Quality and the Commons: The Surf Gangs of California

Daniel T. KAFFINE *

October 2007

*Colorado School of Mines, Division of Economics and Business, 329 Engineering Hall, Golden, CO 80401, dkaffine@mines.edu

Abstract

In Open Access settings, high quality resources are lucrative and difficult to control. Large benefits from closing the commons are to be had, yet fencing out interlopers may be very costly. I examine how quality affects incentives to close the commons. Analytical examples explore the incentives of locals to increase or decrease property right strength, conditional on how locals and non-locals value the quality of the resource. The empirical analysis looks at a unique resource, surf breaks, and estimates the relationship between the exogenous quality of the resource (waves at the surf break) and local attempts to seize the common surf break. Using cross-sectional data on 86 surf breaks along the Southern California coast, this paper finds that a 10 percent increase in quality leads to a 7-17 percent increase in the strength of property rights.

Keywords: property rights, surfing, open access, common property

Since the publication of Hardin's seminal work on the Tragedy of the Commons (Hardin 1968), there has been extensive research and debate regarding the implications of resources without well-defined property rights. If private property rights were put in place over these resources, economically efficient behavior should result (Coase 1960; Demsetz 1967). Some authors (Ostrom 1990; Cole 2002) argue that rules of use have been developed in many Common Property resources which allow users to avoid the Tragedy of the Commons without the need for formal private property. In either case, theory strongly suggests that the presence of property rights (private or commonly enforced) avoids overexploitation and congestion (Scott 1955; Gordon 1954), leading to rent preservation and increased resource quality.

Equally compelling theoretical claims are made by authors (Demsetz 1967) who argue that property rights will be endogenously created by users when the benefits of developing and enforcing property rights exceed the costs.[1] These two lines of thought imply an endogeneity between resource quality and the strength of property rights. If we observe a high quality fishery with strong property rights, is quality high because strong property

[1] See Umbeck (1981) and Libecap (1989) for studies of the creation of mineral rights in the western United States

rights encourage investment in the resource, or did users recognize the high quality of the resource and move to establish strong property rights?

This paper examines the following questions: What is the impact of exogenous quality on the strength of property rights? Do owners necessarily benefit from an increase in quality? If quality does affect the strength of property rights, what are the implications for empirical studies when resource quality is endogenous to property rights?[2] Data from 86 surf breaks (locations where waves are particularly conducive to surfing) along the California Coast from San Diego to Big Sur is used to estimate the impact of exogenous wave quality on the strength of property rights. In the surfing context, groups of users known as "locals" enforce informal property rights, or "localism," in order to reduce congestion from potential entrants, who are denoted "non-locals." "Localism" and "property rights" will be used interchangeably throughout this paper. Surfers in many locations (including California) will tell visitors which breaks are open to anyone to visit, and which ones to steer clear of because of localism.

This paper builds on the common property literature by considering the strength of property rights in an equilibrium setting, where welfare-maximizing locals and open access non-locals derive benefits from a resource of exogenous quality, but suffer costs from either exerting exclusionary effort or from being on the receiving end of exclusionary effort. Locals are assumed to formally or informally solve the collective action problem and decide how much effort should be expended at their local site to keep out non-locals.[3] Simple analytical

[2] For example, when users can invest in a resource, such as replanting of trees or low-impact harvesting techniques.

[3] Common property attempts to close the commons need not be formal. In his book, "The Lobster Gangs of Maine," Acheson (1988) describes the informal system of "territorialism" that dominates the harbor lobster fisheries of coastal Maine. The local lobstermen in each small fishing community effectively exclude all other outside lobstermen from fishing in their harbors. The methods employed to exclude non-locals run from the rather discrete (soft

examples are used to show that an increase in quality does not necessarily make locals better off. Because non-locals are also looking to capture the increased quality, the indirect costs of increased congestion from non-locals may overwhelm the direct benefits of increased quality. Additional examples show that exogenous quality may increase or decrease the strength of property rights; the direction depends on the relative valuation of quality between locals and non-locals.

