These results suggest that the biodiversity protection discount is driven by reduced development opportunities in protected areas. Notably, our estimates indicate biodiversity protection discounts of 20% to 30% of land values even at the 95^{th} percentile value of *Treated Development*. These results imply that a significant biodiversity protection discount persists even when some development inside protected areas is permitted. This persistence in the biodiversity protection discount likely reflects increased compliance or mitigation costs for any development projects that are allowed to proceed inside protected areas.

In sum, the estimation results we report indicate that typical biodiversity protections in the U.S. have significant and immediate effects on land values and impact observed development patterns. Moreover, we present evidence showing that these two findings are linked. Our findings imply that reduced development opportunities represent an important driver of the biodiversity protection discount in the market for vacant land in the U.S.

[17] The median treated property in our sample is in a protected area that exhibits zero *Treated Development* over a given five-year period. The 90^{th} (95^{th}) percentile property is in an area with 14% (53%) *Treated Development*. By contrast, the median control property is located around a protected area with 4.5% *Control Development*, whereas the 90^{th} (95^{th}) percentile property is near an area with 26% (43%) *Control Development*.

7 Heterogeneity in the Biodiversity Protection Discount

In this section, we assess potential heterogeneity in the biodiversity protection discount. These analyses provide additional evidence on the economic mechanisms driving the observed data patterns.

7.1 Heterogeneity by Local Land Scarcity

We explore heterogeneity based on the scarcity of developable land to shed further light on the extent to which development opportunities drive the biodiversity discount. If restrictions to development opportunities are a key driver of the biodiversity protection discount, we expect this discount to be larger in locations that have less developable land. We proxy for land scarcity using indicators for locations (i) where land represents an above- vs. below-median share of property values, (ii) that have above- vs. below-median shares of developable land as a function of their topography, (iii) that are classified as metropolitan vs. non-metropolitan areas, and (iv) that feature above- vs. below-median strictness of land use regulations. The data on land shares are from the FHFA as of 2012 (see Davis et al., 2021). The data on land unavailability are from Lutz and Sand (2023) and represent a highly disaggregated refinement of the measure proposed in Saiz (2010). The data for metropolitan area status are from the U.S. Census Bureau as of 2010. The data on land use regulations are from the Wharton Residential Land Use Regulatory Index as of 2008 (see Gyourko et al., 2008). We re-estimate Eq. (1) across the treated and control properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015, partitioned along the location characteristics outlined above. Table 11 presents the results.

[Insert Table 11 about here.]

The estimates reported in columns 1 and 2 indicate that the biodiversity protection discount is concentrated in locations where land represents a larger share of property values. While a higher land share may be correlated with greater land scarcity, it is endogenously determined. The estimates in columns 3 and 4 indicate that the biodiversity protection discount is also concentrated in locations with lower land availability as a function of their topography. This measure is arguably a more exogenous indicator of land scarcity (see, e.g., Lutz and Sand, 2023). Both sets of estimates suggest that the availability of developable land in a location modulates the biodiversity protection discount. Thus, the results presented in columns 1 through 4 corroborate our inferences that current development opportunities are a key driver of the biodiversity protection discount we document.

The estimates reported in columns 5 and 6 of Table 11 indicate that the biodiversity protection discount persists across metropolitan and non-metropolitan areas. However, the estimates reported also indicate significant differences in the external effects of biodiversity protections across these location types. Specifically, we find that these effects are concentrated in metropolitan areas, where the values of control properties increase in the distance from protected area borders. Our analyses reveal similar patterns across locations with high vs. low land use regulations (see columns 7 and 8). Again, we find that the biodiversity protection discount persists across both location types, but external effects are concentrated in locations with high levels of regulation. In sum, the results reported in columns 5 through 8 suggest that external effects of biodiversity protections are stronger in denser, more tightly regulated locations where land development is arguably more difficult.

7.2 Heterogeneity by Local Political Regimes

In our second set of heterogeneity tests, we study how the biodiversity protection discount relates to local political regimes. These analyses are motivated by the link between optimal conservation policy and political regimes discussed in Harstad and Mideksa (2017) and Harstad (2023). One conclusion from this discussion is that conservation requires repeated political commitment to ward off the threat of exploitation, which need only occur once to deplete resources or destroy habitat. The resulting requirement of constantly renewing political commitment to conservation suggests that land owners form expectations about the future existence of conservation policies. The discussion in in Harstad and Mideksa (2017) and Harstad (2023) suggests that these expectations may be a function of the prevailing political regime. Specifically, we draw on a large body of work indicating that Republicans are less concerned about environmental risks and therefore less supportive of environmental policies (see, e.g., Dunlap and McCright, 2008; Konisky et al., 2008; Bernstein et al., 2022; Bisetti et al., 2022). Against this background, we expect that the biodiversity protection discount will be smaller in Republican-dominated areas.

To test this conjecture, we define Republican-dominated areas on the county-level using the share of Republican votes in the 2012 presidential election (denoted *Rep. (%)*). Alternatively, we define an indicator for counties with above-median Republican vote shares in this election (denoted *Rep.Ind.*). We then re-estimate (1) in the double cross-section of vacant land observed in the U.S. in 2010 and 2015, conditioning on Republican vote shares as outlined above. Table 12 presents the results.

[Insert Table 12 about here.]

The coefficient estimate on *Treated* in column 1 indicates a 57% biodiversity protection discount in Democratic-dominated counties. The estimate on the interaction term in this column indicates that the discount is only half as large in Republican-dominated counties. The estimates in column 2 corroborate these results. The coefficient on *Treated* in this column corresponds to an 80% discount in a hypothetical county with 100% Democratic votes. By contrast, the coefficient on the interaction term between *Treated* and *Rep. (%)* indicates that there is no significant discount in a hypothetical county with 100% Republican votes. Columns 3 and 4 present sub-sample analyses across counties with above- versus below-median Republican support. We observe a significant discount in both sub-samples, but the coefficient on *Treated* is smaller and only marginally significant in Republican-dominated counties. In sum, these results are consistent with our prior that local political regimes affect the biodiversity protection discount.

In column 5, we test whether the effect of local political regimes on the biodiversity protection discount is related to protected area ownership. Specifically, we expect the influence of local political regimes to attenuate when protected areas are not government-owned. We test this conjecture by introducing a triple interaction between *Treated*, *Rep.Ind.*, and an indicator for non-government ownership (*Non-Govt. Own.*).[18] Consistent with our prior, we find that this interaction is significantly negative. The magnitude of the coefficient estimate suggests that county-level politics have no significant effect on the biodiversity protection discount surrounding the 25% of protected areas owned by private or non-governmental entities. For the other 75% of protected areas, which are owned by government entities, political regimes significantly predict the discount. The estimated discount around government-owned areas in Democratic (Republican) counties is approximately 56% (25%).

Our results thus far indicate that development opportunities and political regimes determine the biodiversity protection environment. Next, we study the extent to which these two factors are related. To that end, we augment our regressions with *Treated Development* and *Control Development* from Table 10. In column 6 of Table 12, we include the interaction between Treated and these additional variables. The corresponding coefficient estimates show that the effect of political regimes on the biodiversity protection discount is virtually unchanged after the inclusion of these control variables. The development covariates themselves also continue to significantly predict the biodiversity discount with similar magnitudes to those estimated in Table 10.

[18] Non-government ownership includes private and NGO owners. Other forms of ownership are local, state, federal, or district (i.e., regional) government ownership, as well as designated protected areas. The results are similar whether or not we include the 3% of areas with unknown ownership structures as control units.

Our results suggest that while development opportunities and political regimes predict the biodiversity discount, these two drivers appear to be largely independent of each other. This result would not be expected if the effect of political regimes on the biodiversity discount was driven primarily by differences in the current enforcement of existing biodiversity protections. Our findings are more consistent with the interplay between political regimes and the biodiversity protection discount being due to variation in land owners' expectations about the longevity of biodiversity protections.

8 Conclusion

Biodiversity loss is increasingly recognized as a significant risk to the global economy. Given that land use changes represent a key driver of biodiversity loss, many nations have responded to this risk with local land use restrictions designed to conserve biodiversity. In the U.S., approximately 8% of land is located in biodiversity-protected areas, which significantly restrict permitted land use. Yet, the academic literature lacks clean estimates of how these biodiversity protections affect land values. Such estimates are essential for designing optimal conservation policy.

We provide novel evidence on how U.S. biodiversity protections impact land values and development. We document an average biodiversity protection discount of 45%, with little evidence of external effects on neighboring unprotected properties on average. This discount is accompanied by reduced development in biodiversity-protected areas and it is strongest (1) in protected areas where land development is least likely to occur, (2) in locations where developable land is more scarce, and (3) in counties where land owners expect repeated political commitment to conservation.

Our estimates contribute to the growing body of research studying the costs of preserving and restoring global biodiversity. These costs need to be weighed against the benefits of protecting and restoring biodiversity to determine optimal conservation policies. The costs of biodiversity protections that we document in terms of reduced asset values in the U.S. market for vacant land represent an important input to understanding the economic trade-offs involved in conservation efforts.

