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New Models and Methods for Efficient Land Conservation

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New Methods and Models for Efficient Land Conservation

by

Reid L. Johnsen

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Committee in charge:

Professor Gordon Rausser, Chair
Professor Lynn Huntsinger
Associate Professor Ethan Ligon

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Abstract

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This dissertation presents a series of essays that illustrate opportunities for improving the economic efficiency of conservation easement purchases and land conservation in general. Each essay provides concrete methods to address a current issue in conservation easement purchasing or valuation.

The first essay explores the relationship between the degree to which landowners identify as ranchers and their preferences between a lump sum and a perpetuity form of compensation. Using original survey data from 231 California landowners in Sonoma and Marin Counties, we elicit measures of rancher identity and preferences among three compensation packages for the sale of a conservation easement. We find that the majority of participating landowners prefer a perpetuity over a lump sum, suggesting that conservation groups could more efficiently conserve land by offering a perpetuity payment option. By randomly perturbing the identity salience of some landowners, we attempt to determine the causal impact of identity on preferences. Although our results lack statistical power, they provide suggestive evidence in support of the hypothesis that preference for a perpetuity over a lump sum is a function of identity as a rancher.

The second essay addresses one of the key challenges in calculating return on investment (ROI) for a conservation easement purchase. From the perspective of a land conservation group, the three components of ROI for a conservation easement are the value of ecosystems services (ES) that the conserved property provides, easement price, and probability of development under a counterfactual scenario in which the easement had not been enacted. In this essay we assess the relative importance of uncertainly in ecosystem service values compared to uncertainty in land development projections. To do so we estimate the value of the ecosystems services provided by 19 conservation easements held by a California land trust, based on ES values from 9 stated preference studies. For each property we then

consider 3 plausible counterfactual development scenarios, resulting in a total of 27 different valuations (3 counterfactuals x 9 ES values). Pairwise analysis suggests that, while the impact of both choices is large, the choice of counterfactual has a substantially larger impact on ES value than the choice of ES value transfer study. In our study area, choosing an alternative counterfactual scenario changes the valuation by an average of 648% relative to the base case, while choosing an alternative value transfer study changes the valuation by an average of 132%.

The third essay assesses whether the easement price information in property appraisals contains any information, aside from easement price, that impacts conservation group ROI. Before a conservation easement is sold an appraisal is usually commissioned in order to determine the value of the conserved property before and after the easement is put into place. The difference between these two values is the appraised value of the easement, which represents the value of the easement to the landowner. However, since landowners and conservation groups have very different objective functions, the value of the easement to the landowner is not necessarily equal to the value of the easement to a conservation group. Using a dataset of 36 appraisals for conserved California rangeland, we test the hypothesis that ecosystems service value is correlated with appraised value. We also test the hypothesis that counterfactual conservation easement value, which is the value of the easement to a conservation group, is captured in appraised value. We find that ecosystems service value is highly uncorrelated with appraised value, and that counterfactual easement value is slightly positively correlated with, though non-linearly related to, appraised value.

To Letha Ch'ien and the rest of my family

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Acknowledgments

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Chapter 1

Introduction

More than 20 million acres of American land are currently protected against development through conservation easements (Stroman 2016). Typically, conservation easements sales are negotiated between a landowner and a land conservation group, and there are currently more than 150 land conservation groups operating in California alone (CCLT 2019). Some of these conservation groups are publicly-funded, while others are non-profits or NGOs. Conserved land is a public good—it provides cultural and ecosystems services to the surrounding communities at no direct cost to its beneficiaries. It is therefore in the public interest that land conservation groups conduct their conservation efforts in an efficient manner. An extensive body of academic literature outlines theoretical frameworks for optimal land conservation under a variety of conservation objectives, including Ando et al. (1998), Polasky et al. (2005), Parker and Thurman (2019), and many others, but it is not clear that conservation groups consider those frameworks when purchasing conservation easements. Despite the volume of high-quality theoretical literature, it is often observed that conservation choices frequently lack scientific direction (Prendergast et al. 2001, Knight et al. 2006).

One explanation for the disparity between theory and practice of conservation choices is a lack of accessible, front line tools that are tailored for use by conservation groups. This dissertation presents immediately actionable methods and models for improving the economic efficiency of conservation easement purchases. In each essay we highlight an aspect of conservation easement purchasing or valuation and provide empirically-supported strategies or techniques that enhance the efficiency of land conservation efforts.

Rancher Identity and Time Horizons: Alternative Payment Structures for Conservation Easements

The first essay, Chapter 2, explores the relationship between rancher identity and preferences between a lump sum and a perpetuity as compensation for a conservation easement sale. Using original survey data from 231 landowners in Sonoma and Marin Counties, we elicit measures of rancher identity and preferences among three compensation packages for the sale of a conservation easement. We test the hypothesis of a causal relationship between identity and preferences using a novel randomized controlled trial that is integrated with our survey.

From the perspective of a land conservation group, the most immediately actionable question asked in Chapter 2 is also the simplest: Do some landowners prefer a perpetuity to a lump sum as payment for a conservation easement? We find that the majority of survey respondents prefer a perpetuity. This is an immediately actionable finding for land conservation groups. If rates of time preference differ between land conservation groups and land owners, or if land trusts have access to financial instruments that are not available to individual land owners, land trusts could potentially improve the welfare of both groups by offering a perpetuity instead of a lump sum.

Of secondary importance to land conservation groups is the relationship between identity and payment structure preferences. A conservation group need not offer landowners payment structures that are tailored to their perception for the landowner's identity as a rancher–the conservation group could instead provide options for payment structures and allow the rancher to choose the structure that is most appealing to them. Nonetheless, this chapter underscores the range of rancher identity that can be found among the potential conservation easement sellers.

Valuing Ecosystems Services: Does the Counterfactual Matter?

Before any payment structure is offered to a landowner, the conservation group must determine if the subject property is a good candidate for conservation. Chapter 3 addresses an important source of uncertainty that conservation groups face when evaluating potential conservation easements or land acquisitions. When a conservation group calculates the return on investment (ROI) for a prospective easements, they must consider the value of the ecosystems services (ES) that the property provides, as well as the likelihood of a loss of those ES under a counterfactual scenario in which the easement had not been enacted. Both ES valuation and counterfactual modeling can be expensive, and both are highly uncertain processes. In this chapter we ask to which of these two components of ROI should a researcher dedicate their resources.

We assess the relative importance of uncertainly in ecosystem service values compared to uncertainty in land development projections by simulating a researcher's decision to seek further information. Using a set of 3 plausible counterfactual development scenarios and 9 stated preference studies of household ES values, we estimate the value of the ecosystems services provided by 19 California conservation easements. For each pair of stated preference study and counterfactual scenario, we simulate the percentage change in ES that would result from choosing a new counterfactual scenario or choosing a new stated preference ES valuation. Pairwise analysis suggests that, while the impact of both choices is large, the choice of counterfactual has a substantially larger impact on ES value than the choice of ES value transfer study. In our study area, we find that the choice of value transfer study changes the valuation by an average of 132%, while the impact of the choice of counterfactual scenario is approximately 5 times greater, at an average of 648%.

Assessing Conservation Easement Value Using Appraised Value

It is not always possible to comprehensively evaluate a property's return on investment, including both the value of its ecosystems services and counterfactual likelihood of development. In Chapter 4 we develop a rule of thumb for predicting if a California rangeland property will yield a high ROI without the need for a complete ES valuation. Before a conservation easement is sold an appraisal is usually commissioned to determine the value of the conserved property before and after it is encumbered with the easement. The difference between these two values is the appraised value of the easement, and the conservation group will often purchase the easement for a price at or near this appraised value. While the appraised value represents the easements value to the landowner, it does not necessarily approximate the value of the easement to the conservation group.

In this chapter we first ask if appraised easement value is correlated with the level of ecosystems services that the subject property provides. Using a dataset of 36 appraisals for conserved California rangeland, we calculate ES based on stated preference studies and the number of households within commuting distance of the subject property. Since appraised value is a function of the parcel's development potential, appraised value could plausibly be correlated with the number of households within commuting distance as well. We find that ecosystems service value is highly uncorrelated with appraised value, that is, the appraised value of a conservation easement contains almost no information about the value of the ecosystems services that the property provides.

Second, we ask if the easement value in light of a counterfactual development scenario, which represents the value of the easement to the land trust, is correlated with appraised value. Even if ES value is not correlated with appraised value, we showed in Chapter 3 that the choice of counterfactual development scenario is at least as important as ES value in determining easement value. By employing a modeled counterfactual scenario to quantify the relationship between appraised value and easement value, we identify a statistically significant positive correlation between appraised value and counterfactual value. This relationship is highly non-linear. The most efficient conservation opportunities in our sample are found in easements with appraised cost between $724 and $1725 per acre (2011 USD). However, appraised cost alone is not entirely predictive of easement value. Some easements within the range of greatest efficiency return low or zero ROI.

Chapter 2

Rancher Identity and Time Horizons: Alternative Payment Structures for Conservation Easements

2.1 Introduction

Conservation easements have emerged as one of the primary channels for protecting private land against development. Easements restrict development in designated areas, and these restrictions apply both to current and future owners of the land. Since easements reduce development potential, resale value of the land is presumably diminished. Landowners are typically compensated with a one-time payment from a conservation group. Conservation easements are growing in popularity—between 2000 and 2016 the amount of US land protected under conservation easements increased more than sixfold to 20 million acres (Stroman 2016).

A large body of literature studies optimal behavior by conservation groups, such as efficiently achieving conservation targets and selection of optimal parcels for conservation. Ando et al. (1998) and Newburn (2005), among many others, observe the importance of incorporating biological factors and ecosystems services in models of optimal conservation. Polasky et al. (2005) and more recently Duke et al. (2015) and Mitchell et al. (2015) emphasize the importance of spatial optimization and landscape fragmentation in conservation choices. A broad literature debates the merits of various methods of valuing conserved land, including Babcock et al. (1997), Naidoo et al. (2009), Duke et al. (2014), and Boyd et al. (2015). Other studies have examined the mechanisms that deliver efficient outcomes during conservation easement negotiations, such as Polasky et al. (2005), who discuss optimal conservation easement auctions under asymmetric information, and Anderson and King (2004), who examine equilibrium behavior of land owners and conservation groups in light of the property tax impacts on the surrounding community.

However, to our knowledge little academic work has studied the optimal payment structure for a conservation easement, given that a parcel has been selected for conservation. Organizations such as land conservation groups are unlikely to discount future payments in the same way that individual landowners do (Marglin 1963). Further, well-endowed conservation groups may have greater access to financial instruments, including perpetuities, than do individual landowners. A land trust seeking to maximize its level of conservation may therefore achieve a higher level of conservation by tailoring payment structures to individual landowners. The first purpose of this paper is to ask whether some landowners prefer a perpetuity to an equivalent lump sum payment. We answer the first question through simple elicitation from landowners.

The second, deeper purpose of this paper is to determine whether cultural identity has a causal influence on time horizons, and whether rate of time preference for payments associated with identity-signaling goods differs from that for payments that are not. This second purpose gives rise to the testable hypothesis of this paper: Does the degree of a landowner's self-identification as a rancher have a causal impact on the landowner's preference between a lump sum and a perpetuity?