One empirically desirable feature of surf breaks relative to more frequently studied resources is that wave quality is exogenous with respect to property rights.[4] The complex combination of tides, geology and climatology that lead to high quality waves would remain unchanged, even under private ownership. Waves do not care if they are ridden or not, which removes the feedback effects between the biophysical and social systems that are present in fisheries, for example. This natural exogeneity combined with localism scores compiled by users isolates the exogenous effect of quality in the estimation of its impact on property rights.

The regression analysis finds a significant positive correlation between exogenous wave quality and localism, such that a 10% increase in quality is associated with a 13% increase in localism. This suggests that the gains from exclusive access to more valuable resources outweigh the exclusionary cost. Thus, per Demsetz, the gains of creating property rights outweigh the costs of enforcing them, and we observe stronger property rights over better surfing sites. This suggests that caution must be exercised in empirically attributing high

social pressure), to the less subtle (cutting of lobster traps that do not belong to the local harbor), to the decidedly unsubtle burning of boats and physical threats. Attempts to "close the commons" by local surfers follow a very similar pattern.

[4] Rider (1998) is the only other paper I am aware of that explicitly models surfing behavior in an economic framework.

resource quality to investment from stronger property rights.

1 Surfing and Localism in California

Surfing in California has typically been associated in the popular zeitgeist with the image of laid-back surfer dudes and dudettes hangin' ten and soaking up the warm sun. But surfing in California has a less pleasant side: localism. Even though the law defines the coast as open access up to the High Tide mark, surfers at many breaks enforce informal property rights known as "localism." It has been noted that many longtime surfers feel they "own" a break after surfing it for years and display varying degrees of hostility to non-locals who try to surf their prized spots. This pattern of behavior has been observed in other open access resources as well.[5] In the surfing context, hostility towards non-locals often takes the form of aggressive maneuvers on the waves, verbal abuse, or even physical confrontation.

Surfline.com's Surfology Glossary defines "locals" as: "Long time regulars at a particular surf spot or area. Locals may or may not live at or near the spot, but their regular surfing means they are accepted as particularly knowledgeable or experienced by the local surfing community. Locals can be very protective of their surf spot and outsiders need to be very aware to the fact that they are visitors."

While localism may run counter to the common perception of surfers, it is a phenomenon that makes a great deal of economic sense. The finite number of waves per hour imply surf breaks are a congestible resource. In response, both localism and rules of etiquette have emerged to deal with congestion.[6] Etiquette helps users determine who gets to ride which

[5] Again, Acheson (1988) provides vivid examples of such behavior by Maine lobstermen.

[6] See Rider (1998) for a game theoretic take on the evolution of etiquette and "norms" in

wave at a site (reducing collisions and increasing everyone's benefit), while localism is a method for rationing who gets to surf where.

Oftentimes, surf breaks will have well-defined zones where waves routinely break, which leads to an informal line-up of surfers in the water taking turns catching waves. While dropping in front or behind another surfer after they have claimed a wave is typically a gross breach of etiquette, those techniques may also be used by locals to intimidate or just ruin the day of non-locals. Off the waves, localism at its worst can take the form of broken surfboard fins, slashed tires and broken windows, or even physical violence.[7]

Despite the opposition that non-locals may face, the brave and daring are willing to take a chance if the waves are particularly good. Along the Santa Barbara County coast, a collection of breaks known as "The Ranch" are famous for their world-class waves and their first-rate localism. The undeveloped coastline was purchased for a healthy sum by landowners who do not allow public access by land to the breaks. Nonetheless, enterprizing surfers frequently launch boats from Point Conception and Gaviota and motor or paddle up the coast and moor offshore. Surfline warns: "First timers boating or, arms willing, kayaking in, will almost certainly be met with scowls and frowns of disapproval, if not outright shouting and physical hostility."

In the next section, an analytical model captures the general features of this dynamic where locals decide on the intensity of their exclusionary efforts towards non-locals, taking into account the quality of the resource.

---

surfing.

[7] A former neighbor and professional surfer recalls a trip with his dad where their car's tires were popped by spike strips thrown by locals. Their transgression: bringing longboards to a "shortboards only" site, immediately identifying themselves as non-locals.