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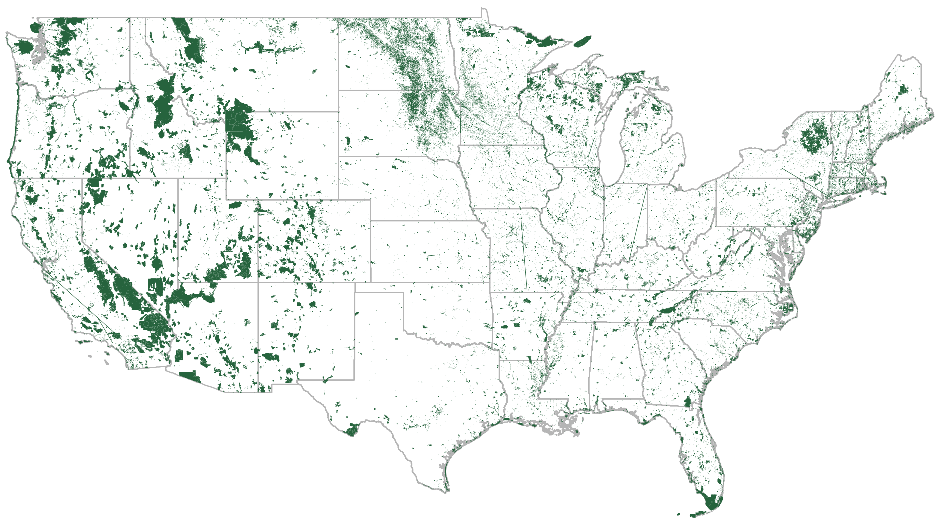
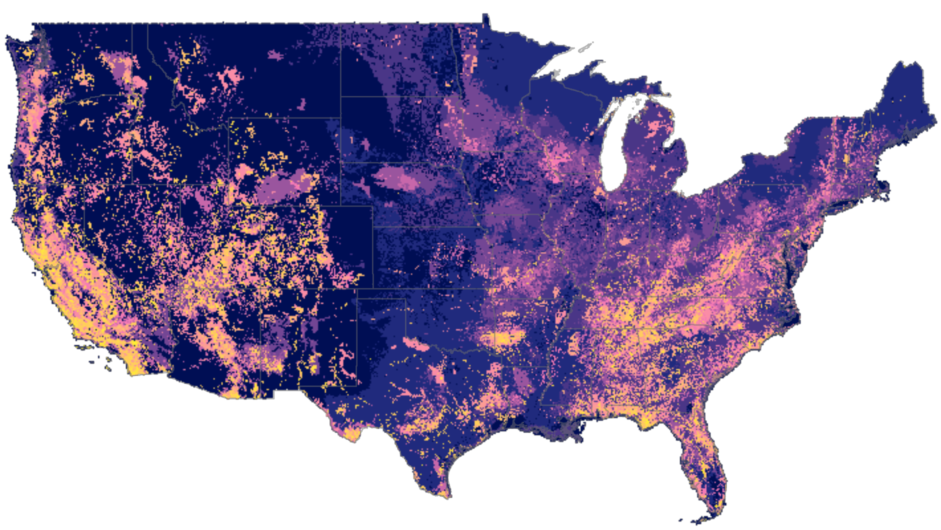
Figure 1. Biodiversity Protections and Imperiled Species Habitats in the U.S.

This figure presents the spatial distribution of biodiversity-protected areas and imperiled species habitats in the contiguous U.S. Panel A shows the geographic extent of protected areas based on the USGS Protected Areas Database as of 2024 (PAD-US 4.0). Dark green shading indicates areas with permanent biodiversity protections in place (those with GAP status 1 and 2). Panel B shows the spatial concentration of imperiled species and their habitats based on high-resolution habitat suitability analyses for over 2,200 endangered species including vertebrates, vascular plants, freshwater invertebrates, and pollinators as of 2018 from Hamilton et al. (2022). Lighter (yellow) shading indicates a higher concentration of imperiled species. The data used to produce this figure are from NatureServe/ESRI, the USGS, and the U.S. Census Bureau.



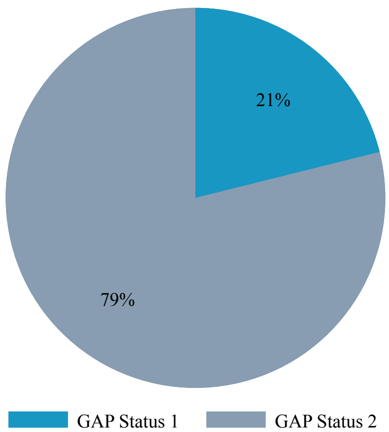
(A) Distribution of Protected Areas



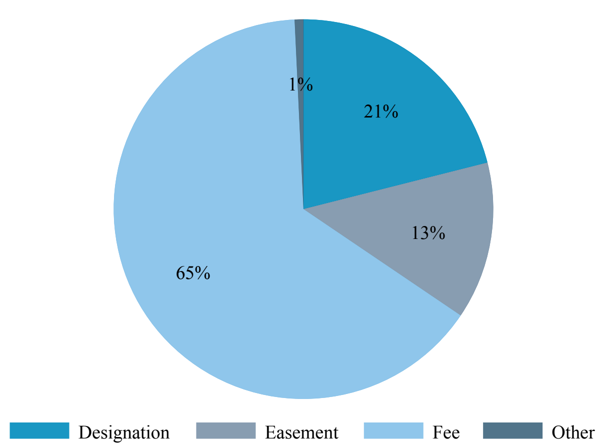
(B) Concentration of Imperiled Species

Figure 2. Sample Distribution of Treated Properties

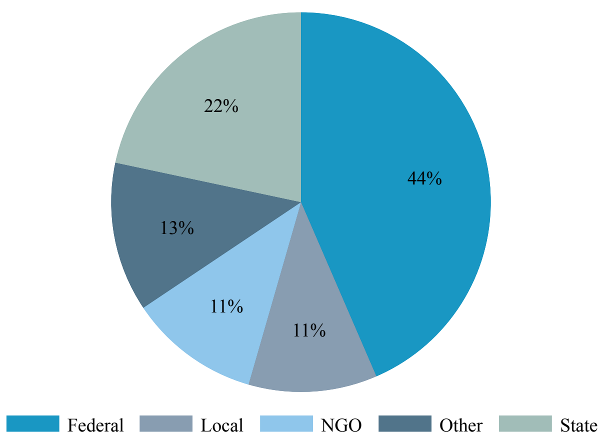
This figure depicts the breakdown of the treated properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015 by GAP status (Panel A), mechanism of protected area establishment (Panel B), protected area management type (Panel C), and location type (Panel D). Treated properties are those located inside a protected area with GAP status 1 or 2. The data used to produce this figure are from Corelogic, the USGS, and the U.S. Census Bureau.



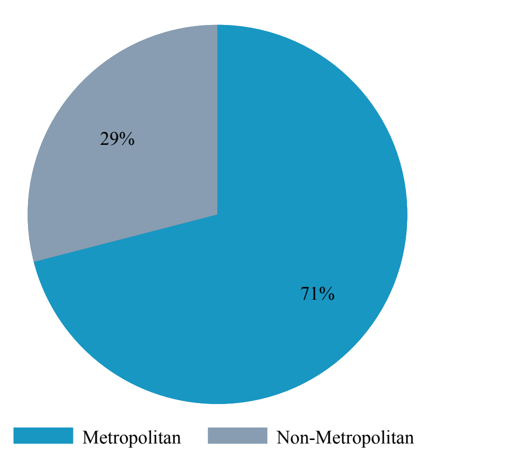
(A) By GAP Status



(B) By Mechanism of Establishment



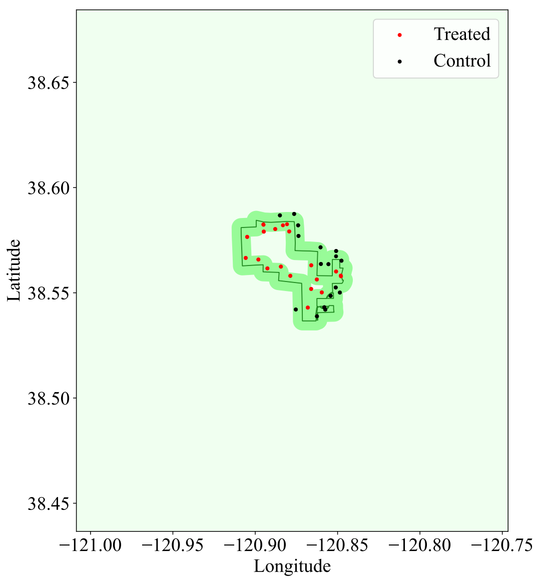
(C) By Management Type



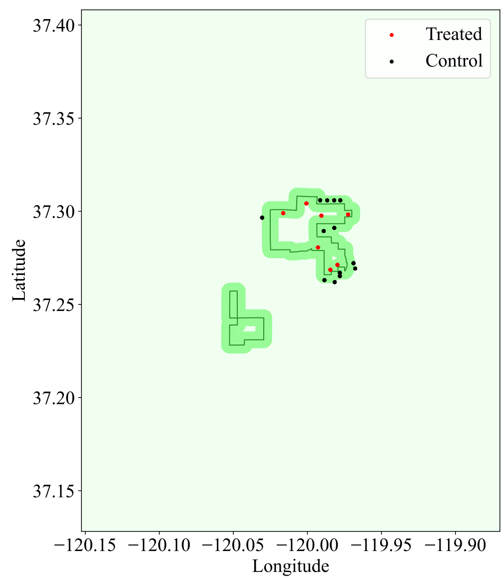
(D) By Location Type

Figure 3. Illustration of Properties in the Regression Discontinuity Sample

This figure depicts the locations of example properties from our estimation samples. Panel A shows the outline of the El Dorado Ranch near Sacramento, California. The El Dorado Ranch is a biodiversity-protected area with GAP status 2, comprising 3,137 acres, owned and managed by the American River Conservancy, an NGO, and established by fee interest prior to 2006. Panel B shows the outline of the Grassland Reserve in Mariposa, California. The Grassland Reserve is a biodiversity-protected area with GAP status 2, comprising 3,916 acres, which is privately owned and managed, and was created by conservation easement in 2012. In both panels, the border of the protected area is shown in dark green, while the light green shading around the protected area border indicates a 500 meter bandwidth. The markers in Panel A (respectively, Panel B) indicate the locations of treated and control properties included in our baseline regression discontinuity design from Eq. (1) (in our dynamic regression discontinuity design from Eq. (2)).