Akerlof and Kranton's (2000) foundational paper builds a theoretical framework for the economics of identity and gives some examples of game theoretic outcomes among agents working within that framework. In recent years a handful of work brings Akerlof and Kranton's framework to empirical settings. Benjamin et al. (2010) test the causal relationship between ethnicity salience, which is the reinforcement of identity, and rate of time preference. D'Acunto (2015) uses a perturbation to gender salience to identify a causal impact on risk preferences, and Benjamin et al. (2016) find a similar relationship between religious salience and risk aversion. Willer et al. (2013) take a different approach to gender identity perturbation, provoking an overcompensation response and finding a casual impact on willingness to pay for SUVs.

We build on this strand of literature by asking how cultural identity affects economic outcomes. Following Willer et al, we establish causality by perturbing landowner self-identification as a rancher, provoking an overcompensation response. According to psychoanalyst Alfred Adler's ([1910] 1956) Masculine Overcompensation Thesis, men who feel inferior tend to exhibit more masculine behavior. We extend Adler's thesis to threats to an aspect of identity other than gender, that is, cultural identification as a rancher. Further, we define an identity-signaling good as a good for which ownership communicates information about the owner's identity. For example, the purchase of organic food might signal environmentalist identity, or in the context of this paper rangeland ownership might signal rancher identity. To our knowledge we are the first to apply an empirical identity perturbation to an existing market, and to study the role of identity signaling in that market.

2.2 Analytical Framework

We model the impact of rancher identity on landowner discount rates by combining the Akerlof and Kranton (2000) model of identity with an extension to the Becker and Mulligan (1997) model of endogenous time preferences. Akerlof and Kranton model individual j's utility function as

$$U_j = U_j(a_j, a_{-j}, I_j) \tag{2.1}$$

where a_j is a vector of j's actions, a_{-j} is a vector of everyone else's actions, and I_j is j's identity function defined by

$$I_j = I_j(a_j, a_{-j}, c_j, \epsilon_j, P) \tag{2.2}$$

where c_j is a social category, P is a vector of norms that govern c_j, and ϵ_j is difference between P and the innate characteristics of j.
Individual j's utility function is assumed to satisfy

$$\frac{\partial U_j}{\partial I_j} > 0 \tag{2.3}$$

that is, higher identity raises utility.

In our analysis, we take c_j as the category "rancher", thus I_j is the degree to which individual j feels that she is a rancher. We take P and a_j as given, but observe that a_{-j} and a_j are subject to interventions by the researcher. For example, the researcher's actions could be contained within the vector a_{-j}. Alternatively, we could note that while Akerlof and Kranton describe ϵ_j as the difference between P and j's innate characteristics, we might define ϵ_j as individual j's *perceived* difference between P and her innate characteristics. The researcher could then potentially perturb ϵ_j by altering j's perception of her characteristics rather than her actual characteristics. Regardless of the precise mechanism of the researcher's perturbation of I_j, we would expect the outcome to be analytically identical.

Becker and Mulligan (1997) model lifetime utility with endogenous time preferences as

$$V = \sum_{t=0}^{T} \beta(S) U_t(x_t) \tag{2.4}$$

where S is the level of resources spent on imagining the future, $\beta(S)$ is the discount rate, x_t is consumption at time t, and T is the most distant time period that the individual considers. A typical example of investment in S is investment in economics education. Trained economists are more likely to view future utility as a stream of discounted utility gains and will therefore have a larger $\beta(S)$.

We make the simplifying assumption that $u_t(x_t) = u(x_t) \quad \forall t$, that is, at the time of her decision to sell a conservation easement the landowner does not expect her utility function to change in the future. Assuming that the landowner has decided to sell a conservation easement, we can model her choice of payment structures as

$$\max\{LUMP, PERPETUITY\} \tag{2.5}$$

$$LUMP = \sum_{t=0}^{T^*} \beta(S)^t U(x_t + \alpha_t L) + \sum_{t=T^*+1}^{T} \beta(S)^t U(x_t) \tag{2.6}$$

$$PERPETUITY = \sum_{t=0}^{T} \beta(S)^t U(x_t + A) \tag{2.7}$$

Where L is a lump sum, A is an annual payment, and the series $\{\alpha_t\}$ represents the landowner's chosen consumption path for the lump sum payment, with $\{\alpha_t\}$ satisfying $\sum \alpha_t = 1$.

We consider three possible ways in which rancher identity may enter the landowner's multi-period utility maximization problem (we show only the perpetuity function, the lump sum function is similar):

$$PERPETUITY = \sum_{t=0}^{T} \beta(S)^t U(x_t + A, I)) \tag{2.8}$$

$$PERPETUITY = \sum_{t=0}^{T} \beta(S, I)^t U(x_t + A) \tag{2.9}$$

$$PERPETUITY = \sum_{t=0}^{T(I)} \beta(S)^t U(x_t + A) \tag{2.10}$$

Equation (2.8) states that identity enters the rancher's utility function just as in Akerlof and Kranton's model. Equation (2.9) states that identity directly affects an individual's discount rate, suggesting that the degree to which a landowner identifies as a rancher affects the clarity with which she perceives future payoffs. Equation (2.10) states that time horizon is a function of identity, suggesting that the degree to which a landowner identifies as a rancher can change her valuation of a payment in the distant future from zero to some positive number. There is no reason to assume that identity does not simultaneously affect utility in more than one of the three listed ways, indeed, without specifying functional forms for β and U it would be very difficult to devise an empirical test that eliminates any of the three possibilities.

2.3 Rancher/Conservation Group Interaction

Whether a perpetuity improves welfare over a lump sum payment structure is a feature of the interaction between the rancher's and the conservation group's preferences. Suppose that a conservation group offers to purchase a conservation easement from a rancher. Let L_C be the maximum lump sum amount that the conservation is willing to pay for the easement. In practice, L_C is often determined by an appraiser and is the amount that is offered to the rancher. Let P_C be the perpetuity payment, as defined by equation 2.7, for which the conservation group is indifferent between L_C and P_C. P_C and its parameter A are determined by conservation group's discount rate β and utility function U. Further, let L_R be the minimum lump sum that the rancher will accept as payment for a conservation easement. Similarly, let P_R be the minimum perpetuity that the rancher will accept as payment.

Suppose that the conservation group offers to purchase a conservation easement from the rancher and gives the rancher her choice of either L_C or P_C as compensation. The eight possible outcomes are given in table 2.1.

Table 2.1: Possible interactions of L_C, P_C, L_R, and P_R

Scenario	Outcome	Description
$L_R < L_C$ and $P_R < P_C$ and $L_R < P_R$	Sold at P_C	Rancher prefers P_C
$L_R > L_C$ and $P_R < P_C$ and $L_R < P_R$	Sold at P_C	Rancher prefers P_C
$L_R > L_C$ and $P_R < P_C$ and $L_R > P_R$	Sold at P_C	Rancher prefers L_R, but $L_R > L_C$
$L_R < L_C$ and $P_R < P_C$ and $L_R > P_R$	Sold at L_C	Rancher prefers L_C
$L_R < L_C$ and $P_R > P_C$ and $L_R > P_R$	Sold at L_C	Rancher prefers L_C
$L_R < L_C$ and $P_R > P_C$ and $L_R < P_R$	Sold at L_C	Rancher prefers P_R, but $P_R > P_C$
$L_R > L_C$ and $P_R > P_C$ and $L_R < P_R$	No sale	Neither offer is acceptable to the rancher
$L_R > L_C$ and $P_R > P_C$ and $L_R > P_R$	No sale	Neither offer is acceptable to the rancher

In those cases in which the outcome is "Sold at P_C," an offer of P_C would have increased rancher welfare over an offer of L_C alone. In one of those cases either L_C or P_C would have been acceptable to the rancher, so the easement would have been sold even if only L_C had been offered. In the other two cases the rancher would not have accepted L_C, so the easement would not have been sold without the offer of P_C. In those two cases conservation group welfare is increased by the offer of P_C, in addition to increased rancher welfare, because the conservation group is able to conserve land that it otherwise would not have.

Lack of certainty surrounding the land trust's ability to make payments to the landowner in perpetuity may contribute the landowner's preferences between the two payment structures. The landowner may require some protections in case of land trust default. One possible way to offer this protection is to write the easement in such a way that the encumbrance is removed from the property's title in the event of a missed payment. In such a case, land trust default would represent a windfall to the landowner in the form of dramatically increase property value. However, in our survey we do not specify the compensation the landowner would receive in the event of land trust default, so it is unclear whether or not survey respondents considered that possibility.

2.4 Empirical Specification

This paper tests the hypothesis that rancher identity has a causal impact on preferences between a lump sum and a perpetuity payment for the sale of a conservation easement. We employ a randomized controlled trial and a two stage least squares (2SLS) specification to isolate the causal effect. We remain agnostic about the exact mechanism by which identity enters into the landowner's utility maximization problem—any combination of the three potential channels described in section 3.4 are plausible options. The first stage of our 2SLS specification is

$$Identity_i = \alpha + \beta_1 Treatment_i + +\beta Demographics_i + \nu_i \tag{2.11}$$

where $Identity_i$ is a measure of rancher identity, $Treatment_i$ is a dummy variable that takes on the value of 1 if the landowner's identity as a rancher has been perturbed (zero otherwise), and $Demographics_i$ is a vector of variable describing i, including income, parcel size, percent of income derived from agriculture, number of generations involved in agriculture, and others. ν_i is an error term. The second stage is

$$Pref_i = \alpha + \beta_1 \widehat{Identity}_i + \beta Demographics_i + \epsilon_i \tag{2.12}$$

where $Pref_i$ is a measure of landowner i's preference between a lump sum and a perpetuity, $\widehat{Identity}_i$ is the estimated value from the first stage, and ϵ_i is an error term.

Our treatment consists of survey question number 3 (see Appendix A), which highlights rapid population growth and suburban expansion in the San Francisco Bay Area. This question is intended to perturb rancher identity by increasing identity salience in survey recipients. By emphasizing a threat to rural lifestyles, in the form of urban encroachment on rangelands, we seek to provoke overcompensation in rancher identity. Immediately after the treatment question, we ask a series of questions eliciting rancher identity. We randomly designate approximately 50% of the surveys to be part of the treatment group, and those surveys include the treatment question. Those surveys that do not receive the treatment question constitute the control group.

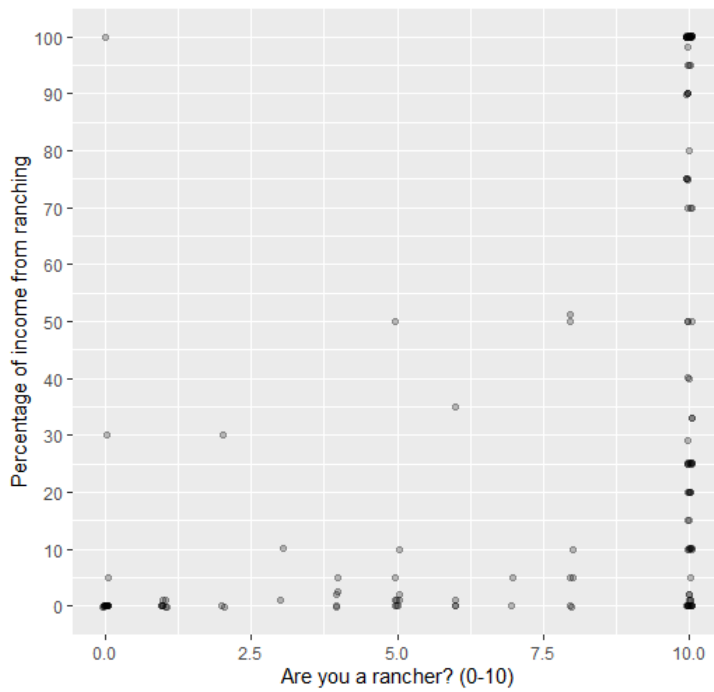
2.5 Data

We conduct our analysis on a dataset composed from a survey of 1007 landowners in Sonoma and Marin counties. Landowners were selected to receive the survey based on the two criteria. First, selected landowners must own a parcel of 50 acres or larger. Second, the parcel should have the potential to support livestock. In order to identify parcels that have the potential to, but do not currently, support livestock, we supplement the tax roll with spatial data from the California Department of Forestry and Fire Protection (CDFFP). The CDFFP data layer contains vegetation type data at the pixel level for the state of California. We designate a parcel as capable of supporting livestock if it is covered by more than 70% herbaceous plant material, shrubs, or grassland. For Sonoma County, we utilize the Sonoma County tax assessment roll, which identifies parcels that were in service as pasture or dairy at the time of most recent sale. The Marin County tax roll does not identify pasture land specifically, but it does designate parcels as agricultural or non-agricultural. As in Sonoma County, we supplement the set of agricultural parcels with those identified by the CDFFP data layer. The entire population of landowners in our study area that satisfied those criteria were included in our analysis. The surveys were distributed by mail, and a reminder postcard was sent one month after the initial mailing. Follow up phone calls were made to those landowners that did not respond by mail. In total, 231 landowners responded, or approximately 23%. Of these, 197 surveys were administered by mail and 34 were administered by phone.