2 Locals, non-locals and the Commons

This section analytically describes local attempts to close the commons. The potential population of users are separated into two groups, locals and non-locals.[8] Both locals and non-locals are assumed to have perfect information about the resource site. Simple examples consider the equilibrium strength of property rights when an exogenous local population exerts exclusionary effort against an endogenous non-local population with an open access reservation utility.

2.1 User Enforced Property Rights

Consider a fixed number of identical locals $\bar{n}_L$ maximizing their return from a resource of exogenous quality by collectively determining a level of exclusionary effort, or localism, y, to apply to non-locals:[9]

$$\max_y U_L(q, n_{NL}) - c(y) \tag{1}$$

where U_L describes the utility locals receive from a resource of exogenous quality q with congestion from the number of non-locals n_{NL}.[10] $c(y)$ is an increasing cost function ($c'(y) >$

[8] Rider (1998) employs a game theory model with a similar distinction between locals and highway surfers (non-locals). The author argues that a local's only policy may be a rational response to congestion pressure from highway surfers.

[9] I will (heroically) ignore the problem of collective action on the part of the locals, and assume they can specify a collective level of localism that members will assert. Given the homogeneity assumption and the fact that locals tend to have other social mechanisms enforcing cooperation (Ellickson 1986), the assumption becomes less heroic.

[10] This exogeneity assumption is crucial. If resource quality is not exogenous, feedback between the strength of property rights and quality would need to be considered as well. Treating quality as exogenous isolates the incentives locals have to close the commons. Incorporating investments in resource quality as a function of exclusionary effort (localism) would be an interesting extension, but is beyond the scope of this paper.

0 and $c''(y) > 0$) for exerting localism. Assume that benefits of the resource increase with quality $\frac{\partial U_L}{\partial q} > 0$, benefits decrease with congestion $\frac{\partial U_L}{\partial n_{NL}} < 0$, and the marginal benefit of resource quality is decreasing with congestion $\frac{\partial^2 U_L}{\partial q \partial n_{NL}} < 0$. This utility function assumes that the exogenous number of locals $\bar{n}_L$ has no influence on their own utility, thus the optimization above can be thought of as a second stage decision after locals have worked out the first stage collective action problem.

Non-locals on the other hand are assumed to be large in number, and will come to the resource site as long as the value of using that site meets or exceeds their next best alternative. Thus, the resource has infinite congestion pressure from the area at large, and all non-locals receive utility $\bar{V}$ under open access. Therefore, the non-local utility function is given as:

$$U_{NL}(q, n_{NL}) - p(y) = \bar{V} \tag{2}$$

where U_{NL} describes the benefit non-locals receive from a resource of quality q with congestion from other non-locals n_{NL}, and $p(y)$ is the increasing punishment of localism y at the resource site. The assumptions on U_{NL} are the same as U_L ($\frac{\partial U_{NL}}{\partial q} > 0$, $\frac{\partial U_{NL}}{\partial n_{NL}} < 0$, $\frac{\partial^2 U_{NL}}{\partial q \partial n_{NL}} < 0$).

Equation 2 thus implicitly defines the number of non-locals as a function of quality, localism, and reservation utility as

$$n_{NL} = n(q, y, \bar{V}) \tag{3}$$

which is increasing in q, decreasing in y, and decreasing in $\bar{V}$. This is intuitive as: higher quality resources will have more people interested in using that resource, stronger property rights will deter more people from using that resource, and fewer people will be interested in using a resource if better returns can be had elsewhere.

Given equations 1-3, what level of localism y should locals choose, and will it be increasing or decreasing in quality?

2.2 Closing the Commons

Equation 3 implicitly defined the number of non-locals that would harvest at a resource site given quality q, localism y, and reservation utility $\bar{V}$. When locals decide y, they will choose a level of exclusionary effort with the knowledge that they can "kick out" some of the non-locals by making it more costly to use the site. Thus, substituting 3 into the optimization problem 1 gives:

$$\max_{y} U_L(q, n(q, y, \bar{V})) - c(y) \tag{4}$$

which will be solved by some optimal level of localism $y^\star \geq 0$. Because we are interested in the effect of resource quality on the strength of property rights, we would like to know how the optimal strength of property rights changes with respect to quality, or $\frac{\partial y^\star}{\partial q}$. On one hand, an increase in quality would give locals more benefit to capture, but it also will increase the number of non-locals at the site, indirectly decreasing the benefits for locals.