(A) Baseline RD Sample



(B) Dynamic RD Sample

Figure 4. Threshold Manipulation Test

This figure depicts the results from a threshold manipulation test around protected area borders in the first year after these areas are established. The solid lines show the point estimates from local polynomial density estimations with data-driven bandwidth selection. The shaded areas indicate 90% confidence intervals around these point estimates. The threshold is the protected area border. Properties on the left hand-side of the threshold (shown in red) are located inside a protected area, while those on the right hand-side of the threshold (shown in blue) are located outside the protected area. The estimated difference in the density of the distance variable at the threshold is 0.05, and the robust p-value associated with the test of the null hypothesis that this difference is zero is 0.75. The data used to produce this figure are from Corelogic and the USGS.

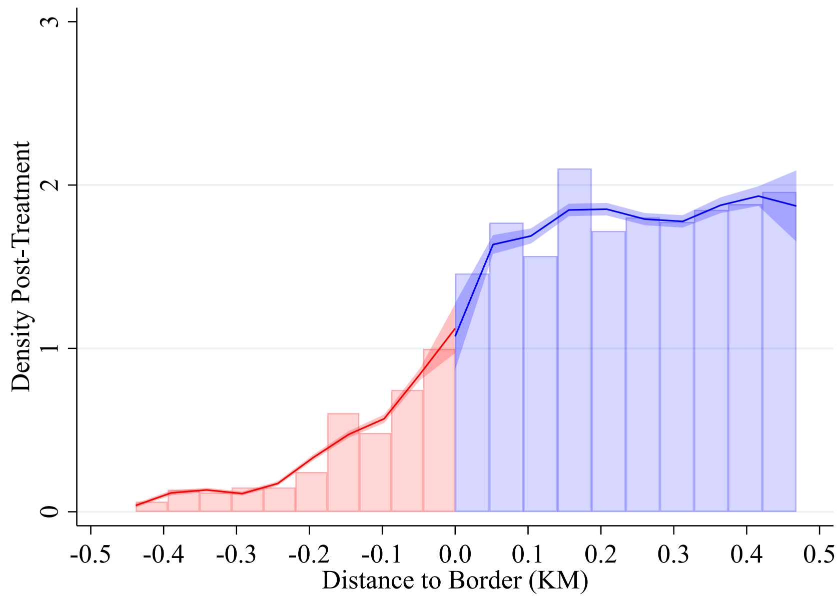


Figure 5. Biodiversity Protections and Land Values by Bandwidth

This figure depicts the biodiversity protection discount in the market for vacant land derived from estimating Eq. (1) for different sub-samples from the double cross-section of vacant land observed in the U.S. in 2010 and 2015 based on the bandwidth around protected area borders. Specifically, *Distance to Border* is the distance between the centroid of a lot and the nearest protected area border (in meters). The circles indicate the coefficient estimates on the variable *Treated*. The capped bars indicate 90% confidence intervals (CI) around these estimates. The solid bars indicate the number of treated observations remaining in each sub-sample estimation. The data used to produce this figure are from Corelogic, the USGS, and the U.S. Census Bureau.

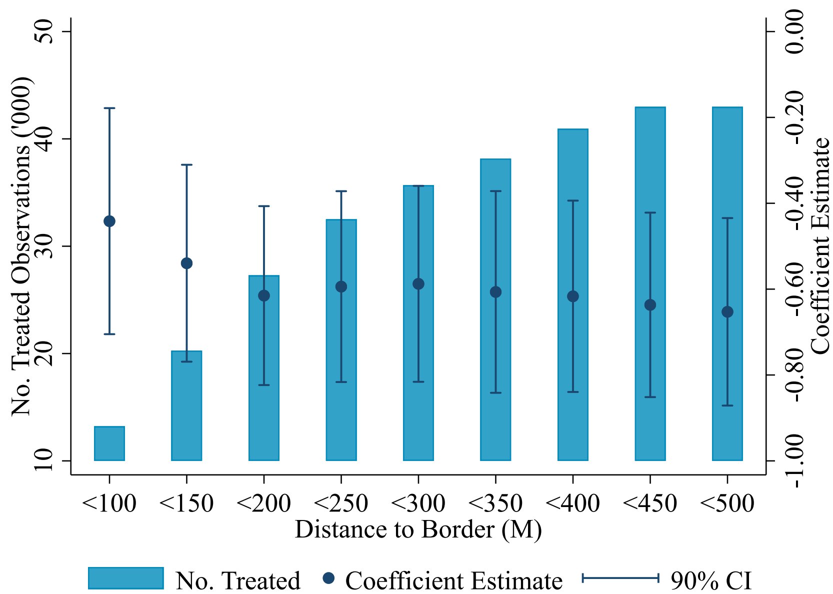
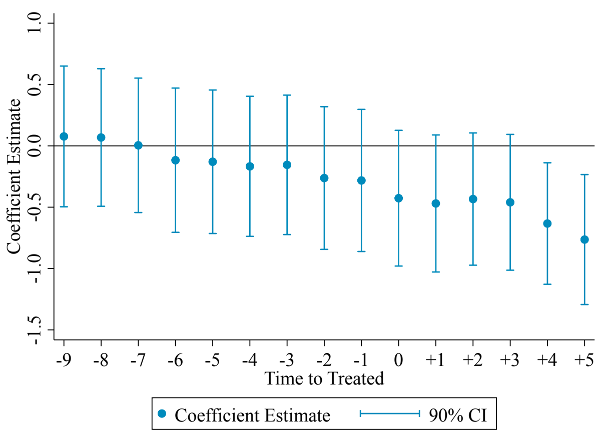
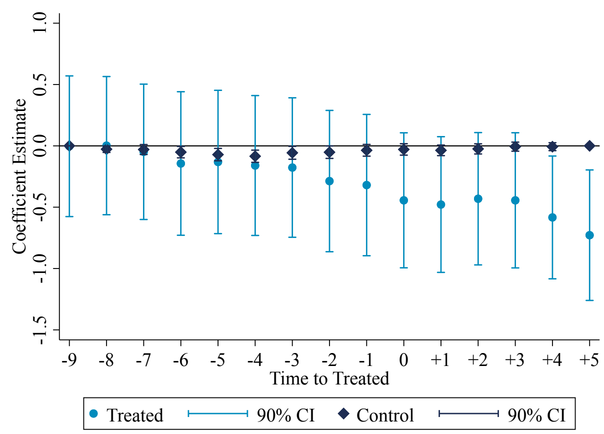


Figure 6. Biodiversity Protections and Land Values over Time

This figure depicts the biodiversity protection discount in the market for vacant land derived from estimating Eq. (2) in the annual panel of vacant land observed in the U.S. between 2010 and 2020. *Time to Treated* represents the difference between the observation year and the year when the nearest protected area border is established. In Panel A, the circles indicate the coefficient estimates on the variable *Treated* in a given year. In Panel B, the circles (respectively, diamonds) represent the coefficient estimates for treated properties (control properties) in a given year. The capped bars indicate 90% confidence intervals around the coefficient estimates. The data used to produce this figure are from Corelogic, the USGS, and the U.S. Census Bureau.



(A) By Time to Treated



(B) By Treated and Time to Treated

Table 1. High-Level Drivers of Biodiversity Protections in U.S. States

This table presents output from estimating simple OLS regressions in the cross-section of U.S. states. The dependent variable is the total area currently under permanent biodiversity protections in a state, scaled by the total area of the state, both in acres (*% Protected*). *% Plants at Risk* (respectively, *% Animals at Risk*) is the percentage of plant (animal) species local to a state that are considered to be imperiled or vulnerable to extinction. *% Dem. Vote Share (Pres.)* is the average state-level democratic vote share in historical presidential elections completed between 2000 and 2020. *% Dem. Vote Share (Sen.)* is the average state-level democratic vote share in historical senate elections completed between 2000 and 2020. *% Public Land* is the total area currently under governmental management in a state, scaled by the total area of the state, both in acres. Areas under permanent biodiversity protections are those classified as GAP status 1 or 2 in the PAD-US database. Data on the total area under permanent biodiversity protections in a state, on the total area under governmental management, and on the total area of the state are as of 2024, obtained from the USGS PAD-US database version 4.0. Data on the percentage of at-risk plant and animal species in a state are as of 2022, obtained from NatureServe (2023). Data on democratic vote shares in a state are from the MIT Election Lab. Robust standard errors are shown in parentheses. Statistical significance is indicated as follows: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	(1) % Protected	(2) % Protected	(3) % Protected	(4) % Protected	(5) % Protected	(6) % Protected
% Plants at Risk	0.241***	0.223***	0.093**			
	(0.07)	(0.07)	(0.04)			
% Animals at Risk				0.190***	0.172***	0.088*
				(0.05)	(0.04)	(0.05)
% Dem. Vote (Pres.)	-8.208			-6.104		
	(7.35)			(7.92)		
% Dem. Vote (Sen.)		2.887			4.518	
		(6.86)			(6.90)	
% Public Land			21.473***			22.313***
			(5.19)			(4.91)
Mean Dep. Var. (%)	7.73	7.73	7.73	7.73	7.73	7.73
Observations	51	51	51	51	51	51
R-sq.	0.17	0.16	0.62	0.08	0.08	0.61