Our survey is part of a larger initiative by the Sonoma County office of the University of California Cooperative Extension (UCCE). UCCE has an interest in following up on a previous survey of landowners that had sold conservation easements (Rilla and Sokolow 2000), with purpose of determining how perceptions of conservation easements had changed over time. We supplement the UCCE survey with questions that elicit identity, a randomly assigned question meant to perturb identity, and a question that elicits preferences among three different payment structures for conservation easements. Additionally, we add questions targeted at landowners that have not sold an easement and landowners that purchased a parcel with an easement in place at the time of sale. The full survey consists of 43 questions, see Appendix A.

2.6 Results

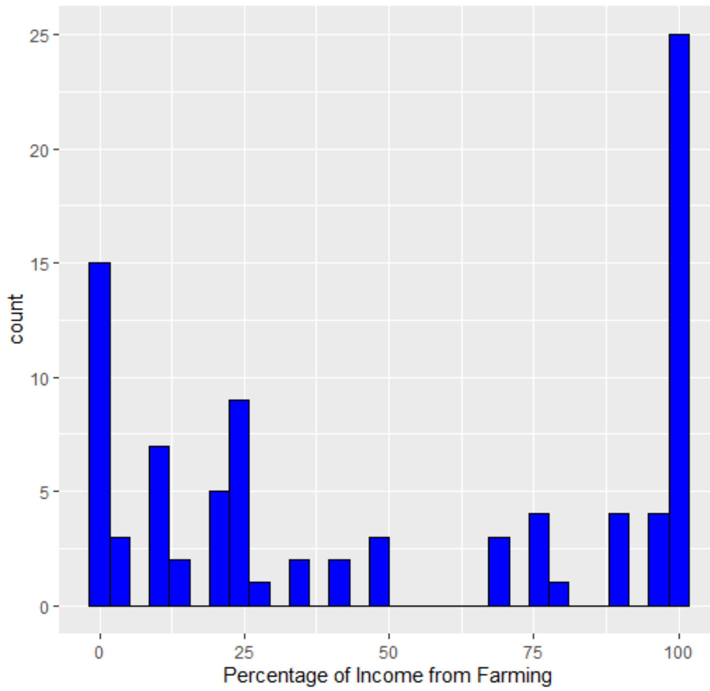
Figure 2.1: Scatterplot of Identity and Percentage of Income from Agriculture



Identity does not appear to be a function of percent income from farming alone. There are clusters of landowners that strongly (weakly) identify as a rancher and receive a large (small) amount of their income from agriculture, but there are also many landowners for which the relationship between the two variables is less clear. Scatterplot points are randomly perturbed a small amount to illustrate cluster size.

Figure 1.1 illustrates the importance of eliciting rancher identity from landowners rather than attempting to infer identity from more concrete demographic information. Income from ranching/farming is clearly not the sole determinant of rancher identity, as illustrated by the large number of observations that do not fall within the clusters in the lower left and upper right corners of the figure. Even within the set of landowners that report identity equal to 10, as shown in figure 1.2, there is substantial variation in percentage of income that comes from agriculture, including several observations at 0%.

Figure 2.2: Histogram of Income among Ranchers with Identity = 10



Even among those landowners that reported an identity value of 10 there is a large amount of variability in the percentage of income that comes from agriculture.

Table 2.2 gives descriptive statistics for several of the variables in our dataset. Two variables, "I am a rancher (0-10)" and "I am part of a ranching community (0-10)" are meant to elicit rancher identity. The variable "Preference for PERP over LUMP" indicates the difference between stated rankings of a perpetuity (0-10) of $14,000 and a lump sum of $200,000. Of the 109 landowners that expressed a preference between the lump sum and perpetuity, a clear majority (69), preferred the perpetuity. This preference is more pronounced among landowners that do not currently have a conservation easement on their property, of whom 60 prefer the perpetuity and 28 prefer the lump sum. Selection bias among easement holders may contribute to a preference for the lump sum—landowners that have sold an easement may have had an urgent financial reason to do so. Another possible explanation is that when we ask easement holders to compare a lump sum that they have already received to a hypothetical perpetuity, their relative valuation may be influenced by the difference between willingness to pay and willingness to accept.

Table 2.2: Descriptive statistics

Statistic	N	Mean	St. Dev.	Min	Max
Treatment	231	0.488	0.501	0.000	1.000
Part of a ranching community (0-10)	198	7.455	3.712	0.000	10.000
Years family in ranching	163	66.580	44.503	0.000	160.000
Number of children	160	2.263	2.258	0.000	24.000
Number of children in ranching	207	0.551	0.943	0	7
Percent income from ranching	154	32.698	39.775	0.000	100.000

Table (2.2) gives descriptive statistics for selected survey questions. Most surveys were returned with some questions unanswered. The statistic N gives the number of respondents for the given question.

Table (2.3) show results from regression (2.11), the first stage of our 2SLS regression. The tables indicate that our instrument is weak; under no specification is the treatment's effect on rancher identity statistically significant. One possible explanation for the lack of statistical significance is that the sample size is not sufficiently large. Almost 80% of the surveys were not returned, and only 3% more responded to a follow up postcard or phone call. A second possible explanation for the lack of statistical significance in tables (2.3) is that the treatment is not effective in perturbing rancher identity. It may be that we were not successful in our effort to increase rancher identity salience. Despite the lack of statistical significance on the *treatment* coefficient, it is worth noting that the point estimates of the effect of the treatment on identity are fairly stable and positive, suggesting that we induced a small perturbation to rancher identity.

Table 2.3: Regressions of Rancher Identity on Treatment

	Dependent variable:				
	I am Part of a Ranching Community (0-10)				
	(1)	(2)	(3)	(4)	(5)
Treatment	−0.021	0.142	0.157	0.590	0.863
	(0.528)	(0.616)	(0.608)	(0.592)	(0.623)
Existing easement		0.352	0.455	0.619	1.060
		(0.659)	(0.653)	(0.656)	(0.786)
Residence on parcel		2.727***	2.510***	2.048***	2.141***
		(0.661)	(0.663)	(0.654)	(0.721)
Household income		0.198	0.227	−0.374	−0.764*
		(0.336)	(0.332)	(0.366)	(0.383)
Children in ranching		0.519*	0.553*	0.259	−0.242
		(0.293)	(0.290)	(0.288)	(0.313)
Pct income ranching		0.034***	0.031***	0.026***	0.020**
		(0.008)	(0.008)	(0.008)	(0.008)
Female		0.259	−0.048	0.106	0.097
		(0.758)	(0.767)	(0.715)	(0.718)
Grazing on parcel			1.184*	0.515	−0.314
			(0.650)	(0.666)	(0.739)
Years family in ranching				0.007	−0.005
				(0.008)	(0.008)
Neighboring agriculture					1.902
					(1.493)
Years in ranching					0.032*
					(0.018)
PCT income from ranching					−0.026
					(0.036)
Constant	7.490***	3.568***	3.001**	5.538***	7.545**
	(0.370)	(1.333)	(1.352)	(1.640)	(3.084)
Observations	196	96	96	82	59
R^2	0.00001	0.345	0.369	0.375	0.454
Adjusted R^2	−0.005	0.293	0.311	0.297	0.311
Residual Std. Error	3.698	2.985	2.947	2.645	2.207
F Statistic	0.002	6.625***	6.364***	4.800***	3.186***

Note: *p<0.1; **p<0.05; ***p<0.01

In the spirit Benjamin et al. (2010), we formulate a second method of evaluating the effectiveness of the treatment by running regressions of the form

$$Pref_i = \alpha + \beta_1 Treatment_i + \beta Demographics_i + \epsilon_i \tag{2.13}$$

If the treatment affects preferences only through identity, we could identify the average treatment effect and entirely avoid measuring identity by simply including the treatment as a dependent variable, as in equation (2.13). However, as table (2.4) shows our point estimates of the average treatment effect are not precisely estimated. As in table (2.3), the point estimates are fairly consistent across specifications, suggesting that we may have successfully induced a treatment effect but without sufficient power to deliver statistically significant results.

Table 2.4: Regressions of Preferences on Treatment

	Dependent variable:				
	Preference for perpetuity over lump sum				
	(1)	(2)	(3)	(4)	(5)
Treatment	−0.408	−1.197	−1.196	−1.259	−1.019
	(0.603)	(0.910)	(0.916)	(1.003)	(1.332)
Existing easement		−1.759*	−1.751*	−2.110*	−2.429
		(0.986)	(0.996)	(1.127)	(1.680)
Residence on parcel		0.084	0.070	0.256	0.642
		(0.989)	(1.013)	(1.125)	(1.541)
Household income		−0.235	−0.233	−0.337	−0.128
		(0.505)	(0.508)	(0.631)	(0.818)
Children in ranching		−0.043	−0.042	0.123	0.391
		(0.430)	(0.433)	(0.482)	(0.670)
Pct income ranching		−0.015	−0.015	−0.012	−0.021
		(0.012)	(0.012)	(0.013)	(0.018)
Female		2.175*	2.156*	2.109*	2.342
		(1.111)	(1.147)	(1.203)	(1.536)
Grazing on parcel			0.072	0.382	0.708
			(0.990)	(1.144)	(1.581)
Years family in ranching				−0.016	−0.020
				(0.013)	(0.018)
Neighboring agriculture					0.217
					(3.192)
Years in ranching					0.016
					(0.039)
PCT income from ranching					−0.019
					(0.078)
Constant	0.638	1.691	1.656	2.759	2.545
	(0.421)	(2.003)	(2.071)	(2.822)	(6.596)
Observations	205	99	99	85	59
R^2	0.002	0.100	0.100	0.129	0.155
Adjusted R^2	−0.003	0.031	0.020	0.025	−0.066
Residual Std. Error	4.316	4.491	4.516	4.568	4.721
F Statistic	0.458	1.447	1.253	1.238	0.701
Note:			*p<0.1; **p<0.05; ***p<0.01		

Since our instrument lacks statistical strength, we cannot make causal statements about the impact of identity on preferences between a perpetuity and a lump sum. However, we can still estimate the correlation between identity and those preferences. Table (2.5) presents estimates of those results from an ordinary least squares regression similar to the 2SLS specification given in equation (2.12). Rancher identity is negatively correlated with preference for a perpetuity over a lump sum, although the level of statistical significance is low in all specifications. Negative correlation is a surprising finding and runs counter to the hypothesis that ranchers prefer payment structures that encourage the long term sustainability of ranching. One possible explanation for this result is that risk aversion or distrust of institutions are components of rancher identity. It may be that, while ranchers are personally invested in sustaining ranching, they are less inclined to believe that conservation groups will meet their commitments to making perpetuity payments in the long run. This effect may dominate any positive correlation between time horizons and identity.