While the effect of quality on property right strength may be difficult to predict, it seems logical that an increase in quality should at least make locals better off. However, it is ambiguous whether or not an increase in quality is actually beneficial to locals. While the direct benefits are certainly positive, they may be offset by the onrushing hordes of non-locals who are also looking to get a piece of the higher quality resource.

Let the value function for locals be given by:

$$V = \max_{y} U_L(q, n(q, y, \bar{V})) - c(y). \tag{5}$$

The change in locals' value function due to a change in quality, $\frac{\partial V}{\partial q}$, is then given by

$$\frac{\partial V}{\partial q} = \frac{\partial U_L}{\partial q} - \frac{\frac{\partial U_L}{\partial n}}{\frac{\partial U_{NL}}{\partial n}} \frac{\partial U_{NL}}{\partial q} \tag{6}$$

and may be positive, negative, or equal to zero.[11] The first term represents the direct benefits that locals receive from the resource, and the second term represents the indirect congestion costs due to an increase in non-locals.

This tension between the direct quality and the indirect congestion effects also plays a significant role in determining the relationship between quality and property right strength. This relationship is explored in the following examples.

2.3 Analytical examples

Consider the following three cases:[12]

[11] By the Envelope Theorem, the impact of quality on the choice of localism can be ignored. Thus $\frac{\partial V}{\partial q} = \frac{\partial U_L}{\partial q} + \frac{\partial U_L}{\partial n}\frac{\partial n}{\partial q}$. By the Implicit Function Theorem (see Thm. 4.17 in Sydsaeter et al. (1999)), $\frac{\partial n}{\partial q} = -\frac{\frac{\partial U_{NL}}{\partial q}}{\frac{\partial U_{NL}}{\partial n}}$, and that substitution gives Equation 6. To confirm that $\frac{\partial V}{\partial q}$ may take any sign, recall the assumptions regarding the shape of U_L and U_{NL} with respect to quality and congestion.

[12] Let q and n be defined on $(1, \infty)$ for the following examples.

2.3.1 Locals and non-locals derive constant benefits from increasing quality

When would we expect an increase in quality to have no effect on the strength of property rights? Thinking about Equation 6, intuition suggests that if the direct and indirect effects of quality and congestion cancel each other out, the net effect on locals' incentives to create stronger property rights would be zero.

Suppose local and non-local utility functions are linear transforms of each other and Equations 1 and 2 take the form:

$$\max_y \frac{B_L q}{n} - cy^2 \tag{7}$$

$$\frac{B_{NL} q}{n} - py = \bar{V} \tag{8}$$

where B_L and B_{NL} represent valuation parameters for locals and non-locals, and p and c represent cost parameters associated with the punishment from and the exertion of localism. Rearranging for n:

$$n = \frac{B_{NL} q}{\bar{V} + py} \tag{9}$$

and inserting into the locals' optimization problem and solving for $y^\star$ yields:

$$y^\star = \frac{B_L p}{2 B_{NL} c} \tag{10}$$

which is independent of quality q, thus $\frac{\partial y^\star}{\partial q} = 0$.

Under this case, even if locals derive more benefit per unit of quality ($B_L > B_{NL}$), there is no incentive to increase localism. But when might the impact of quality on the strength of property rights be non-zero?

2.3.2 Locals/non-locals derive convex/constant benefits from increasing quality

Intuitively, if the direct effect of increased quality outweighs the indirect effect of increased congestion, locals will increase their protection of the resource. Suppose locals get an increasing benefit from increased resource quality, such that an additional bit of congestion is very harmful for locals. When the quality increase leads to more entry by non-locals, an incentive is created for locals to increase their exclusionary efforts to avoid the large negative utility from increased congestion and $\frac{\partial y^\star}{\partial q} > 0$.