Table 2. Descriptive Statistics Vacant Land Samples Post-Treatment

This table presents summary statistics on the vacant land samples used in this study in the post-treatment period when land use restrictions for the protection of biodiversity are in place. Panel A presents summary statistics for the treated and control properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. By definition, this sample is focused on land around protected area borders that were established at least five years prior to the first sample observations. Treated properties are those located inside a protected area with GAP status 1 or 2. Control properties are those not located in any protected area. *Value/Acre* is the calculated value per acre of vacant land (in $'000). For properties observed in 2010, that value is the average calculated value per acre over the 2010–2014 period. For properties observed in 2015, that value is the average calculated value per acre over the 2015–2019 period. *Acres* is the size of the vacant land in acres in 2010 (respectively, 2015). *Developed* is an indicator that takes the value of one for property i observed in year 2010 (respectively, 2015) if that property has a property type code of (non-) residential instead of vacant land by 2014 (respectively, 2019). Additional development indicators are defined analogously for residential land (classified based on land use codes 460 and 465). *Res. Dev.* is an indicator for residential development. *Res. Lot* is an indicator that takes the value of one if the land is classified as a residential lot rather than residential acreage (based on land use code value 465 rather than 460). *Sewer* is an indicator that takes the value of one if the land is classified to have a sewer system present (based on sewer code commercial, private, public, or septic). *Sold* is an indicator that takes the value of one for property i observed in year 2010 (respectively, 2015) if that property is observed in the transaction sample by 2014 (respectively, 2019). Panel B presents summary statistics for the treated and control properties in the annual panel of vacant land observed in the U.S. between 2010 and 2020. Descriptive statistics are computed over the time period after protected area borders are established. Variable definitions follow those from the double cross-section, except we use annual, point-in-time observations. Calculated values per acre for treated and control properties are winsorized at the 1^{st} and 99^{th} percentiles.

(A) Double Cross-Section

	Treated Properties			Control Properties			
	N	Mean	Median	N	Mean	Median	Difference
Value/Acre	46,155	20.84	1.48	224,200	54.19	7.42	-33.35***
Acres	46,155	76.40	12.21	224,200	16.32	1.79	60.08***
Developed	46,155	0.07	0.00	224,200	0.11	0.00	-0.04***
Res.Dev.	46,155	0.01	0.00	224,200	0.05	0.00	-0.04***
Lot	46,155	0.08	0.00	224,200	0.21	0.00	-0.13***
Sewer	46,155	0.03	0.00	224,200	0.05	0.00	-0.02***
Sold	46,155	0.01	0.00	224,200	0.02	0.00	-0.01***

(B) Annual Panel

	Treated Properties			Control Properties			
	N	Mean	Median	N	Mean	Median	Difference
Value/Acre	6,779	4.08	1.00	39,322	23.66	3.83	-19.58***
Acres	6,779	134.49	39.00	39,322	28.00	3.44	106.49***
Developed	6,779	0.05	0.00	39,322	0.06	0.00	-0.01***
Res. Dev.	6,779	0.01	0.00	39,322	0.03	0.00	-0.02***
Lot	6,779	0.03	0.00	39,322	0.14	0.00	-0.11***
Sewer	6,779	0.04	0.00	39,322	0.05	0.00	-0.01
Sold	6,779	0.01	0.00	39,322	0.02	0.00	-0.01***

Table 3. Descriptive Statistics Protected Areas

This table presents summary statistics on the protected areas that feature in the vacant land samples used in this study. Panel A presents summary statistics for the protected areas represented in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. Panel B presents summary statistics for the protected areas represented in the annual panel of vacant land observed in the U.S. between 2010 and 2020. *No. Treated Obs.* is the number of treated observations included in a protected area in a given year. *GAP Status* is the GAP status of a protected area. *Year Established* is the year in which a protected area was established. *Acres* is the size of a protected area in acres.

(A) Double Cross-Section

	N	Mean	Median
No. Treated Obs.	58,284	398.72	62
GAP Status	58,284	1.79	2
Year Est.	30,445	1985	1992
Acres	58,284	140,085	2,959

(B) Annual Panel

	N	Mean	Median
No. Treated Obs.	35,441	73.39	14
GAP Status	35,441	1.84	2
Year Est.	35,441	2016	2016
Acres	35,441	23,288	197

Table 4. Validation of Regression Discontinuity Design

This table presents output from estimating Eq. (1) across the treated and control properties in the annual panel of vacant land observed in the U.S. between 2010 and 2020. Estimations are limited to the period at least five years prior to the formation of a given protected area border. The dependent variable in column 1 is the calculated value per acre of vacant land in $'000 (*Value/Acre*). The dependent variable in column 2 is *Acres*, the size of the vacant land in acres. The dependent variable in column 3 is *Developed*, an indicator that takes the value of one if a property changes property type code from vacant land to (non-) residential. The analyses in columns 4 through 6 focus on residential land (classified based on land use codes 460 and 465). The dependent variable in column 4 is *Res. Dev.*, an indicator for residential development. The dependent variable in column 5 is *Res. Lot*, an indicator that takes the value of one if the land is classified as a residential lot rather than residential acreage (based on land use code value 465 rather than 460). The dependent variable in column 6 is *Sewer*, an indicator that takes the value of one if the land is classified to have a sewer system present (based on sewer code commercial, private, public, or septic). *Treated* is an indicator that takes the value of one for to-be-treated land at times more than five years before the establishment of the nearest protected area, and zero for land that is not to-be-treated. To-be-treated means that the vacant land is located where a protected area with GAP status 1 or 2 is later established. *Distance* is the distance from the centroid of the vacant land to the nearest protected area border in KM. For treated properties, this variable measures the distance to the nearest border of the protected area containing the land. For control properties, this variable measures the distance to the nearest border of the surrounding protected areas with GAP status 1 or 2 in the same state. Fixed effects for protected area-year are included as indicated. Sample restrictions by bandwidth around protected area borders are applied as indicated. Linear, squared, and up to cubic controls for *Distance* are included as indicated. The mean of the dependent variable in each estimation is reported in $'000 (column 1), acres (column 2), or decimal form (columns 3 through 6). Calculated values per acre are winsorized at the 1^{st} and 99^{th} percentiles. Robust standard errors, clustered by protected area, are shown in parentheses. Statistical significance is indicated as follows: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	(1) Value/Acre	(2) Acres	(3) Developed	(4) Res. Dev.	(5) Res. Lot	(6) Sewer
Treated	0.118	0.653	-0.005	0.001	0.104	-0.025
	(0.45)	(0.42)	(0.01)	(0.02)	(0.08)	(0.05)
Distance	-15.939*	8.973	0.068	0.059	-2.849***	0.799
	(9.22)	(6.50)	(0.13)	(0.34)	(0.97)	(0.78)
Treated×Distance	-3.124*	-3.240	-0.066	0.009	-0.210	-0.127
	(1.63)	(4.30)	(0.06)	(0.13)	(0.67)	(0.32)
Area-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Bandwidth	0.5 KM	0.5 KM	0.5 KM	0.5 KM	0.5 KM	0.5 KM
Distance Controls	Cubic	Cubic	Cubic	Cubic	Cubic	Cubic
Mean Dep. Var.	20.87	31.16	0.02	0.02	0.45	0.06
Observations	38,168	38,168	38,168	10,633	10,633	10,633
Pseudo R-sq.	0.62	0.64	0.35	0.31	0.63	0.46

Table 5. Biodiversity Protections and Land Values

This table presents output from estimating Eq. (1) across the treated and control properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. The dependent variable is the calculated value per acre of vacant land in $'000. For properties observed in 2010, that value is the average calculated value per acre over the 2010–2014 period. For properties observed in 2015, that value is the average calculated value per acre over the 2015–2019 period. *Treated* is an indicator that takes the value of one if the vacant land is located inside a protected area with GAP status 1 or 2, and zero if it is not located in any protected area. *Distance* is the distance from the centroid of the vacant land to the nearest protected area border in KM. For treated properties, this variable measures the distance to the nearest border of the protected area containing the land. For control properties, this variable measures the distance to the nearest border of the surrounding protected areas with GAP status 1 or 2 in the same state. *Acres* is the size of the vacant land in acres. Fixed effects for protected area-year are included as indicated. Sample restrictions by bandwidth around protected area borders are applied as indicated. Linear, squared, and up to cubic controls for *Distance* are included as indicated. The mean of the dependent variable in each estimation is reported in $'000. Calculated values per acre are winsorized at the 1^{st} and 99^{th} percentiles. Robust standard errors, clustered by protected area, are shown in parentheses. Statistical significance is indicated as follows: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	(1) Value/Acre	(2) Value/Acre	(3) Value/Acre
Treated	-0.598***	-0.653***	-0.615***
	(0.11)	(0.13)	(0.13)
Distance	0.075	0.091	0.262
	(0.78)	(0.14)	(0.37)
Treated×*Distance*	-1.023	-0.473	-0.375
	(2.47)	(0.56)	(0.96)
Treated×*Acres*	0.066***	0.066***	0.080***
	(0.01)	(0.01)	(0.01)
Acres	-0.080***	-0.080***	-0.100***
	(0.01)	(0.01)	(0.01)
Area-Year FEs	Yes	Yes	Yes
Bandwidth	0.5 KM	0.5 KM	0.2 KM
Distance Controls	Cubic	Linear	Linear
Mean Dep. Var.	48.71	48.71	46.92
Observations	268,513	268,513	114,553
Pseudo R-sq.	0.68	0.68	0.72