2.7 Discussion

Selection Bias

Survey response rates are rarely 100%, so selection bias is almost always a concern when analyzing survey data. If the act of responding to the survey is correlated with something that the survey measures, selection bias is introduced and it is difficult to justify making statements about the survey population as a whole, as opposed to the group that responded to the survey. Selection bias is further complicated by our argument that rancher identity, one of the central variables that we seek to elicit, is very difficult to predict using observable landowner characteristics. Further, identity may very well be correlated with the choice not to participate in surveys.

Armstrong and Overton (1977) wrote a foundational paper on estimating selection bias. The difficulty in applying their methods, and indeed the methods of all other bias estimation procedures that we are aware of, is that they rely upon observed data on the non-respondents, in our case tax assessment roll data. However, we have argued that identity as a rancher is not highly correlated with any observable characteristics of ranchers.

The Heckman (1977) selection model is one popular method of correcting selection bias. Some econometricians have criticized the Heckman model for its foundational assumptions, without which the model fails to deliver consistent results. The first assumption is that the error terms in the two stages of the model are jointly normally distributed. The second assumption is that, in the absence of an instrumental variable, identification is based on error term distributional assumptions and correct functional form assumptions for the model of the choice to participate in the survey. It is difficult to justify applying the Heckman model under these conditions. Further, the Heckman model would suffer from the same issue that we would encounter when estimating bias–we have argued that identity is not strongly

Table 2.5: OLS Regressions of Preferences on Identity

	Dependent variable:				
	Preference for perpetuity over lump sum				
	(1)	(2)	(3)	(4)	(5)
Identity as rancher	−0.160*	−0.178	−0.207	−0.218	−0.195
	(0.082)	(0.147)	(0.152)	(0.181)	(0.297)
Existing easement		−1.763*	−1.708*	−2.123**	−1.958
		(0.941)	(0.946)	(1.060)	(1.644)
Residence on parcel		0.805	0.744	0.928	1.031
		(1.028)	(1.033)	(1.117)	(1.616)
Household income		−0.173	−0.151	−0.412	−0.250
		(0.481)	(0.483)	(0.595)	(0.834)
Children in ranching		0.339	0.367	0.521	0.314
		(0.427)	(0.429)	(0.465)	(0.644)
Pct income ranching		−0.016	−0.016	−0.014	−0.019
		(0.012)	(0.012)	(0.013)	(0.019)
Female		2.451**	2.283**	2.195*	2.447
		(1.072)	(1.095)	(1.131)	(1.501)
Grazing on parcel			0.757	1.105	0.712
			(0.955)	(1.067)	(1.530)
Years family in ranching				−0.016	−0.020
				(0.013)	(0.018)
Neighboring agriculture					0.813
					(3.175)
Years in ranching					0.025
					(0.039)
PCT income from ranching					−0.038
					(0.074)
Constant	1.698**	1.708	1.462	3.201	4.064
	(0.681)	(1.927)	(1.955)	(2.759)	(6.900)
Observations	198	98	98	84	60
R^2	0.019	0.130	0.136	0.180	0.151
Adjusted R^2	0.014	0.062	0.058	0.080	−0.065
Residual Std. Error	4.262	4.304	4.313	4.300	4.679
F Statistic	3.827*	1.917*	1.749*	1.807*	0.699

Note: *p<0.1; **p<0.05; ***p<0.01

correlated with any observable variables.

In short, the best and surest way to protect against selection bias in this case is to eliminate it as completely as possible. While we collected phone numbers for the majority of the property owners and followed up by phone with those that did not respond to the mailed survey, our ultimate response rate was not sufficient to establish statistical significance or eliminate concerns of selection bias.

However, selection bias is not a primary concern if our goal is to determine whether land conservation groups can increase their efficiency by offering perpetuities in tandem with lump sums. We need only show that perpetuities are more attractive than lump sums to some land owners, without necessarily identifying the particular landowners that hold that preference.

Weak or ineffective treatment

Our first stage regression results generate point estimates that have plausible signs but are not statistically significant. Adding all available covariates did not substantially improve statistical significance. Our treatment does not perturb rancher identity effectively enough to allow us to make causal statements about the effect of identity on preferences. We consider two possible reasons that the treatment might fail. First, the treatment might be too subtle, that is, it might not prompt a strong enough overcompensation response in the survey recipient. Second, it is possible that the act of eliciting landowner identity increases identity salience to that the point at which an overcompensation response is not measurable. For example, suppose that a landowner considers herself to be an 8 on a 0 to 10 rancher identity scale. If the act of asking her to report her identity increases her identity salience, she may report that she is a 10. In this case, the treatment can no longer have a measurable effect.

2.8 Conclusion

The results of the empirical analysis, though suggestive, are largely inconclusive. The coefficients of interest are generally consistent but lack statistical significance. However, statistical significance is not always a necessary feature of actionable results. We have shown that landowners within our study area that have not previously sold a conservation easement prefer a 6% perpetuity to an equivalent lump sum by a ratio of approximately 2:1. We have provided strong evidence that conservation groups can improve efficiency, rancher welfare, and the total amount of conserved rangeland in Sonoma and Marin Counties by offering perpetuity payments either as an alternative to or in tandem with lump sums. This result is immediately actionable for land conservation groups that are seeking to maximize both rancher welfare and the amount of land protected under conservation easements.

Chapter 3

Valuing Ecosystems Services: Does the Counterfactual Matter?

3.1 Introduction

Global biodiversity is in decline and scientists suggest that conserving greater portions of the earth for nature is one of the best ways to halt this trend. While general calls such as Half Earth are broadly useful to motivate the public, making smart conservation decisions requires a systematic approach. How to best conserve land has therefore become a key question for researchers in fields as diverse as conservation biology, bio-geography and economics (Butsic et al. 2013).

Recent work suggests that economic frameworks, such as return on investment, can lead to more efficient conservation (Murdoch et al. 2007). To calculate ROI one must know the stream of benefits that will come from a conserved piece of land, the cost of conserving the piece of land, and a counterfactual of the benefits that would have been produced had the land not been conserved. When these three values can be reliably estimated conservation decisions that maximize ROI can lead to efficient conservation outcomes.

While the price paid for a conservation purchase may be known to the body purchasing the property, there is uncertainty in estimating both benefits and counterfactual scenarios. One common way to think of benefits from conservation purchases is as ecosystem services (ES), the services provided to people from nature. Ecosystem service valuation is a specific realm of non-market valuation, and techniques to value ecosystem services have been under development since the 1990's, see Costanza et al. (1997) and Daily (1997). Still, the accuracy of various approaches remains an area of active research and debate (Spangenberg and Settele 2010, Pandeya et al. 2016). From a policy perspective, it is particularly important to understand how uncertainty around ecosystem service values may change optimal conservation decisions.

Developing counterfactual, or alternative, land use scenarios is a common methodology for understanding social and ecological outcomes from land use change, and several papers point out the need for high-quality counterfactual modeling (Ferraro and Pattanayak 2006, Ferraro 2009, Caplow et al. 2011, Maron et al. 2013, Bull et al. 2014). Modeling and simulating land use change in order to understand conservation challenges has become a central method for analyzing future human and natural states. Yet it is rare to see alternative land use change models compared, even though most land use change models confront large uncertainties either in model parameters or model assumptions. This lack of comparison across models makes it difficult to understand the magnitude of a role that model choices play in generating specific outcomes.

In this paper we ask how uncertainty in ES values and counterfactual scenarios impact conservation easement valuation and return on investment (ROI) for conservation easement purchases. Using a dataset of 19 conservation easements in California for which we have the purchase price, location, and detailed appraisals, we simulate conservation easement values based on 9 alternative ecosystem service estimates and 3 different counterfactual land use scenarios. We show that while both choice of counterfactual scenario and choice of ES valuation transfer study have a large impact on valuation, the choice of counterfactual scenario has an impact approximately 5 times that of the choice of transfer study.

3.2 Site Description

We study 19 conservation easements that are held by a single land conservation non-profit group. The easements are widely distributed across California. While most are located in rural areas, some are much more remote than others; household counts within 50 miles of the easements vary from fewer than 59,000 to more than 1.6 million households. The easements range in size from 271 to 7,024 acres, with a mean size of 2,454 acres. Most easements are zoned for agricultural use, but the zoning details vary significantly between counties. Within the conservation easements, vegetative cover consists of approximately 65% Mediterranean region grassland, 26% woodlands, 8% temperate forest, and 1% sparse vegetation. Table 3.1 presents summary statistics for the conserved parcels.

Table 3.1: Characteristics of 19 conservation easements

	Mean	Median	Min	Max	Std dev
Acreage	2,454	2,099	271	7,024	1,872
Households within 50 mi radius	495,242	401,941	58,918	1,673,100	416,755
Purchase price per acre	\$939	\$872	\$275	\$2,443	\$552
Forest pct	26.7%	28.3%	0.0%	62.2%	23.5%
Woodland pct	45.5%	38.0%	11.0%	87.6%	23.5%
Grassland pct	25.6%	22.1%	0.0%	80.2%	25.9%
Developed/barren pct	2.2%	1.8%	0.0%	8.9%	2.5%

3.3 Simulations

In order to empirically estimate the relative importance of choosing a value to transfer to the site and estimating a counterfactual scenario, we perform the following thought experiment: Suppose that a researcher had identified a single plausible benefits transfer study and a single counterfactual scenario. We simulate this situation by randomly selecting a counterfactual and benefits transfer value from their respective sets of plausible cases. We call this pair the base case and calculate the ES value for the 19 conservation easements under the assumption that the base case correctly values the easements. Now, suppose that the researcher decides to search for a second benefits transfer value that could plausibly transfer to the site. We simulate this decision by randomly selecting a benefits transfer value from a set of plausible values. We record the absolute percentage change in total valuation for the easements under the new benefits transfer value and the counterfactual scenario from the base case. Similarly, we randomly select a counterfactual scenario from a set of plausible scenarios and calculate the total value of the easements using the new counterfactual and the transferred value from the base case. As before, we calculate the absolute value of the percentage change in the total value of the ES of all easements. We repeat the simulation 10,000 times, allowing us to make observations about the average impact of a change in counterfactual scenario as compared to that of a change in choice of BT study.

3.4 Counterfactual Scenarios

We define a counterfactual scenario as the level of ES that the conserved parcels would deliver in the absence of the conservation easements. The value of the conservation easement is therefore the difference between the value of ES provision with the easement in place and the ES value in the counterfactual scenario. The modeled counterfactual scenarios, which we describe in section 3.4, project land use change out to the year 2101. Although our other counterfactual scenarios do not explicitly specify a time frame in which they will be realized, we take those scenarios as plausible development projections for the year 2101 as well.