In this case, congestion disutility affects locals worse than non-locals, such that $\frac{\partial U_L}{\partial n} < \frac{\partial U_{NL}}{\partial n}$ and $\frac{\partial^2 U_L}{\partial q \partial n} < \frac{\partial^2 U_{NL}}{\partial q \partial n}$, where equations 1 and 2 take the form:

$$\max_y \frac{B_L q^2}{n} - cy^2 \tag{11}$$

$$\frac{B_{NL} q}{n} - py = \bar{V} \tag{12}$$

Note that quality now enters locals' utility as a convex, quadratic term. Rearranging for n yields 9. Inserting into the locals' optimization problem and solving for $y^\star$ yields:

$$y^\star = q \frac{B_L p}{2 B_{NL} c} \tag{13}$$

which depends positively on quality q, thus $\frac{\partial y^\star}{\partial q} > 0$.

It is plausible that local and non-local users might derive different benefits from different quality resources (for example due to better information or local specialized techniques). In this case, the increasing benefits for locals relative to non-locals provide an incentive to increase localism.

2.3.3 Locals/non-locals derive concave/constant benefits from increasing quality

At the same time, if non-locals derive higher benefits from higher quality resources and are more costly to eject, an incentive is created to decrease the strength of property rights as it is relatively more costly for locals to push out non-locals.

Suppose local and non-local utility functions take a form where congestion disutility affects non-locals worse than locals, such that $\frac{\partial U_L}{\partial n} > \frac{\partial U_{NL}}{\partial n}$ and $\frac{\partial^2 U_L}{\partial q \partial n} > \frac{\partial^2 U_{NL}}{\partial q \partial n}$, where equations 1 and 2 take the form:

$$\max_y \frac{B_L \sqrt{q}}{n} - cy^2 \tag{14}$$

$$\frac{B_{NL} q}{n} - py = \bar{V} \tag{15}$$

In this case, the square root of quality now enters locals' utility. Rearranging for n yields 9. Inserting into the locals' optimization problem and solving for $y^\star$ yields:

$$y^\star = \frac{1}{\sqrt{q}} \frac{B_L p}{2 B_{NL} c} \tag{16}$$

which decreases when quality q increases, thus $\frac{\partial y^\star}{\partial q} < 0$.

The case presented above may represent a situation where non-locals gain a greater benefit from increasing quality relative to locals, for example in a developing country where non-locals may possess a technological or market advantage in exploiting a resource. In this case, the decreasing benefits for locals relative to non-locals provide an incentive to decrease localism.

Because the empirical model will be estimating localism y, the above equations allow us to discuss the impact of various parameters on equilibrium localism. Equations 10, 13 and 16 share a common term of $\frac{B_L p}{2B_{NL}c}$, which shows that increasing the valuation parameter for locals, B_L, leads to more localism.[13] Conversely, an increase in the valuation parameter, B_{NL} for non-locals leads to less localism. Also, an increase in the effectiveness of punishment, p, leads to more localism, while an increase in the cost of enforcing property rights, c, leads to less localism.[14]

These examples point to the importance of the relative shape of locals' and non-locals' utility functions in determining the response of localism to quality. Thus, in environments with many heterogeneous agents potentially using a resource, the endogeneity between the quality of the resource and the strength of property rights may pose a greater empirical concern when assessing the impact of property rights on investments in resource quality.

In order to isolate the response of property right strength to resource quality, a resource is needed whose quality is exogenous to property rights. In the next section, a resource with exogenous quality is examined: surf breaks in Southern California. Using data on these surf breaks, I estimate how localism varies with quality, $\frac{\partial y^\star}{\partial q}$.

[13] Perhaps because locals have more experience or knowledge of how to best use their local resource. Anyone who has fished an unfamiliar lake with a local angler can attest to the value of knowing which lure to use where and at what time.

[14] In systems of informal property rights like the one described here, exertion of exclusionary effort is done in lieu of formal government policing. Costs of enforcing informal property rights may increase if, for example, government bodies crack down on non-state enforcement of property rights (Ostrom 1990).

3 Empirical Model

In this section, the empirical model used to test the impact of quality on the strength of property rights is described, using data from surfing locations along the California Coast.