Table 6. Biodiversity Protections and Land Values—Robustness Tests

This table presents output from estimating a set of robustness tests around the baseline specification from Eq. (1). The results in columns 1 through 6 are estimated across the treated and control properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. The dependent variable in these columns is the calculated value per acre of vacant land in $'000. For properties observed in 2010, that value is the average calculated value per acre over the 2010–2014 period. For properties observed in 2015, that value is the average calculated value per acre over the 2015–2019 period. The results in columns 7 and 8 are estimated across the treated and control properties in the sample of vacant land transactions completed in the U.S. between 2010 and 2020. The dependent variable in these columns is the transaction price per acre of vacant land in $'000. Across all columns, *Treated* is an indicator that takes the value of one if the vacant land is located inside a protected area with GAP status 1 or 2, and zero if it is not located in any protected area. *Distance* is the distance from the centroid of the vacant land to the nearest protected area border in KM. For treated properties, this variable measures the distance to the nearest border of the protected area containing the land. For control properties, this variable measures the distance to the nearest border of the surrounding protected areas with GAP status 1 or 2 in the same state. *Acres* is the size of the vacant land in acres. Fixed effects for protected area-year are included as indicated. Given the smaller size of the transaction sample, the estimations reported in columns 7 and 8 include county-year-land use fixed effects instead of protected area-year fixed effects. Sample restrictions by bandwidth around protected area borders are applied as indicated. Linear, squared, and up to cubic controls for *Distance* are included as indicated. Robust. Check denotes the sub-sample or alternative specification used in a given robustness test. Calculated values and transaction prices per acre are winsorized at the 1^{st} and 99^{th} percentiles. Robust standard errors, clustered by protected area, are shown in parentheses. Statistical significance is indicated as follows: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	(1) Value/Acre	(2) Value/Acre	(3) Value/Acre	(4) Value/Acre	(5) Value/Acre	(6) Value/Acre	(7) Price/Acre	(8) Price/Acre
Treated	-0.596***	-0.551***	-0.590***	-0.555***	-0.670***	-0.627***	-0.941***	-0.827**
	(0.07)	(0.07)	(0.13)	(0.13)	(0.07)	(0.08)	(0.34)	(0.39)
Distance	0.294***	-0.186	0.080	0.129	0.275***	0.436*	0.132	0.874**
	(0.07)	(0.24)	(0.14)	(0.38)	(0.07)	(0.26)	(0.12)	(0.37)
Treated×*Distance*	-0.946***	-1.407***	-0.595	-0.601	-1.338	-2.642*	0.857	1.685
	(0.24)	(0.44)	(0.52)	(0.94)	(1.07)	(1.56)	(0.94)	(2.88)
Treated×*Acres*	0.000	0.000**	0.061***	0.076***	0.035***	0.044***	0.216***	0.222***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.06)	(0.03)
Acres	-0.000*	-0.001**	-0.072***	-0.092***	-0.040***	-0.048***	-0.268***	-0.364***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.06)	(0.03)
Area-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bandwidth	0.5 KM	0.2 KM	0.5 KM	0.2 KM	0.5 KM	0.2 KM	0.5 KM	0.2 KM
Distance Controls	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear
Robust. Check	Log OLS	Log OLS	Land Use FEs	Land Use FEs	Weights	Weights	Transactions	Transactions
Observations	268,513	114,553	265,202	111,458	268,513	114,553	87,766	29,736
(Pseudo) R-sq.	0.59	0.61	0.71	0.75	0.78	0.82	0.66	0.73

Table 7. Biodiversity Protections and Land Values over Time

This table presents output from estimating Eq. (2) in the annual panel of vacant land observed in the U.S. between 2010 and 2020. The dependent variable is the calculated value per acre of vacant land in $'000 (*Value/Acre*). *Treated* is an indicator that takes the value of one for to-be-treated land at times more than five years before the establishment of the nearest protected area, and zero for land that is not to-be-treated. To-be-treated means that the vacant land is located where a protected area with GAP status 1 or 2 is later established. *4-0 Yrs. Pre* is an indicator that takes the value of one at times between four and zero years before the establishment of the nearest protected area. *1-5 Yrs. Post* is an indicator that takes the value of at times between one and five years after the establishment of the nearest protected area. Fixed effects are included as indicated. Sample restrictions by bandwidth around protected area borders are applied as indicated. Linear, squared, and up to cubic controls for *Distance* are included as indicated. Covariates for *Distance* and *Acres* are included in the estimations but not tabulated. The mean of the dependent variable in each estimation is reported in $'000. Calculated values per acre are winsorized at the 1^{st} and 99^{th} percentiles. Robust standard errors, clustered by protected area, are shown in parentheses. Statistical significance is indicated as follows: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	(1) Value/Acre	(2) Value/Acre	(3) Value/Acre
Treated	-0.046	-0.092	-0.079
	(0.34)	(0.34)	(0.34)
Treated × *4-0 Yrs. Pre*	-0.216**	-0.189**	-0.204**
	(0.10)	(0.08)	(0.09)
Treated × *1-5 Yrs. Post*	-0.473***	-0.413***	-0.440***
	(0.17)	(0.15)	(0.16)
4-0 Yrs. Pre		-0.017	-0.019
		(0.01)	(0.01)
1-5 Yrs. Post		0.005	0.009
		(0.02)	(0.01)
Fixed Effects	Area-by-Year	Area & Year	Area & Cty.-Yr.
Bandwidth	0.5 KM	0.5 KM	0.5 KM
Distance Controls	Cubic	Cubic	Cubic
Covariates	Yes	Yes	Yes
Mean Dep. Var.	20.81	20.72	20.74
Observations	150,487	151,352	151,201
Pseudo R-sq.	0.66	0.66	0.66

Table 8. Biodiversity Protections and Land Development

This table presents output from estimating Eq. (1) across the treated and control properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. The dependent variable in columns 1 through 3 is *Developed*, an indicator that takes the value of one for property i observed in year 2010 (respectively, 2015) if that property has a property type code of (non-) residential instead of vacant land by 2014 (respectively, 2019). The analyses in columns 4 through 6 focus on residential land (classified based on land use codes 460 and 465). The dependent variable in column 4 is *Res. Dev.*, an indicator for residential development. The dependent variable in column 5 is *Res. Lot*, an indicator that takes the value of one if the land is classified as a residential lot rather than residential acreage (based on land use code value 465 rather than 460). The dependent variable in column 6 is *Sewer*, an indicator that takes the value of one if the land is classified to have a sewer system present (based on sewer code commercial, private, public, or septic). *Treated* is an indicator that takes the value of one if the vacant land is located inside a protected area with GAP status 1 or 2, and zero if it is not located in any protected area. *Distance* is the distance from the centroid of the vacant land to the nearest protected area border in KM. For treated properties, this variable measures the distance to the nearest border of the protected area containing the land. For control properties, this variable measures the distance to the nearest border of the surrounding protected areas with GAP status 1 or 2 in the same state. *Acres* is the size of the vacant land in acres. Fixed effects for protected area-year are included as indicated. Sample restrictions by bandwidth around protected area borders are applied as indicated. Linear, squared, and up to cubic controls for *Distance* are included as indicated. The mean of the dependent variable in each estimation is reported in decimal form. Robust standard errors, clustered by protected area, are shown in parentheses. Statistical significance is indicated as follows: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	(1) Developed	(2) Developed	(3) Developed	(4) Res. Dev.	(5) Res. Lot	(6) Sewer
Treated	-0.036***	-0.032***	-0.031***	-0.043***	-0.172***	-0.025***
	(0.01)	(0.00)	(0.01)	(0.01)	(0.03)	(0.01)
Distance	-0.001	0.022***	0.014	0.030**	0.096***	0.007
	(0.07)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Treated×*Distance*	0.049	0.000	0.006	-0.047	0.083	0.015
	(0.14)	(0.02)	(0.04)	(0.04)	(0.11)	(0.03)
Treated×*Acres*	0.000	0.000	0.000	0.000**	0.000*	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Acres	0.000	0.000	0.000	-0.000**	-0.000*	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Area-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Bandwidth	0.5 KM	0.5 KM	0.2 KM	0.5 KM	0.5 KM	0.5 KM
Distance Controls	Cubic	Linear	Linear	Linear	Linear	Linear
Mean Dep. Var.	0.10	0.10	0.09	0.11	0.50	0.07
Observations	268,513	268,513	114,553	103,038	103,038	103,038
R-sq.	0.29	0.29	0.3	0.27	0.42	0.49