Zoning maximum counterfactual

The zoning maximum counterfactual assumes that in the absence of the conservation easements, the conserved parcels would be developed into the largest possible number of home sites as allowed by current zoning. We assume that each home site results in the loss of two acres worth of ecosystems services. For example, if a 1,000 acre parcel were zoned for one residence per 100 acres, under the maximum zoning counterfactual we would assume that 10 home sites would be developed, resulting in a loss of 20 acres worth of ecosystems services.

Highest and best use counterfactual

The highest and best use (HBU) counterfactual assumes that each parcel is developed to degree identified as the highest and best use by a current appraisal. As in the zoning maximum counterfactual, we assume that each home site eliminates two acres worth of ecosystems services. For example, one appraisal states that the highest and best use for the appraised parcel is "...two 20± acre parcels as home sites and retain the remainder of the property for livestock grazing, recreational uses, and/or two single home sites." We interpret this assessment as a scenario in which a total of four home sites are developed, for a total of eight acres removed from providing ecosystems services.

Modeled counterfactual

We choose a modeled counterfactual based on the LUCAS model: annual land use/land cover (LULC) projections for California developed by Sleeter et al. (2017), which spans 2001 through 2101. LUCAS applies a 1 km grid to the state of California and projects LULC among twelve land classes, which we further condense into four categories based on the ecosystems services that each provides: grassland, woodland, forest, and barren/developed. LUCAS employs four development scenarios, denoted BAU, BAU HIGH, BAU MED, and BAU LOW, which represent business as usual and high, medium, and low population growth respectively. For the easements in our sample the four scenarios are essentially identical, so we include only the BAU scenario in our analysis. For each conserved parcel, we use ArcGIS to extract LULC projections for the year 2101, which we compare to the year 2001. We take the projected percentage change in undeveloped land within the easement area as the counterfactual development scenario in the absence of the easement. For example, suppose that a 100 acre conserved parcel consisted of 25% woodland and 75% grassland in 2001, and that under the BAU LUCAS projection for 2101 the parcel would consist of 20% woodland, 70% grassland and 10% barren/developed. We interpret the difference between the two land cover distributions as a counterfactual scenario in which the ecosystems services provided by 5 acres of woodland and 5 acres of grassland are lost.

Full development counterfactual

The full development counterfactual is built on the assumption that in the absence of conservation easements, all ecosystems services provided by the conserved parcels would eventually be lost. This counterfactual is commonly used in non-peer reviewed analyses, such as Sargent-Michaud (2009) and Schmidt et al (2014), and results in the largest possible valuation of the conservation easements for any given valuation method. While the full development counterfactual is attractive to conservation groups, it is difficult to justify its application to rural or remote parcels, which are extremely unlikely to be fully converted away from agriculture. For this reason we do not include the full development scenario in our main analysis.

3.5 Benefits Transfer Studies

Benefits transfer, also called value transfer, is the process of applying values from an existing study to a new study, often at a different study location (Boyle and Bergstrom 1992). Transfer validity is largely contingent on similarity between the original study location and the new study location along a variety of metrics, including similar populations and similar ecosystems services provision (Brouwer 2000). We perform a comprehensive literature review and identify 9 stated preference studies across 7 peer-reviewed publications that could plausibly transfer to California rangeland. Each study was conducted within the past 25 years in either the US or Canada and estimates willingness to pay (WTP) for either grassland, rangeland, or fallow farmland. Most of the studies that we identify present WTP on a per acre per household per year basis, that is, the amount that a household would be willing to pay annually to conserve one acre of land. When a single publication presents results from multiple experiments, we treat the results of each experiment as an independent value transfer study. When a single experiment produces a range of household WTP, we treat the mean of that range as the study result. For those studies that present household WTP as a one time lump sum payment, we convert WTP into a per acre per year value using present value discounting at a rate of 5% and a time horizon of 100 years. Additionally, we convert all values to 2018 USD using the US Department of Labor Statistics' chained CPI adjustment. Table 3.2 summarizes the benefits transfer studies that we identify. For a thorough description of benefits transfer methodology see Brouwer (2000).

Table 3.2: Plausible benefits transfer studies for California Rangeland

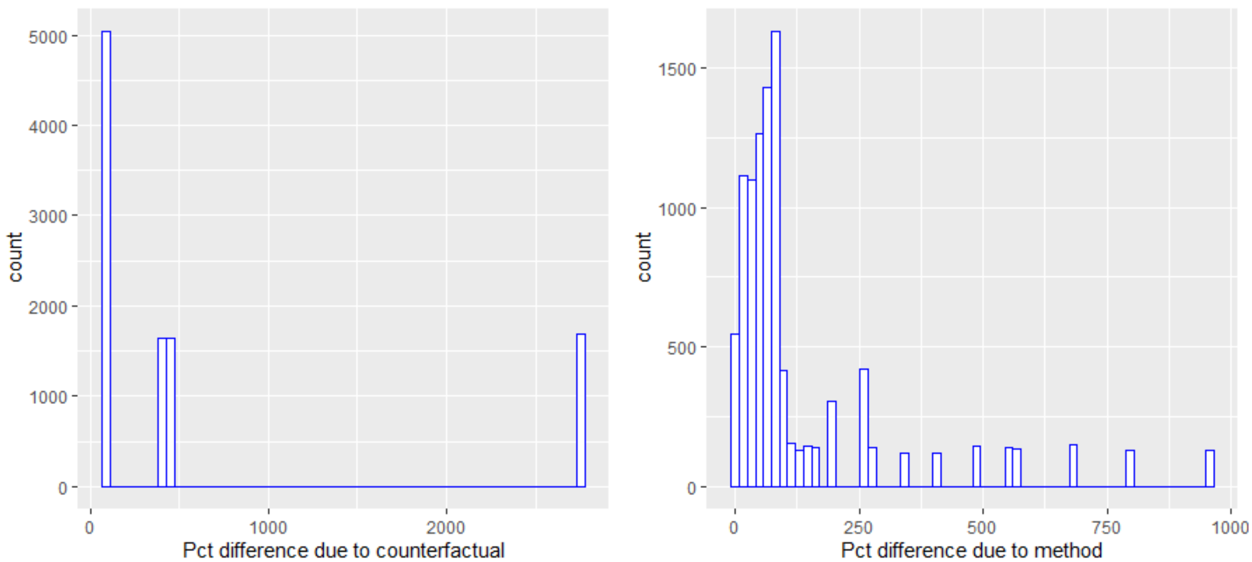
Author(s)	Method	Household WTP (2018$)
Duke and Ivento (2004)	Conjoint analysis	$0.06264
Duke et al. (2014)	Choice experiment	$0.00800
Kashian and Skidmore (2002)	Contingent valuation	$0.01740
Ready et al. (1997)	Contingent valuation	$0.00696
Ready et al. (1997)	Contingent valuation	$0.03507
Johnston and Duke (2009)	Choice experiment	$0.01781
Johnston and Duke (2009)	Choice experiment	$0.00592
Rosenberger and Walsh (1997)	Contingent valuation	$0.00948
Wang and Swallow (2016)	Choice experiment	$0.00956

For each parcel, we are interested in the value of ecosystems services provided to the local community, rather than to an individual household. In order to calculate the value to the community, we use ArcGIS and US Census data to determine the number of households within a 50 mile radius buffer of each of the conserved parcels. We choose a mile radius for two reasons: first, a 50-mile radius approximates the radii of the study areas in the studies that we draw upon, which range from 4 to 113 miles; second, households within commuting distance of a conserved parcel have much higher values than those that are farther away. Fifty miles is a plausible boundary for traveling to or within sight of an easement fairly often. Beyond that distance, people tend to place much lower values for the ecosystem services on properties that they rarely see.

3.6 Results

In each of 10,000 simulations we compare the base case to a new counterfactual and a new BT value. On average, choosing an alternative counterfactual changes the total ES value of the parcels by 648% in absolute value, with a standard deviation of 956% Choosing an alternative BT value changes the total ES value by an average 132%, with a standard deviation of 184%. Figure 3.1 shows the distribution of the simulation outcomes.

Figure 3.1: Histograms of individual simulation results



This result is fairly robust to Leave-One-Out (LOO) analysis, in which the percentage change is recalculated using a set of either counterfactuals or BT studies with one example omitted in each set of simulations. Table 3.3 summarizes the LOO analysis. The LOO analysis indicates that the zoning counterfactual is more similar to the HBU and BAU counterfactuals than either is to one another. When the zoning counterfactual is left out, choosing an alternative counterfactual changes the total ES value by an average of 1439%. Leaving out BT value 1 results in the largest deviation from the analysis on the full set of BT studies, but at 86.3% the change is much smaller than the change due to choice of counterfactual scenario.

Table 3.3: Results of Leave-One-Out analysis of valuation for all parcels

CF or method removed	PCT difference due to CF	PCT difference due to method
None	647.6%	131.6%
BAU (CF)	242.5%	131.9%
Zoning development (CF)	1439.1%	130.9%
HBU development (CF)	271.3%	131.1%
BT val 1 (method)	649.2%	86.3%
BT val 2 (method)	629.8%	141.2%
BT val 3 (method)	658.7%	146.1%
BT val 4 (method)	643.1%	137.5%
BT val 5 (method)	627.2%	125.0%
BT val 6 (method)	656.3%	146.2%
BT val 7 (method)	642.8%	128.0%
BT val 8 (method)	633.4%	150.1%
BT val 9 (method)	635.5%	146.3%

Individual Easement Results

Since the value of individual easements in light of the counterfactual scenario is sometimes 0, it is not straightforward to present the change in value for individual easements due to alternative counterfactuals or transfer studies. Any to change to a positive value from a value of zero is undefined in percentage terms. In order to enable us to make comparisons across individual easements we treat any change from a value of 0 as 100%. Table 3.4 gives the results of running 10,000 simulations for each individual easement. Our new definition of change from a value of 0 means that these results are not directly comparable to the aggregated results previously presented, but it does allow us to evaluate the variation in value change across individual easements.

Table 3.4: Change in value for individual parcels all parcels

Easement ID	PCT difference due to CF	PCT difference due to method
1	230.9%	92.1%
2	287.8%	92.1%
3	2958.5%	130.5%
4	272.5%	86.2%
5	176.3%	87.3%
6	135.4%	86.4%
7	67.2%	45.4%
8	1121%	87.8%
9	67.3%	86.5%
10	22.1%	133.4%
11	66.6%	88.8%
12	210.7%	90.4%
13	66.6%	44.4%
14	239.6%	88.3%
15	162.5%	23.3%
16	71.9%	90.4%
17	184.0%	90.0%
18	80.6%	89.2%
19	3022.6%	134.2%

In 14 of the 19 easements a change in counterfactual scenario has a larger impact, on average, than a change in BT study. For 3 of the easements the average change resulting from counterfactual change is extremely large: over 1000%.

3.7 Discussion

Our simulation results reinforce the calls in the existing academic literature for high quality counterfactual modeling. All of the counterfactual scenarios that we include in our analysis are reasonable projections for future development, but the choice of counterfactual scenario has a tremendous impact on the ultimate valuation of the subject properties, both individually and as a group. Not only is the average percentage change in value due to a change in counterfactual scenario extremely large, at 648%, the standard deviation of the change is significantly larger than that of a change in benefits transfer study: 956% vs 184%. One driver of the difference in standard deviation is the larger number of published studies that seek to determine WTP for land preservation. Despite the obvious importance of counterfactual analysis, less effort has historically been directed toward modeling counterfactuals than to eliciting WTP.