3.1 Data on surf breaks

The primary variable of interest is localism at different surf breaks ($localism_i$), but the "strength" of property rights can be a difficult variable to quantify. Fortunately, the surfing resource website Surfline[15] has user-created cross-sectional data for 86 surf breaks from Big Sur in Central California to Imperial Beach near the California-Mexico border which give an indexed level of localism from 0-10. The data is in the form of a summary for each break and was originally compiled from users with extensive absolute and relative knowledge of the breaks in the area. While the cardinality of the index and its subjective nature may raise some red flags, it also provides a consistent assessment of the level of localism as viewed by those who use the resource.

The primary explanatory variable of interest is the quality of the waves at each break. Wave quality is also indexed [0-10] by Surfline in the same cross-sectional data. There may be some concern that the quality measure provided by Surfline may not be truly exogenous and the reported quality may incorporate other characteristics of the break (such as congestion

[15] See the Travel section at www.surfline.com for data on surf breaks around the world. In order to minimize unobservable variations across regions, focus is placed on Central and Southern California. Data was originally taken by the author in 2004. Entries for each break are submitted by reviewers and are updated if found lacking. This user supplied data may be troublesome, but Surfline, as the most comprehensive surf site on the Web, has a strong incentive to provide accurate information to the more than 1,000,000 monthly visitors (and the advertising revenue they bring).

and localism). However, the fact that quality has been separately categorized from other attributes such as congestion, localism, dirtiness, current strength and even shark danger suggests that the variable quality is independently assessed as the quality of the wave.

Data is also included on the congestion ($congestion_i$) at the break, dirtiness of the break ($dirty_i$), and the paddling difficulty ($work_i$), all of which are indexed [0-10] by the same Surfline data. That same data also gives recommended ability levels ($ability_i$) for each break, indexed [1-4], with 1 being a beginner's break, 2 for intermediate surfers, 3 for more advanced surfers, and 4 representing experts only. Again, there is legitimate concern regarding the nature of these subjective indexes, however these indexes are an attempt by the users of the resource in question to capture the impact of these variables. An additional difficulty arises from the textual description for some entries. For example, at Lunada Bay, a notorious den of localism in south Los Angeles County and the site of an assault on a TV news crew, localism is described as "open arms (nuclear)" which has been interpreted as a 10. While this introduces additional measurement error, I have been as consistent as possible in coding text entries using other descriptions associated with the site. That these various indexes have been grouped into the same data also gives hope that the error structures for the variables in question are similar.

The remoteness of different breaks may affect both congestion and localism. Surfers looking to drive to more isolated locales will face greater transportation costs, and at the same time, locals looking to mete out punishment upon non-locals are less likely to incur the wrath of local law enforcement. Data on highway distance ($hwydist_i$) from the nearest major city (population greater than 50,000) to the break was calculated using Mapquest.[16]

[16] Mapquest's (www.mapquest.com) Driving Directions feature gives highway distances in

Variable	Mean	Std. Dev.	Min	Max
Quality	5.72	2.037	2	10
Congestion	4.84	2.614	0	10
Localism	3.93	2.942	0	10
Dirty	3.75	2.285	1	10
Work	4.76	1.568	1	9
HwyDist (mi)	8.80	10.981	0	55
Ability	2.24	0.607	1	4
PopDens (persons/km^2)	496	506	29	1392

Table 1: Summary Statistics

Additionally, population density for each county ($popdens_i$) was obtained from the 2000 US Census.[17]

Table 1 provides summary statistics for the observed data. Each of the six index variables (Quality, Congestion, Localism, Dirty, Work, Ability) have been averaged over the 86 breaks, and have means relatively close to the midrange of the observed values, with the average recommended ability falling between the intermediate and advanced levels. The average distance to a break from a major city was 8.8 miles, with a minimum of 0 miles (representing breaks in the downtowns of major cities) and a maximum of 55 miles (representing breaks in the more remote Central Coast). The average county population density in the area of interest is 496 person/km, with a minimum of 29 persons/km^2 in San Luis Obispo County, and a maximum of 1392 persons/km^2 in Orange County.

miles between two points.