Table 9. Biodiversity Protections and Land Development over Time

This table presents output from estimating Eq. (2) in the annual panel of vacant land observed in the U.S. between 2010 and 2020. The dependent variable in column 1 is *Developed*, an indicator that takes the value of one for property i changes property type code from vacant land to (non-) residential in a given year. The analyses in columns 2 through through 4 focus on residential land (classified based on land use codes 460 and 465). The dependent variable in column 2 is *Res. Dev.*, an indicator for residential development. The dependent variable in column 3 is *Res. Lot*, an indicator that takes the value of one if the land is classified as a residential lot rather than residential acreage (based on land use code value 465 rather than 460). The dependent variable in column 4 is *Sewer*, an indicator that takes the value of one if the land is classified to have a sewer system present (based on sewer code commercial, private, public, or septic). *Treated* is an indicator that takes the value of one for to-be-treated land at times more than five years before the establishment of the nearest protected area, and zero for land that is not to-be-treated. To-be-treated means that the vacant land is located where a protected area with GAP status 1 or 2 is later established. *4-0 Yrs. Pre* is an indicator that takes the value of one at times between four and zero years before the establishment of the nearest protected area. *1-5 Yrs. Post* is an indicator that takes the value of at times between one and five years after the establishment of the nearest protected area. Fixed effects for protected area-year are included as indicated. Sample restrictions by bandwidth around protected area borders are applied as indicated. Linear, squared, and up to cubic controls for *Distance* are included as indicated. Covariates for *Distance* and *Acres* are included in the estimations but not tabulated. The mean of the dependent variable in each estimation is reported in decimal form. Robust standard errors, clustered by protected area, are shown in parentheses. Statistical significance is indicated as follows: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	(1) Developed	(2) Res. Dev.	(3) Res. Lot	(3) Sewer
Treated	0.003	0.012	0.029	0.017
	(0.01)	(0.01)	(0.09)	(0.04)
Treated × *4-0 Yrs. Pre*	-0.006	-0.031**	-0.070***	-0.032*
	(0.00)	(0.01)	(0.02)	(0.02)
Treated × *1-5 Yrs. Post*	-0.005	-0.015*	-0.171***	-0.059*
	(0.00)	(0.01)	(0.06)	(0.03)
Area-Year FEs	Yes	Yes	Yes	Yes
Bandwidth	0.5 KM	0.5 KM	0.5 KM	0.5 KM
Distance Controls	Cubic	Cubic	Cubic	Cubic
Covariates	Yes	Yes	Yes	Yes
Mean Dep. Var.	0.00	0.00	0.00	0.00
Observations	138,424	44,605	44,605	44,605
R-sq.	0.35	0.29	0.57	0.56

Table 10. Biodiversity Protections, Land Values, and Land Development

This table presents output from estimating Eq. (1) across the treated and control properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. The dependent variable is the calculated value per acre of vacant land in $'000. For properties observed in 2010, that value is the average calculated value per acre over the 2010–2014 period. For properties observed in 2015, that value is the average calculated value per acre over the 2015–2019 period. *Treated* is an indicator that takes the value of one if the vacant land is located inside a protected area with GAP status 1 or 2, and zero if it is not located in any protected area. *Treated Development* (respectively, *Control Development*) is the mean rate of development inside (outside) the nearest protected area over the 2010–2014 period and over the 2015–2019 period, respectively. *Distance* is the distance from the centroid of the vacant land to the nearest protected area border in KM. For treated properties, this variable measures the distance to the nearest border of the protected area containing the land. For control properties, this variable measures the distance to the nearest border of the surrounding protected areas with GAP status 1 or 2 in the same state. *Acres* is the size of the vacant land in acres. Fixed effects for protected area-year are included as indicated. Sample restrictions by bandwidth around protected area borders are applied as indicated. Linear, squared, and up to cubic controls for *Distance* are included as indicated. The mean of the dependent variable in each estimation is reported in $'000. Calculated values per acre are winsorized at the 1^{st} and 99^{th} percentiles. Robust standard errors, clustered by protected area, are shown in parentheses. Statistical significance is indicated as follows: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	(1) Value/Acre	(2) Value/Acre	(3) Value/Acre
Treated	-0.584***	-0.639***	-0.620***
	(0.12)	(0.15)	(0.14)
Treated× *Treated Development*	0.614***	0.609***	0.457**
	(0.19)	(0.20)	(0.22)
Treated× *Control Development*	-0.360	-0.366	-0.161
	(0.29)	(0.28)	(0.36)
Distance	0.072	0.092	0.261
	(0.78)	(0.14)	(0.37)
Treated× *Distance*	-1.072	-0.540	-0.464
	(2.55)	(0.55)	(0.99)
Treated× *Acres*	0.066***	0.066***	0.080***
	(0.01)	(0.01)	(0.01)
Acres	-0.080***	-0.080***	-0.100***
	(0.01)	(0.01)	(0.01)
Area-Year FEs	Yes	Yes	Yes
Bandwidth	0.5 KM	0.5 KM	0.2 KM
Distance Controls	Cubic	Linear	Linear
Mean Dep. Var.	48.82	48.82	47.03
Observations	267,226	267,226	113,676
Pseudo R-sq.	0.68	0.68	0.71

Table 11. Biodiversity Protections and Land Values by Local Land Scarcity

This table presents output from estimating Eq. (1) across the treated and control properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. The dependent variable is the calculated value per acre of vacant land in $'000. For properties observed in 2010, that value is the average calculated value per acre over the 2010–2014 period. For properties observed in 2015, that value is the average calculated value per acre over the 2015–2019 period. *Treated* is an indicator that takes the value of one if the vacant land is located inside a protected area with GAP status 1 or 2, and zero if it is not located in any protected area. *Distance* is the distance from the centroid of the vacant land to the nearest protected area border in KM. For treated properties, this variable measures the distance to the nearest border of the protected area containing the land. For control properties, this variable measures the distance to the nearest border of the surrounding protected areas with GAP status 1 or 2 in the same state. *Acres* is the size of the vacant land in acres. Fixed effects for protected area-year are included as indicated. Sample restrictions by bandwidth around protected area borders and by location type are applied as indicated. Linear controls for *Distance* are included as indicated. Location Type denotes the sub-sample used based on measures of local land scarcity. Calculated values per acre are winsorized at the 1^{st} and 99^{th} percentiles. Robust standard errors, clustered by protected area, are shown in parentheses. Statistical significance is indicated as follows: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	(1) Value/Acre	(2) Value/Acre	(3) Value/Acre	(4) Value/Acre	(5) Value/Acre	(6) Value/Acre	(7) Value/Acre	(8) Value/Acre
Treated	-0.381	-0.782***	-0.408	-0.720***	-0.849***	-0.579***	-0.917***	-0.475***
	(0.29)	(0.13)	(0.28)	(0.15)	(0.23)	(0.15)	(0.21)	(0.18)
Distance	0.117	0.049	0.222	-0.022	-0.371	0.246***	0.090	0.216**
	(0.14)	(0.19)	(0.16)	(0.19)	(0.45)	(0.08)	(0.18)	(0.11)
Treated×*Distance*	-0.727	-1.590***	-0.741	-1.657***	-0.443	-0.610	1.099	-0.998
	(0.66)	(0.43)	(0.56)	(0.45)	(0.88)	(0.60)	(1.32)	(0.64)
Treated×*Acres*	0.063***	0.075***	0.047***	0.083***	0.090***	0.058***	0.057***	0.063***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Acres	-0.084***	-0.084***	-0.067***	-0.093***	-0.096***	-0.076***	-0.069***	-0.088***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Area-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bandwidth	0.5 KM	0.5 KM	0.5 KM	0.5 KM	0.5 KM	0.5 KM	0.5 KM	0.5 KM
Distance Controls	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear
Location Type	Low Share	High Share	Low Unavail.	High Unavail.	Non-Metro	Metro	Low Reg.	High Reg.
Observations	105,044	101,729	105,966	118,499	80,444	187,981	98,367	98,201
Pseudo R-sq.	0.61	0.68	0.6	0.69	0.74	0.66	0.68	0.65

Table 12. Biodiversity Protections and Land Values by Local Political Regimes

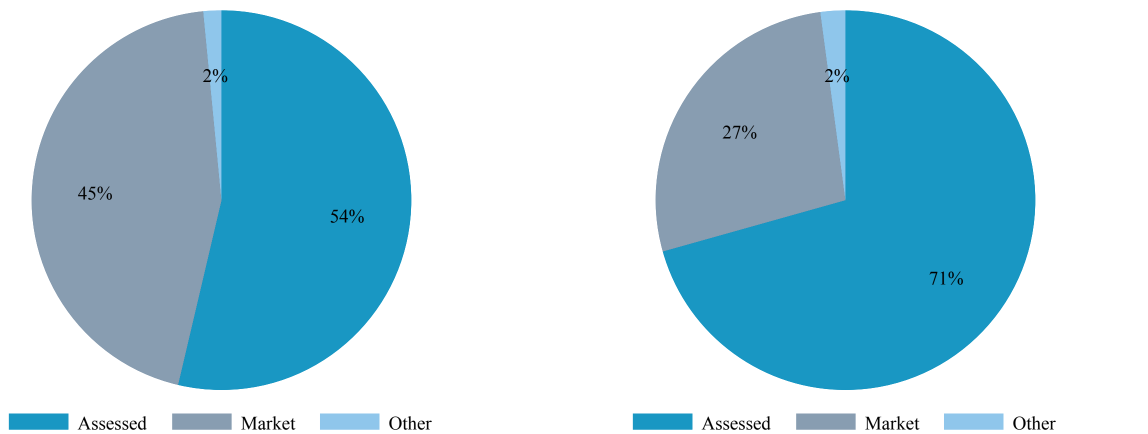
This table presents output from estimating Eq. (1) across the treated and control properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. The dependent variable is the calculated value per acre of vacant land in $'000. For properties observed in 2010, that value is the average calculated value per acre over the 2010–2014 period. For properties observed in 2015, that value is the average calculated value per acre over the 2015–2019 period. *Treated* is an indicator that takes the value of one if the vacant land is located inside a protected area with GAP status 1 or 2, and zero if it is not located in any protected area. *Rep. Ind* is an indicator that takes the value of one in counties with above-median Republican vote shares in the 2012 presidential election. *Rep. %* is the share of Republican votes cast in a county. *Non-Govt. Own* is an indicator that takes the value of one for protected areas owned by private or non-profit organizations. *Treated Development* (respectively, *Control Development*) is the mean rate of development inside (outside) the nearest protected area over the 2010–2014 period and over the 2015–2019 period, respectively. All models include all variables and two-way interactions underlying the coefficients tabulated as well as covariates for *Distance*, *Acres*, and their interactions with *Treated*. Fixed effects for protected area-year are included as indicated. Sample restrictions by bandwidth around protected area borders are applied as indicated. Linear controls for *Distance* are included as indicated. Political Regimes denotes the sub-sample used based on county-level vote shares. Robust standard errors, clustered by protected area, are shown in parentheses. Calculated values per acre are winsorized at the 1^{st} and 99^{th} percentiles. Statistical significance is indicated as follows: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	(1) Value/Acre	(2) Value/Acre	(3) Value/Acre	(4) Value/Acre	(5) Value/Acre	(6) Value/Acre
Treated	-0.842***	-1.593***	-0.391*	-0.814***	-0.819***	-0.795***
	(0.12)	(0.33)	(0.21)	(0.12)	(0.15)	(0.13)
Treated × *Rep. Ind.*	0.469**				0.537**	0.469**
	(0.22)				(0.23)	(0.23)
Treated × *Rep (%)*		2.025***				
		(0.73)				
Treated × *Rep. Ind.* × *Non-Govt. Own.*					-0.778**	
					(0.32)	
Treated × *Treated Development*						0.660***
						(0.21)
Treated × *Control Development*						-0.608*
						(0.33)
Area-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Bandwidth	0.5 KM	0.5 KM	0.5 KM	0.5 KM	0.5 KM	0.5 KM
Distance Controls	Linear	Linear	Linear	Linear	Linear	Linear
Political Regimes	Full	Full	Rep.	Dem.	Full	Full
Observations	268,513	261,063	140,244	128,183	268,513	267,226
Pseudo R-sq.	0.68	0.68	0.72	0.64	0.68	0.68