Our results also emphasize the high levels of variability in WTP studies and uncertainty in the benefits transfer methodology. While the average percent change in value due to choice of BT study is significantly smaller than that of counterfactual choice, a change of 132% is still large in absolute terms. It is beyond the scope of this chapter to assess the accuracy of any particular BT-based valuation, but our simulations provide evidence that substantial care must go into transfer study selection. Our findings also highlights the need for sensitivity analysis in BT.

Our simulations at the individual easement level show significant heterogeneity in the impact of the choice of counterfactual. It is difficult to identify the precise reasons for this heterogeneity, however, the two properties with the largest percentage difference due to counterfactual (3022% and 2958%) have some characteristics in common. Both are located near cities, and have more than 500,000 households located within 50 miles of the them. They were also among the most expensive easements, on a per acre basis, in our sample. These characteristics suggest that the probability of conversion to non-agricultural use is very high for these properties, and that the LUCAS model predicts development well beyond that of the HBU and zoning counterfactuals.

3.8 Conclusion

In this chapter we have quantified the importance of carefully selecting the counterfactual scenario when conducting benefits transfer-based conservation easement valuation. We've shown that, while the choice of both transfer study and counterfactual scenario are important, the variation introduced by selecting an alternative counterfactual scenario is significantly larger than that of selecting an alternative transfer study. In our sample of conservation easement appraisals, the impact of changing counterfactuals is approximately 5 times that of changing transfer studies. While the magnitude of this effect is a function of the available set of plausible counterfactual scenarios and benefits transfer studies, our finding provides strong evidence that the choice of counterfactual matters at least as much as the choice of transfer study.

Chapter 4

Assessing Conservation Easement Value Using Appraised Value

4.1 Introduction

In California, conservation easements have emerged as one of the most widely-used methods for preserving open space and rangeland. Conservation easements are purchased by a variety of land preservation groups, including public and private land trusts, non-profits, and open space districts. Some land conservation groups target specific land cover types or endangered species, others have the objective of preserving large open spaces or working rangelands. Regardless of their specific objectives, most if not all conservation groups are constrained by limited budgets. It is therefore in the interest of conservation groups to use their budgets efficiently by maximizing some measure of return on investment (ROI). Often, ROI is measured in terms of the level of ecosystems services (ES) that the conserved land provides (e.g. Sargent-Michaud (2009) and Schmidt et al (2014)). However, several studies have pointed out that ecosystems service value alone is not sufficient to calculate ROI, and that consideration of the counterfactual scenario is critical to obtaining a complete view of the value of a conservation effort such as an easement (Ferraro and Pattanayak 2006, Ferraro 2009 and others).

While a large body of literature develops the theory behind optimal selection of parcels for conservation, including Polasky et al. (2008), it is often observed that conservation choices frequently lack scientific direction (Prendergast et al. 2001, Knight et al. 2006). Theories of optimal selection can be difficult to put into practice, and land trusts must often operate in an environment of incomplete information, especially with regard to long term projections of land use change. Several studies highlight the importance of parcel characteristics, such as connectedness to wildlife corridors (Hobbs 1992, Lindenmayer and Nix 1993), habitat for specific species (Sorice et al. 2011, and others), or high levels of ecosystems service provision when selecting parcels for conservation. Others point out costs are a critical component of ROI and efficient conservation (Naidoo et al. 2006), and that while accounting for heterogeneity in land prices and market dynamics helps optimize parcel selection (Ando et al. 1998). These factors are often ignored in practice, to the detriment of biodiversity conservation (Armsworth 2006).

Taken as a whole, the existing literature suggests that the best candidates for conservation are those parcels that provide a high level of ecosystems services, can be conserved at a low cost, and are at high risk of development if not conserved. These three objectives tend to work in opposition to one another. Parcels that are near large populations have high development value and are therefore expensive to conserve. When stated preference studies are used to estimate the value of ecosystems services, the estimates rely in large part on the number of households that are near the parcel. Population therefore drives both ecosystems service value and conservation costs.

Several studies use revealed preference methods to assess the value of particular ecosystems services, including a comprehensive literature review by Costanza et al. (1997), which was later extended by de Groot et al. (2012). Others, such as Rausser and Small (2000) model the value commercial conservation: conservation of biodiversity or ecosystems services for commercial use by a particular industry. We limit our analysis to valuation based on household stated preference studies because that approach best approximates the objective function of land conservation groups seeking to maximize the benefit of conserved land to the surrounding communities. In taking this approach we undoubtedly undervalue some ecosystems services. It is difficult, if not impossible, to determine which specific ecosystems services participants have in mind when responding to stated preference studies.

In this paper we quantify the relationship between appraised easement value, ecosystems service value, and counterfactual easement value. We find that appraised value is uncorrelated with ecosystems service value, but that appraised value is weakly positively correlated with expected counterfactual development, and therefore counterfactual easement value. This relationship is highly non-linear, suggesting that the most efficient conservation opportunities are found in easements with appraised value between \$724 and \$1725 per acre (2011 USD). However, appraised value alone is not entirely predictive of easement value. Some easements within the range of greatest efficiency return low or zero ROI.

4.2 Data Description

Appraisal data

We study 36 appraisals provided by a large California land trust. Of these, 11 are appraisal summaries that contain the appraised value of the parcel with and without the easement but do not generally provide additional details. The remaining 25 appraisals are extremely detailed, containing a full description of the parcels. In addition to photographs and topographic maps, the complete appraisals present a description of parcel characteristics that potentially impact easement valuation, such as zoning, the quality of nearby roads, access to a developed water source, access to electricity and telephone, presence of surface water, and the number and quality of existing structures and improvements.

The appraisals use 1 or more of 3 distinct methods for assessing the value of the parcels with and without an easement. The most common is the sales comparison approach. Under this approach, the subject property is compared to similar properties that have recently been sold in the subject property's market area. Similarity is assessed by informal hedonic matching on parcel characteristics. Most of the conserved parcels in our study consist of undeveloped rangeland. However, the appraisals often identify portions of the subject property that could feasibly be used for economic activities other than grazing, such as irrigated agriculture or residential ranches. When alternative uses are legally and financially feasible, those uses are integrated into the process of identifying comparable sales. The sales comparison approach delivers a per acre estimate of value for each category of land use found on the subject property, and computes the property's overall appraised value from those figures.

A second appraisal method that is occasionally employed is the cost approach. The cost approach places a value on buildings and improvements by estimating the current cost to rebuild them. Buildings and improvements do not constitute a large percentage of the value of the properties in most cases, however some properties do include significant improvements, especially infrastructure related to livestock management or water distribution. The cost approach does not provide an estimate of the value of the land itself, and is therefore most commonly used as a supplement to the sales comparison approach.

A third appraisal method is the income approach, which bases an estimate of the subject property's value on the discounted present value of the projected future income stream that the property is expected to generate. Future income streams may include revenue from both agricultural activities and development or subdivision, and are thus highly dependent on projections of land use change. The income approach is rarely used among the supplied appraisals.

While the sales comparison approach is the most commonly used valuation method for properties that are not encumbered by a conservation easement, some appraisals point out the difficulty of using that method for estimating the value of subject properties after an easement has been put in place. Applying the sales comparison approach to a property that is encumbered with an easement requires identifying similar properties that also carry an easement and have been sold recently. Since relatively few properties carry conservation easements, the best comparable sales are often more spatially or temporally distant from the subject property than the appraiser would prefer.

Table 4.1 presents summary statistics for the 36 conservation easements in our sample.

Table 4.1: Summary statistics for 36 conservation easements

Statistic	Mean	St. Dev.	Min	Max
Size (acres)	3,759	3,406	160	14,202
Appraised value (per acre)	867.13	564.09	211.31	2,692.97
Minimum lot size	126	121	2	760
Easement pct of appraised value	0.412	0.130	0.114	0.693
ES value (per acre)	2,478.109	2,571.148	118.587	10,887.110
Counterfactual value (per acre)	361.790	1,161.488	0	6,370
Households within 1 mi	46	112	0.105	631
Households within 50 mi	367,671	381,476.	17,594	1,615,298

There is substantial variation among the easements in nearly every dimension. The mean appraised value, which represents the value of the easement from the perspective of the landowner, is less than the mean ecosystems service value but greater than mean counterfactual easement value, which is the value of the easement from the perspective of the land conservation group. Derivation of these values is discussed in detail in section 4.3. One important landowner benefit of selling an easement is a reduction in annual property tax liability. This reduction is typically proportional to the reduction in appraised value that results from the sale of the easement. In our sample the percentage of the appraised value that is contributed by the easement ranges from 11.4% to 69.3%, with a mean of 41.2%.

In order to facilitate comparison across easements that were appraised in different years, we convert each appraised value into an equivalent 2011 price using the National Agricultural Statistics Service's (NASS) estimates for California pasture values (USDA 2019). We choose 2011 because it is the most commonly occurring appraisal year in our sample. For example, NASS estimates that the average value of an acre of un-irrigated California pasture was \$2,870. In 2011 a similar acre of pasture is estimated to be worth \$2,710. We would scale an appraisal from 2009 by a factor of $2,710/2,870 = .9442$ in order to compare it to the other appraisals in our dataset.

Selection Bias

Selection bias is always a possible source of error when analyzing data that has not been randomly selected from a complete population. Our appraisal data was provided by a land trust, and is certainly not exempt from selection bias. However, after conversations with the land trust we believe that our appraisal dataset is reasonably representative of the population of properties that are available for conservation easement encumbrance in California. Typically, a landowner that is interested in selling a conservation easement to the land trust will begin the process by contacting the trust. The land trust may reject some properties at this stage if for some reason it is not interested in conserving the property, but this is a relatively rare occurrence. If the land trust does not reject the property, then an appraisal is commissioned. On only one occasion has a property been rejected following the appraisal, when the appraised value was too low to cover the transaction costs associated with the sale. The provided appraisals, therefore, comprise a nearly complete set of properties that are acceptable to the land trust and are offered for conservation by a landowner.

4.3 Ecosystems Service Value and Easement Value

Ecosystems service valuation

We employ a benefits transfer methodology to estimate the value of the ecosystems services provided by each of the 36 conservation easements for which we have appraisal data. Benefits transfer requires identification of existing stated preference studies that elicit willingness to pay for preservation of land that is similar to the study area. An ideal transfer study will elicit values from households that are demographically similar to those near the study area. For a detailed overview of benefits transfer in ecosystems services valuation, see Richardson et al. (2015). By conducting a comprehensive review of peer-reviewed valuation literature, we identify 9 stated preference studies that credibly transfer to our study area.. Although none of the studies were conducted in California, each was conducting in the United States or Canada during the past 25 years and estimates household willingness to pay for either open space, rangeland, pasture, or idle farmland. Table 3.2 details more information about the included studies.

In order to make the 9 included studies comparable to one another, we first adjust each valuation into 2018 dollars using the Bureau of Labor Statistics' chained CPI calculator. Several of the studies that we identify estimate the one-time payment amount that an average household is willing to pay to preserve an acre of rangeland in perpetuity. Others estimate the amount that an average household would be willing to repeatedly pay each year to support continued preservation. For those studies that elicit one-time willingness to pay, we convert one-time payments into equivalent annual payments using the formula

$$NPV = P \cdot \frac{1-(1+r)^{-n}}{r} \tag{4.1}$$

where NPV is the one-time payment, P is the equivalent annual payment, r is the discount rate, and n is the number of years over which the payment stream is calculated. We choose a discount rate of .05 following Auffhammer's (2018) choice for long-term social discounting of carbon emissions. Taking the mean of all 9 plausible benefits transfer studies, we estimate household WTP for conserving the easements in our study to be \$0.0192 per acre per household per year.