[17] See www.census.gov

3.2 Estimation strategy

With the cross-sectional data on the 86 surf breaks, the link between exogenous wave quality and the strength of property rights is estimated. The dependent variable, $localism_i$, represents the strength of property rights at break i. The primary regressor of interest is $quality_i$, and the model is controlled for congestion, the dirtiness of the break, the paddling difficulty, and highway distance to the nearest major city. The basic estimation equation is as follows:

$$localism_i = \alpha + \beta_1 quality_i + \beta_2 congestion_i + \delta X_i + \epsilon_i \tag{17}$$

where X_i represents the other control variables. The primary interest is in the coefficient β_1 which represents the impact of exogenous wave quality on localism. Per the analytical model, a positive result would suggest that locals derive greater benefits from increasing quality, while a negative result would suggest that non-locals stand to benefit more from increased quality. A null result would indicate that both groups benefit in a similar fashion from increases in quality, leading to no change in localism.

4 Surfometrics

In this section, results from the empirical test of the localism model are presented. Table 2 gives the estimates for changes in localism against quality and other control variables. In the basic regression, localism is positively correlated with quality such that a 10% increase in quality leads to a $\tilde{1}3\%$ increase in localism. This result is statistically robust to all but one alternate specification, with estimates for a 10% increase in quality ranging from around 7% to 17%. Approximately 50% of the variance in localism is explained by the model regressors

Dependent variable: Localism

	(1)	(2)	(3)	(4)	(5)
	OLS	OLogit	IV_A[1]	IV_B[2]	IV_C[3]
Quality	0.875	0.713	0.759	1.167	0.495
	(0.171)**	(0.184)**	(0.427)*	(0.367)**	(0.457)
Congestion	0.290	0.287	0.446	-0.103	0.433
	(0.126)**	(0.132)**	(0.492)	(0.478)	(0.463)
Dirty	0.144	0.127	0.153	0.122	0.155
	(0.119)	(0.103)	(0.129)	(0.120)	(0.125)
Work	-0.323	-0.287	-0.341	-0.274	-0.330
	(0.168)*	(0.157)*	(0.186)*	(0.193)	(0.187)*
HwyDist	0.015	0.015	0.016	0.011	0.008
	(0.026)	(0.025)	(0.027)	(0.027)	(0.023)
Ability	-	-	-	-	1.459
	-	-	-	-	(0.493)**
Constant	-1.57	-	0.277	-1.421	-3.298
	(1.093)	-	(1.094)	(1.193)	(1.091)**
N	86	86	86	86	86
R^2	0.50	-	0.49	0.43	0.54

*Notes: Robust standard errors in parentheses, * indicates 10 percent significance, ** indicates 5 percent significance. (1) First stage f-statistic is approximately 12. (2) First stage f-statistic is approximately 10. (3) First stage f-statistic is approximately 10.*

Table 2: Estimation Results

in all specifications.

4.1 Estimating Localism

Column 1 in Table 2 presents the results from a standard OLS specification. The point estimate, 0.875 is large and highly significant, indicating that localism increases by 13% due to a 10% increase in wave quality. This suggests that breaks with the best waves are also the breaks that tend to have the strongest enforcement of localism, and thus the gains to locals of closing the commons around high quality waves outweighs the extra cost associated with enforcement.

Congestion is also positive and correlated with localism, and the likely endogeneity between the two variables is an issue addressed below. The dirtiness of the break and highway distance to the nearest city are positively correlated with localism but statistically insignificant. Paddling difficulty (Work) is negatively correlated with localism and statistically significant at the 10% level. This may be because enforcement of localism occurs in the "line-up," which is the queue surfers wait in for their turn to surf a wave. When the current is calm, policing that break is much easier than when the current is roaring and waves are breaking haphazardly. The negative coefficient is consistent with an interpretation of paddling as a cost associated with enforcing property rights, and can be interpreted as a 10% increase in paddling difficulty leading to a 4% decrease in localism. Alternatively, paddling difficulty could reduce localism as the vigor of the current may naturally cull the herd and reduce the need to enforce localism. The coefficients on dirtiness, paddling difficulty and highway distance remain relatively similar across the various specifications.