ONLINE APPENDIX

Figure A.1. Sample Breakdown of Sources of Calculated Values

This figure depicts the distribution of the sources of information for the calculated land values of treated and control properties in the vacant land samples used in this study. Panel A presents the distribution of these sources of information in the cross-section of vacant land observed in the U.S. in 2010 and 2015. Panel B presents the distribution of these sources of information in the annual panel of vacant land observed in the U.S. between 2010 and 2020. Treated properties are those located inside a protected area with GAP status 1 or 2. Control properties are those not located in any protected area. The category "Other" comprises calculated land values derived from appraisals and transitional information. The data used to produce this figure are from Corelogic, the USGS, and the U.S. Census Bureau.

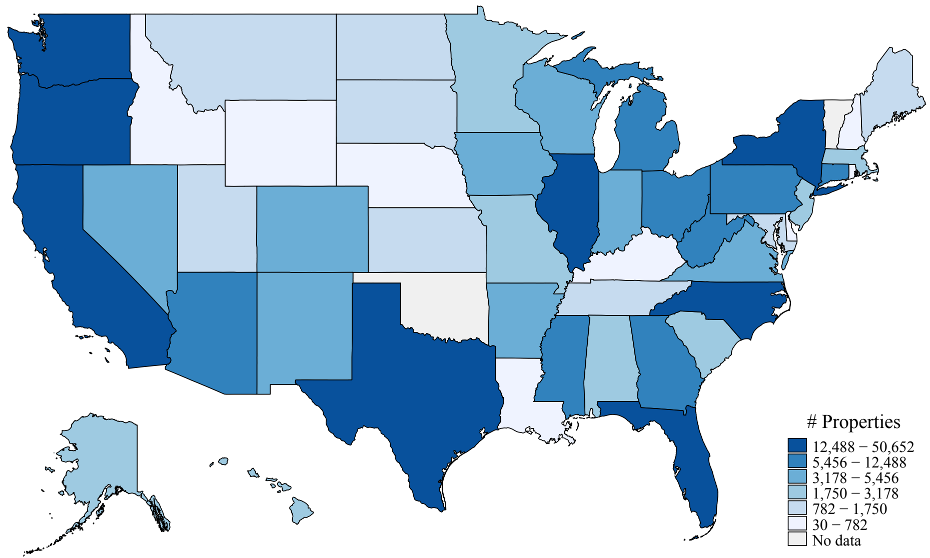


(A) Double Cross-Section

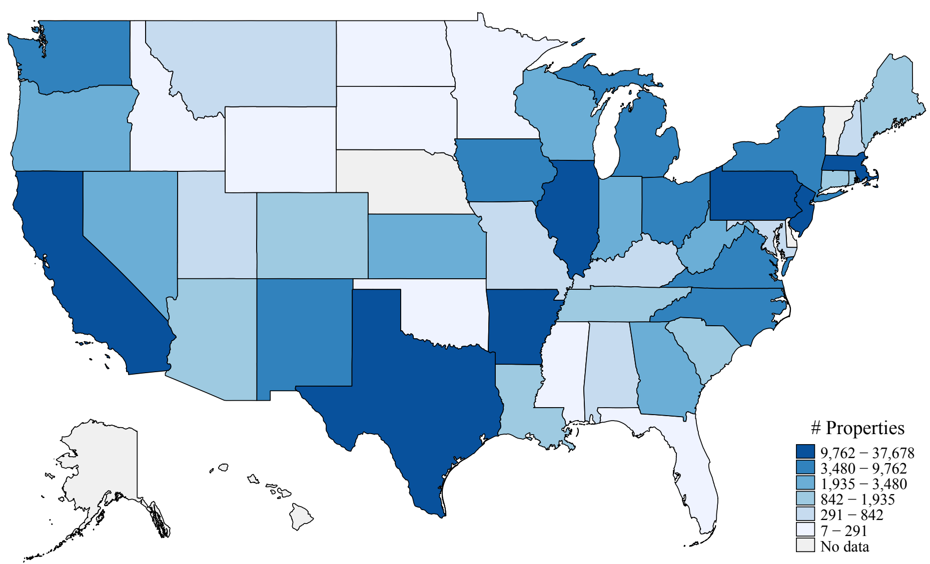
(B) Annual Panel

Figure A.2. Sample Distribution by State

This figure depicts the distribution of treated and control properties in the vacant land samples used in this study by state. Panel A presents the distribution of treated and control properties in the cross-section of vacant land observed in the U.S. in 2010 and 2015. Panel B presents the distribution of treated and control properties in the annual panel of vacant land observed in the U.S. between 2010 and 2020. Treated properties are those located inside a protected area with GAP status 1 or 2. Control properties are those not located in any protected area. Darker shading of state areas indicates a larger number of treated and control properties in a state. The data used to produce this figure are from Corelogic, the USGS, and the U.S. Census Bureau.



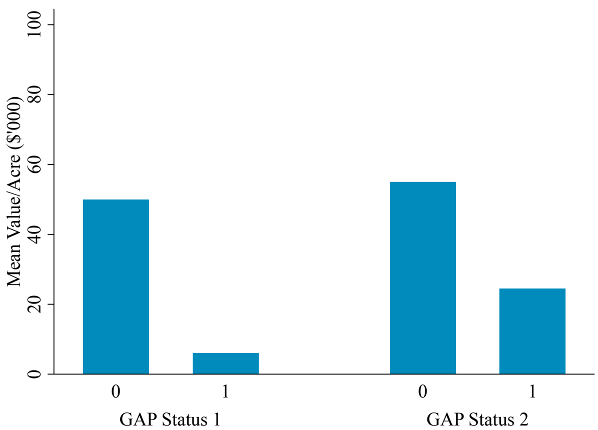
(A) Double Cross-Section



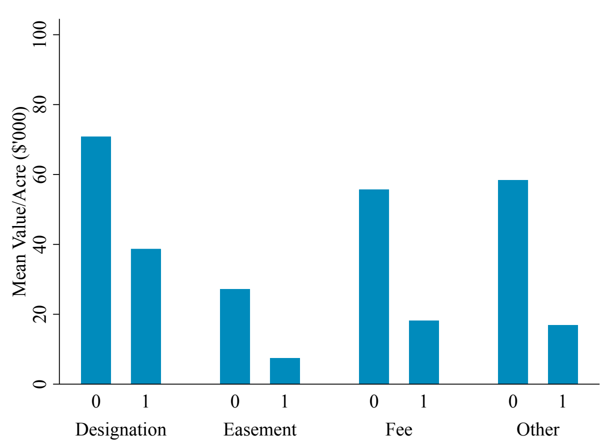
(B) Annual Panel

Figure A.3. Sample Distribution of Land Values

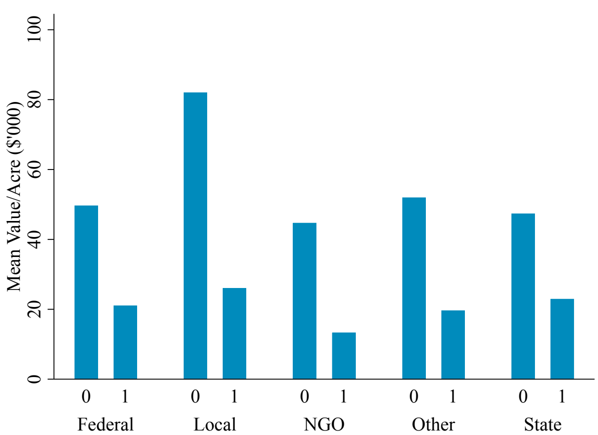
This figure depicts mean calculated land values per acre (in $'000) across treated and control properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015 by GAP status (Panel A), mechanism of protected area establishment (Panel B), protected area management type (Panel C), and location type (Panel D). In each panel, treated (control) properties are marked with an indicator value of 1 (value of 0, respectively). Treated properties are those located inside a protected area with GAP status 1 or 2. Control properties are those not located in any protected area. Calculated land values per acre for treated and matched control properties are winsorized at the 1^{st} and 99^{th} percentiles. The data used to produce this figure are from Corelogic, the USGS, and the U.S. Census Bureau.