One particular challenge of using benefits transfer for valuation in California is the size and population of the state. Typical benefits transfer studies estimate the value of conserving a parcel by using stated preference studies to estimate the value of the services to each household within a state county and then multiplying that value by the number of households in the county. For small counties and states this method is acceptable, however the size of the state of California renders this method impractical–many California households are located very far away from our study parcels, and we would expect a great deal of heterogeneity in the way households value ecosystem services across the state. As Ando and Shah (2010) observe, household WTP for conservation decays as distance from the conserved site increases. Therefore, rather than aggregating WTP over the entire state or within counties, we instead sum over 50-mile radius buffers around the easements. We do this for two reasons: first, a 50-mile radius approximates the radii of the study areas in the studies that we draw upon, which range from 4 to 113 miles; second, households within commuting distance of a conserved parcel have much higher values than those that are farther away. Fifty miles is a plausible boundary for traveling to or within sight of an easement relatively often.

Counterfactual easement value

While the ecosystems service value of a property is approximated by household WTP for that property's conservation, ecosystems service value alone provides an incomplete picture of the value of a conservation easement on that property. Conservation easements prevent residential development and agricultural intensification on the conserved area. However, if there is no possibility of development then the conservation easement value is zero, regardless of the ecosystems service value. In this case, the restrictions imposed by the easement are non-binding constraints on the economically feasible uses of the land, in short, the easement has preserved land that did not need to be preserved. In general, the value of the easement is equal to the value of the ecosystems services provided by the property minus the value of the ecosystems services provided by the property in a counterfactual future in which the easement had does not exist.

We project counterfactual development following the LUCAS model developed by Sleeter et al. (2017). The LUCAS model is a state and transition model that projects land use and land cover change in California for every year from 2001 to 2101. Since LUCAS does not directly account for land use change that will be prevented by conservation easements, it provides a suitable counterfactual scenario in which the subject properties had not been conserved. Sleeter et al. provide 4 projections of land use change based on a range of population growth projections. We choose the Business As Usual (BAU) projection; the alternative projections produce very similar results.

Each LUCAS projection consists of 10 Monte Carlo simulations of development for each pixel of a 1 km by 1 km grid covering the state of California. We calculate the expected loss of ecosystems services for each conserved property by taking the mean of the projected development across the 10 simulations. The value of the conservation easement is the product of the property's ecosystems service value and the percentage of the property that is projected to be developed under the LUCAS counterfactual scenario. We convert the total value of each easement to a per-acre value by dividing by the number of acres that the property comprises.

4.4 Results

A simple measurement of correlation between ecosystems services and appraised easement value returns a value of $-.078$, and a Pearson test of correlation cannot reject the null hypothesis of zero correlation at any reasonable level of significance. This result is further illustrated by table 4.2, which gives the results of OLS regressions of appraised easement value on ecosystems service value and a series of other covariates. In all specifications, the coefficient of interest, which gives the non-causal relationship between ecosystems services on appraised easement value, is a precisely estimated number very near zero. To place the results of regression (3) in context, an increase in the ecosystems service value of \$1.00 is associated with an increase of \$0.022 in appraised easement value in the mean easement, an amount that is statistically indistinguishable from 0.

Table 4.3 gives the results of regressions of counterfactual easement value (as opposed to ecosystems service value in table 4.2) on appraised easement value. All three specifications indicate a positive and statistically significant relationship between counterfactual easement value and appraised easement value. Regression (3), our preferred specification suggests that a \$1.00 increase from the mean appraised easement value corresponds to a \$1.44 increase in counterfactual easement value. Regression (3) also suggests that an increase of 1 from the mean number of households within 1 mile corresponds to a decrease of \$5.83 in easement value.

4.5 Discussion

Ecosystems service value and appraised easement value

The regression results shown in table 4.2 provide strong evidence that ecosystems service value and appraised easement value are uncorrelated. The adjusted R^2 value in our preferred specification is .588, a reasonably high value that suggests that omitted variables are not a serious problem. It appears unlikely that the addition of further covariates would cause a statistically significant relationship between ecosystems service value and appraised easement value to emerge. This lack of correlation implies that a land conservation group that is primarily interested in maximizing ecosystems services cannot gain meaningful information about the conservation value of a property from the appraised value of the easement. From the perspective of the land conservation group the appraised value of the easement reflects

Table 4.2: Regressions of appraised easement value on ecosystems service value

	Dependent variable:		
	appraised easement val/acre (2011$)		
	(1)	(2)	(3)
ecosystems service value	0.034	0.027	0.022
	(0.029)	(0.025)	(0.027)
size (acres)	−0.024	−0.016	−0.017
	(0.022)	(0.019)	(0.019)
minimum lot size	−0.550	−0.959*	−0.877
	(0.624)	(0.534)	(0.556)
households within 1 mi	3.020***	2.582***	2.473***
	(0.668)	(0.582)	(0.615)
households within 5 mi		−0.097***	−0.096**
		(0.035)	(0.035)
households within 10 mi		0.063***	0.061***
		(0.017)	(0.017)
noneasement appraisal pct			−351.822
			(573.638)
Constant	801.900***	668.897***	894.422**
	(160.479)	(138.851)	(393.594)
Observations	36	36	36
R^2	0.455	0.642	0.647
Adjusted R^2	0.385	0.568	0.558
Residual Std. Error	442.344 (df = 31)	370.793 (df = 29)	374.847 (df = 28)
F Statistic	6.480*** (df = 4; 31)	8.667*** (df = 6; 29)	7.323*** (df = 7; 28)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 4.3: Regressions of easement value on appraised easement value

	Dependent variable:		
	easement value		
	(1)	(2)	(3)
appraised easement value	1.193**	1.630***	1.440***
	(0.436)	(0.517)	(0.494)
households within 1 mi	−4.206*	−5.425**	−5.826***
	(2.104)	(2.106)	(1.992)
households within 5 mi		0.237**	0.228**
		(0.112)	(0.105)
households within 10 mi		−0.102*	−0.104*
		(0.058)	(0.054)
size (acres)	−0.009	−0.012	−0.019
	(0.056)	(0.054)	(0.051)
minimum lot size	1.011	1.847	2.386
	(1.566)	(1.596)	(1.523)
noneasement appraisal pct			−3,134.507**
			(1,444.237)
Constant	−569.777	−797.604	1,214.249
	(519.176)	(516.956)	(1,046.996)
Observations	36	36	36
R^2	0.210	0.318	0.416
Adjusted R^2	0.108	0.177	0.270
Residual Std. Error	1,097.034	1,053.709	992.148
	(df = 31)	(df = 29)	(df = 28)
F Statistic	2.058	2.254*	2.852**
	(df = 4; 31)	(df = 6; 29)	(df = 7; 28)
Note:			*p<0.1; **p<0.05; ***p<0.01

only the value of the easement to the landowner.
It is important to note that this result is based on the assumption that the ecosystems service value of the subject property is defined solely in terms of value to the surrounding community, as measured by responses to stated preference studies. A land conservation group may have an alternative objective function, such as the preservation of threatened or endangered species. Whether alternative measures of ecosystems services, such as habitat for specific wildlife species, are correlated with appraised value is an area for further study.

Counterfactual Easement value and appraised easement value

Our preferred specification (3) in table 4.3 indicates that the relationship between counterfactual easement value and appraised value is precisely estimated and positive. This result suggests that, in the area around the mean level of appraised value, higher levels of appraised value are associated with higher counterfactual easement value. However, this relationship appears to be highly non-linear. The two highest cost easements, appraised at $2,333 and $2,693 per acre, both have values of 0 when the counterfactual scenario is considered.

Figure 4.1: Cubic spline regression of easement value on appraised value.

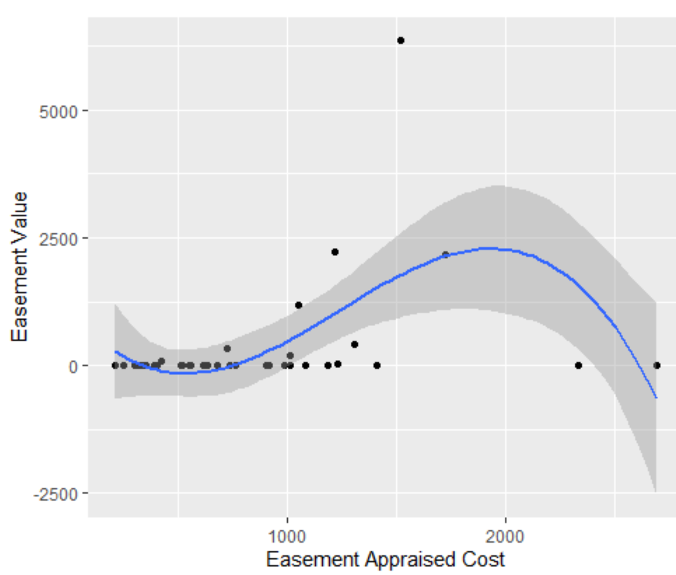


Figure 4.1 illustrates the non-linearity of the relationship between appraised value and counterfactual easement value by plotting a cubic spline regression. A 95% confidence interval is shown in grey. While easements with value of 0 exist across the entire range of appraised values, the cubic spline strongly that the counterfactual easement value is maximized somewhere in the middle of the range of appraised easement values. Table 4.4 gives the per acre

appraised value, counterfactual value, and return on investment for the 13 easements that have non-zero value. The 4 properties that have the highest annual return on investment have appraised value ranging from $1051.15 to $1725.11 per acre.

Two factors drive the non-linear relationship between appraised value and ROI. First, the LUCAS model and appraisals sometimes deviate on the probability of parcel development. LUCAS generally predicts less development than the appraisals. Since LUCAS is a state-and-transition model, it bases its development projections on the land use of adjacent parcels. It therefore may under-predict development in rural areas. Second, properties that are near population centers are likely to have both high probability of development and high purchase cost. As the distance to a population center decreases, purchase cost may increases more quickly than probability of development, leading to decreasing ROI.

The majority of subject easements are projected to have zero value. This result is driven by the LUCAS model's projections of development and, as pointed out in Chapter 3, is highly sensitive to our choice of counterfactual. The LUCAS model is constructed on a 1 km grid, which may be too coarse to capture small changes in development, particularly in very remote areas. One result of the large number of zero-valued easements is that easement value is not a strong predictor of counterfactual easement value, despite the positive linear trend at the mean value indicated in table 4.3. However, figure 4.1 gives evidence in support of the converse: high counterfactual easement value is a strong predictor that appraised value is in the middle of its range. Land conservation groups seeking to maximize return on investment can improve the likelihood of high returns by avoiding easements that have very high or very low appraised per acre values.

4.6 Conclusion

In this chapter we have observed that the appraised value of a conservation easement is based on the perspective of the landowner, whose motivations are rarely in perfect alignment with those of land conservation groups. Our analysis is limited to a group of rangeland conservation easements in California, that are held by a non-government conservation group. We have shown that, within our group of easements, the value of the ecosystems services provided by a conserved parcel are uncorrelated with the appraised value. We have also shown that the counterfactual value of a conservation easement to a land conservation group is positively correlated with the appraised value, and that this relationship is highly non-linear. This finding is immediately actionable to land conservation groups that operate in locations similar to our study area. Within our study area, the properties that generate the highest return on investment have appraised value between $724 and $1725 per acre. However, appraised value alone cannot reliably predict easement value. Many easements within that range exhibit little or no return on investment.

Table 4.4: Per acre appraised value, counterfactual value, and annual return on investment for easements with non-zero value

Easement ID	Counterfactual value (per year)	Appraised easement value	Annual ROI
2	5.49	400.88	0.014
5	6370.14	1516.01	4.201
6	1188.55	1051.15	1.130
8	3.27	211.31	0.015
13	79.41	424.03	0.187
16	11.25	1184.46	0.009
17	2222.67	1215.22	1.829
18	337.20	724.89	0.465
22	8.59	762.59	0.011
23	197.09	1014.24	0.194
24	24.56	1232.36	0.019
29	2159.65	1725.11	1.251
34	416.51	1307.21	0.318

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Appendix A: Sonoma and Marin County Landowner Survey

UCCE

University of California
Agriculture and Natural Resources

Sonoma County
133 Aviation Blvd., Suite 109
Santa Rosa CA 95403
(707) 565-2621 office
(707) 565-2623 fax
http://CESonoma.ucanr.edu

January 23, 2017

Dear Sonoma & Marin County Landowner:

The University of California Cooperative Extension (UCCE) is conducting a survey to review conservation easements in Sonoma and Marin Counties. You have received this letter because you are the listed owner of one or more rangeland parcels in Sonoma or Marin counties. Conservation easements are one of the primary methods for protecting private land against development, but they come with restrictions and these restrictions apply both to current and future owners of the land. The survey assesses how landowners allocated proceeds from easement sales and whether or not the conservation easement program has been successful. The survey will also assess the potential for Payments for Ecosystem Services (PES) structures that could increase sustainability of our local ranching community, providing more money to landowners. Under PES structures landowners receive financial compensation for the services that their land provides, such as carbon sequestration and water capture. PES structures have the potential to deliver the greatest combined advantages to landowners, conservation groups, and the public at large.

Please send your completed survey in the self-addressed stamped envelope or fax it to:

Stephanie Larson
707-565-2623

Thank you in advance for taking the time to complete this survey. Your input and response will enable UCCE to highlight critical impacts that our ranching community makes in Sonoma and Marin Counties. Please contact me if you have any questions.

Sincerely,

Stephanie Larson

Stephanie Larson, PhD
University of California Cooperative Extension
Livestock & Range Management Advisor
133 Aviation Boulevard, Suite 109
Santa Rosa, CA 95403
707.565.2621
slarson@ucanr.edu

LANDOWNER SURVEY (CONSERVATION EASEMENTS)

We would love to speak with you! If you would prefer to conduct this survey by phone or face-to-face, or if you would like to provide more information about any of these questions, please write down your name and phone number and return this page. **All information collected in this survey will be kept anonymous.**

Name______________________________ Phone____________________

Please complete the following survey.

PART A: Parcel Background

1. How many rangeland parcels do you own in Sonoma and Marin Counties?
   Sonoma_____________Marin____________
   [**If you own multiple rangeland parcels, please answer the following questions about the largest parcel that you own]**

2. Could the parcel potentially (with improvements such as fencing or stock ponds) support livestock?
   YES / NO
   [If yes, please continue. If no, please stop here and return the survey in the provided envelope.]

3. More than 90,000 people migrated to the San Francisco Bay Area in 2014. San Francisco, Oakland, and San Jose are all among the top ten most expensive cities in the country. On a scale of 0 to 10, with 0 being strongly disagree and 10 being strongly agree, to what extent do you agree with the following statements?
   a. Population increases in the Bay Area put development pressure on surrounding rural communities. _______ (0-10)
   b. Construction of a commuter rail or bus transit hub in the county in which my parcel is located would be a net benefit to nearby communities. _______ (0-10)

4. On a scale of 1 to 10, with 1 being strongly disagree and 10 being strongly agree, to what extent do you agree with the following statements?
   a. I am a farmer or rancher. _______ (0-10)
   b. I am part of a ranching/farming community. _______ (0-10)
   c. I would like my children to ranch/farm on the land when I retire. _______ (0-10)
   d. I expect my children to ranch/farm on the land when I retire. _______ (0-10)

5. Is it important to you that ranching/farming continue on the land after you retire?
   a. Yes
   b. No

   Why or why not?____

6. Do ranching/farming operations take place on any immediately adjacent parcels?
   a. Yes
   b. No
   c. Don't know (explain)____

7. Do you currently have an easement on your parcel? YES / NO
   [If yes, continue. If no, go to part D]

PART B: Easement Holder Experience

8. Does the permanent aspect of the easement concern you?
   a. Highly concerned
   b. Somewhat concerned
   c. No opinion
   d. Somewhat unconcerned
   e. Unconcerned

9. Are you satisfied with the information that you received about details and the consequences of the easement?
   a. Highly satisfied
   b. Somewhat satisfied
   c. No opinion
   d. Somewhat dissatisfied
   e. Highly dissatisfied

   Comments: ____

   ____

10. Overall, how satisfied are you with the program as a participating landowner?
    a. Highly satisfied
    b. Somewhat satisfied
    c. No opinion
    d. Somewhat dissatisfied
    e. Highly dissatisfied

11. How often is your easement monitored?
    a. Monthly
    b. Annually
    c. Never
    d. Other _________________

12. How effective is the easement program in preserving farm land?
    a. Highly effective
    b. Somewhat effective
    c. No opinion
    d. Somewhat ineffective
    e. Highly ineffective

13. Are conservation easements effective in helping the visibility of local agriculture?
    a. Highly effective
    b. Somewhat effective
    c. No opinion
    d. Somewhat ineffective
    e. Highly ineffective

14. How do you compare the effectiveness of easements with other protection techniques?
    a. Highly effective
    b. Somewhat effective
    c. No opinion
    d. Somewhat ineffective
    e. Highly ineffective

15. In the absence of this program, how would the land be used?
    a. More agriculture
    b. Less agriculture
    c. Remain the same

16. In your view, what is the most important objective of protecting farmland?
    a. Agricultural production
    b. Open space
    c. Ecosystems services
    d. Other____

17. The existence of an easement does not necessarily mean that the easement has restricted your operations. For example, if you had no intention of developing your land, the fact that the easement prohibits development would not have affected your land use choices. Has the easement altered the way in which you use your land?
    a. Yes
    b. No

    Explain____

18. Was the easement in place when you acquired the parcel? YES / NO
    [If no, continue. If yes, go to part E]

PART C: Easement sales experience (landowners that sold easements)

19. How was the easement money used? (Check all that apply and indicate approximate percentages)
    a. Debt repayment ____%
    b. Land investment ____%
    c. Farm investment ____%
    d. Personal or family use ____%
    e. Savings ____%
    f. Other____ ____%

20. Has there been a change in profitability or income of the farm operations since the easement sale?
    a. Yes (please explain)____
    b. No

21. How did you hear about the easement program? (select all that apply)
    a. Neighbors
    b. Land Trust Agreement
    c. Other farmland owners
    d. Previous easement sellers
    e. None of the above

22. How satisfied were you with the experience of negotiating price and other aspects; did you get a “fair” price in your view?
    a. Highly satisfied
    b. Somewhat satisfied
    c. No opinion
    d. Somewhat dissatisfied
    e. Highly dissatisfied

    Comments: ____

    ____

23. How much was your land worth before the easement sale?___________________

24. How much was your land worth after the easement sale?_____________________

25. Did your experience in selling the easement influence other landowners to participate in the program?
    a. Highly influenced
    b. Somewhat influenced
    c. Did not influence
    d. No opinion

26. Based on your experience, would you apply for an easement today?
    a. Yes
    b. Maybe
    c. No

    Comment: ____

27. The easement sale gave you a one-time financial benefit that won't be repeated in the future. Is this an issue for you and your family?
    a. A large problem
    b. A minor problem
    c. Not a problem, not a benefit
    d. A minor benefit
    e. A large benefit

28. When you sold your easement, you received a one-time payment. Suppose you had been offered the following choice of payment structures. On a scale of 0 to 10, where 0 is very unattractive and 10 is very attractive, rate the following payment structures:
    a. A one-time payment of $200,000 today, subject to income tax. _______ (0-10)

    b. A payment of $14,000 annually in perpetuity, subject to income tax. This payment is attached to the land, so if your children inherit the land they will receive the annual payment. _______ (0-10)

    c. A variable payment of $13,000 - $15,000 depending on the amount of residual dry matter (RDM) left on your land at the end of the grazing season. This payment is also subject to income tax and attached to the land in perpetuity. _______ (0-10)

    Why?____

    [Please skip ahead to part F]

PART D: Landowners that have not sold easements

A conservation easement is an agreement between a conservation group and a landowner in which the landowner is compensated for agreeing not to develop their land. Future owners of the land are also not be allowed to develop. The owner's property tax liability is usually decreased, and the owner typically receives a one-time payment from a conservation group.

29. Have you ever considered selling an easement? Why did you decide not to?
    a. Price too low (how much were you offered?_____________)
    b. Land trust funds not available
    c. Commitment too long
    d. Desire to develop land
    e. Complicates inheritance
    f. Other____
    g. Have never considered selling an easement

30. Suppose (hypothetically) that you have decided to sell an easement on your land. In exchange for restricting development on your parcel you have a choice of three payment structures. On a scale of 0 to 10, where 0 is very unattractive and 10 is very attractive, rate the following payment structures.
    a. A one-time payment of $200,000 today, subject to income tax. _______ (0-10)

    b. A payment of $14,000 annually in perpetuity, subject to income tax. This payment is attached to the land, so if your children inherit the land they will receive the annual payment. _______ (0-10)

    c. A variable payment of $13,000 - $15,000 depending on the amount of residual dry matter (RDM) left on your land at the end of the grazing season. This payment is also subject to income tax and attached to the land in perpetuity. _______ (0-10)

    Why?____

[Please skip ahead to part F]

PART E: Landowners who purchased the land with the easement in place

31. How did the easement affect your decision to purchase? ______________________________

    ____

    ____

32. How did the easement affect the price of the parcel?__________________________________

    ____

    ____

PART F: Landowner Background

33. What is the current use of land: □ agricultural type______________________________________
    □ no agricultural commodities

34. Who farms/ranches on the land? □ you □ your family member
    □ other □ N/A

35. Is your primary residence located on the parcel? YES / NO

36. Suppose you did not own your parcel. How much would you be willing to pay to purchase it today?

    ____

37. How did you acquire the parcel?
    a. purchase from a private seller
    b. purchase from a relative
    c. inheritance
    d. other____

38. a. How long have you been ranching/farming in Sonoma or Marin County? ________________
    b. How many years has your family been ranching/farming in Sonoma or Marin County? ______
    c. How many generations?____
    d. Number of children? _______ How many involved in agriculture? ______________________

39. Ten years from now, do you foresee any changes in the productivity of the parcel?
    a. Increased
    b. Decreased
    c. Remained the same

    Please explain____

40. If your neighbor stopped ranching/farming, would you change your farming operations?
    a. Yes
    b. No
    c. Don't know
    d. My neighbors do not farm their land

    How would your operations change?____

41. If your neighbor developed their land, would you change your ranching/farming operations?
    a. Yes
    b. No
    c. Don't know

    How would your operations change?____

42. What is your family's primary source of income?_______________________
    a. What % of your family income comes from farming? ______________________________
    b. Who are all the owners? ____
    c. Ages? ____

43. What is your approximate annual household income?
    a. 0 – 30 thousand
    b. 30 – 60 thousand
    c. 60 – 120 thousand
    d. 120+ thousand

Thank you for completing this survey. Your input helps us sustain ranching in the Bay Area. If you are willing to speak in person or make further comments about any of the questions on this survey, please include your name and phone number at the top of page one.