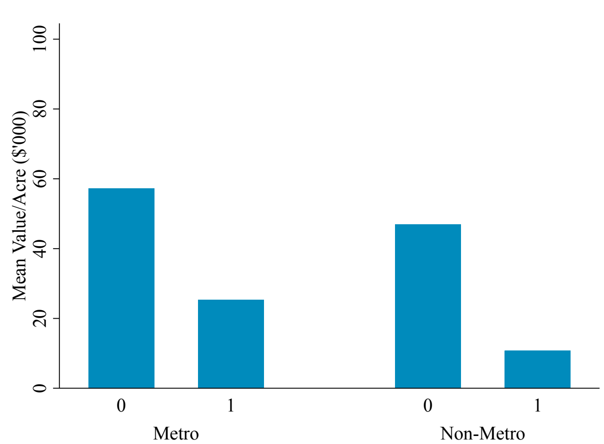
(A) By GAP Status



(B) By Mechanism of Establishment



(C) By Management Type



(D) By Location Type

Table A.1. Top-10 Protected Areas

This table presents the top-ten protected areas by frequency of observations in this study. Panel A presents the top-10 protected areas in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. The protected areas in this sample are selected to have been established in 2005 or earlier. Panel B presents the top-10 protected areas in the annual panel of vacant land observed in the U.S. between 2010 and 2020. The protected areas in this sample are selected to have been established in 2010 or later.

(A) Double Cross-Section

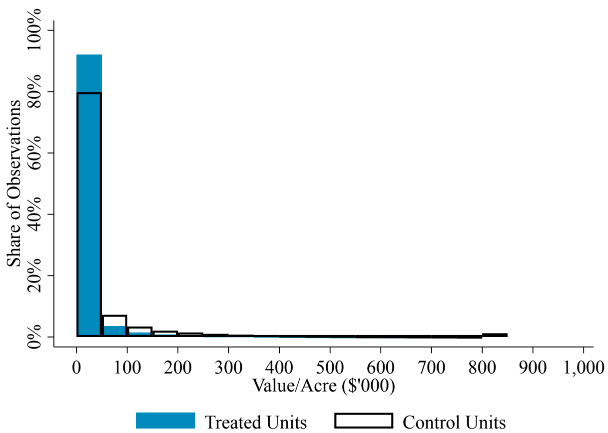
Area Name	Acres	Establishment	State	N	Pct.
Joshua Tree National Park	784,201	Fee	CA	5,333	1.82
Lake Mead National Recreation Area	1,291,856	Fee	AZ	4,201	1.39
Apalachicola National Estuarine Research Reserve	114,616	Fee	FL	3,123	1.03
Santa Rosa And San Jacinto National Monument	280,010	Designation	CA	2,763	0.91
Everglades National Park	109,347	Fee	FL	2,725	0.90
Oregon Islands National Wildlife Refuge	804,785	Designation	OR	2,724	0.90
Santa Rosa-San Jacinto Mountains	195,091	Designation	CA	2,686	0.88
Fakahatchee Strand Preserve State Park	77,370	Fee	FL	2,681	0.88
Mojave National Preserve	1,497,876	Fee	CA	2,650	0.87
Boiling Spring Lakes Preserve	6,691	Easement	NC	2,466	0.81

(B) Annual Panel

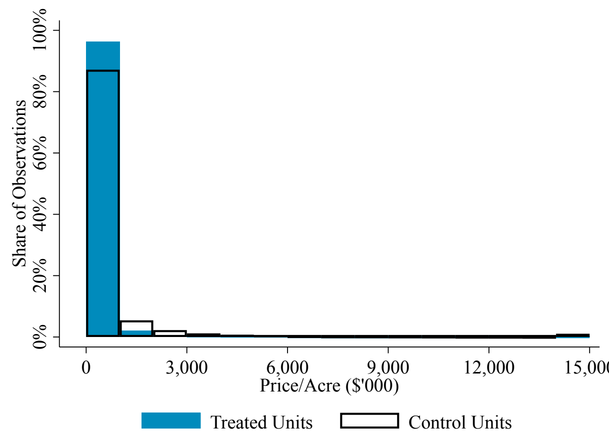
Area Name	Acres	Establishment	State	N	Pct.
Sand to Snow National Monument	175,017	Designation	CA	9,695	4.45
San Gabriel Mountains National Monument	345,222	Designation	CA	7,843	3.60
Berryessa Snow Mountain National Monument	406,901	Designation	CA	3,908	1.79
The Nature Conservancy Conservation Easement	12,383	Easement	GA	2,929	1.35
Earth Conservancy Property	5,251	Fee	PA	2,561	1.18
Buckshutem Wildlife Management Area	391	Fee	NJ	2,231	1.02
Goodhorse	233	Fee	TX	2,162	0.99
Organ Mountains Wilderness Area	19,832	Designation	NM	2,064	0.95
Great Egg Harbor River Wildlife Management Area	1,045	Fee	NJ	1,715	0.79
Agricultural Conservation Easement Program	5,970	Easement	AR	1,463	0.67

Figure B.1. Distribution of Calculated Values and Transaction Prices

This figure depicts overlaid histograms for the distribution of land values and transaction prices per acre. Panel A shows the distribution of the calculated value per acre of vacant land (in $'000) of treated and control properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. Panel B shows the distribution of transaction prices per acre of vacant land (in $'000) of treated and control properties in the sample of vacant land transactions completed in the U.S. between 2010 and 2020. Treated properties are those located inside a protected area with GAP status 1 or 2. Control properties are those not located in any protected area. Calculated values and transaction prices per acre for treated and control properties are winsorized at the 1^{st} and 99^{th} percentiles. The data used to produce this figure are from Corelogic, the USGS, and the U.S. Census Bureau.



(A) Calculated Values



(B) Transaction Prices

Figure C.1. Distribution of Time to Establishment

This figure depicts the distribution of the timing of observations relative to the establishment of the nearest protected area border in the annual panel of vacant land observed in the U.S. between 2010 and 2020. The data used to produce this figure are from Corelogic, the USGS, and the U.S. Census Bureau.

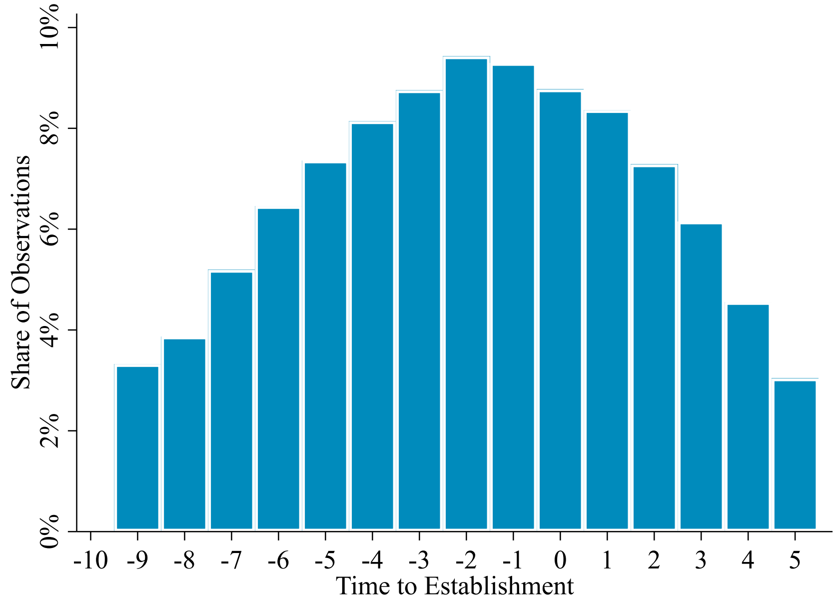


Table D.1. Biodiversity Protections and Liquidity

This table presents output from estimating Eq. (1) across the treated and control properties in the double cross-section of vacant land observed in the U.S. in 2010 and 2015. The dependent variable is *Sold*, an indicator that takes the value of one for property i observed in year 2010 (respectively, 2015) if that property is observed in the transaction sample by 2014 (respectively, 2019). *Treated* is an indicator that takes the value of one if the vacant land is located inside a protected area with GAP status 1 or 2, and zero if it is not located in any protected area. *Distance* is the distance from the centroid of the vacant land sold to the nearest protected area border in KM. For treated parcels, this variable measures the distance to the nearest border of the protected area containing the land. For control parcels, this variable measures the distance to the nearest border of the surrounding protected areas with GAP status 1 or 2 in the same state. *Acres* is the size of the vacant land in acres. Fixed effects for protected area-year are included as indicated. Sample restrictions by bandwidth around protected area borders are applied as indicated. Linear, squared, and up to cubic controls for *Distance* are included as indicated. The mean of the dependent variable in each estimation is reported in decimal form. Robust standard errors, clustered by protected area, are shown in parentheses. Statistical significance is indicated as follows: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	(1) Sold	(2) Sold	(3) Sold
Treated	-0.005*	-0.007***	-0.004**
	(0.00)	(0.00)	(0.00)
Distance	0.038	0.002	0.011
	(0.03)	(0.00)	(0.01)
Treated× *Distance*	-0.006	-0.003	-0.011
	(0.04)	(0.01)	(0.01)
Treated× *Acres*	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)
Acres	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)
Area-Year FEs	Yes	Yes	Yes
Bandwidth	0.5 KM	0.5 KM	0.2 KM
Distance Controls	Cubic	Linear	Linear
Mean Dep. Var.	0.02	0.02	0.02
Observations	300,639	300,639	129,342
R-sq.	0.04	0.04	0.06