Two immediate issues spring to the fore regarding this estimation. First, the OLS estimation assumes that the measures of localism are of equal interval spacing (the difference between a localism measure of 3 and 4 is the same as the difference between a localism measure of 7 and 8). Given the subjective indexing of localism, this may be a weak assumption. To ensure this result is not spurious, an ordered logit (OLogit) is estimated. As shown in Column 2, the estimate for quality is still significant, and consistent with the OLS estimate in Column 1.

The other major issue of concern is that congestion is endogenous with localism, leading to erroneous estimates. While tests suggest only a weak endogeneity problem, an instrumental variable (IV_A) model is nonetheless estimated in Column 3. Congestion is instrumented using county population densities, under the assumption that high population densities would likely lead to larger crowds, all else equal, while having no direct impact on localism. The estimate on quality is slightly smaller and less significant than under OLS (an 11% increase in localism due to a 10% increase in quality), and congestion is no longer significant, suggesting that congestion has no exogenous effect on localism.

In Column 4, the robustness check is continued by adding Ability as an additional instrumental variable. If we interpret the recommended ability as a proxy for the difficulty of surfing at a particular site, then an increase in the difficulty of surfing may be culling the herd and reducing congestion, all else equal. This specification, labeled IV_B yields the largest quality estimates of any specification with a 10% increase in quality leading to a 17% increase in localism.

On the other hand, it is possible that the recommended ability level of a break also tells us something about the locals associated with it.[18] In the final column, recommended ability is included as an explanatory variable of localism in the final model IV_c. Including ability decreases the coefficient on quality to a smaller and insignificant estimate of a 7% increase in localism for a 10% increase in quality. The coefficient on ability is highly significant, with a 10% increase in recommended ability leading to a 10% increase in localism. However, a Pearson Correlation of 0.605 (significant at the 1% level) suggests a high degree of collinearity, which makes identifying the effects of quality versus the effects of ability difficult.

[18] Under a Tiebout sorting process, expert surfers might be expected to settle near expert breaks. If so, these better surfers might be more apt at excluding non-locals, reducing the cost of exclusion.

4.2 Implications

What can we learn from the preceding estimation results? First, drawing from the analytical model, we see localism is significantly and positively correlated with quality, suggesting that locals derive more benefit from increasing quality than non-locals. Locals have recognized the benefits of high quality waves and endogenously created strong property rights to capture them.

Second, the negative relationship between paddling difficulty and localism demonstrates the role that costs play in determining enforcement. While the coefficient on highway distance is insignificant, its consistent positive sign may be indicative that more remote locations (far from urban centers) lead to more localism. This is consistent with suggestions that when authorities look the other way, informal property rights tend to be stronger (Acheson and Brewer 2000). Intimidating non-locals on a deserted stretch of the Central Coast may go unnoticed, while similar behavior along a busy urban beach in Orange County would draw far more attention from local authorities.

Finally, the correlation between exogenous quality and property rights strength suggests that studies looking to strong property rights as a determinant of resource quality need to account for this endogeneity. For example, if we return to the Lobster Gangs of Maine (Acheson 1988), the highly productive lobster grounds found in the waters of the more vigorously defended islands are contrasted with the less productive lobster grounds of the less defended mainland harbors to suggest that vigorous defense by island lobstermen has led to better fishing. The results presented in this paper suggest there may be a plausible alternative whereby lobstermen recognized the higher quality fishing grounds near the islands and established their informal property rights to protect them. There may be many reasons why the island fisheries would be more productive, independent of any institutional argument, such as: oceanographic currents supplying more food, or there is less run-off and pollution near the islands, or the underwater topography is more conducive, or any other number of factors. This is not to suggest that the vigorous defense of property rights by the island groups have had zero influence on resource quality, but rather to highlight a potential endogeneity concern raised by these results. Most likely, there are feedbacks (potentially positive) between quality and property rights leading to the observed relationship between the vigorous island defense and productivity.

5 Conclusions

This paper has expanded on the property rights literature to consider the impact of exogenous resource quality on informal property rights when both locals and non-locals compete for resources. The simple analytical model finds that an increase in quality does not necessarily make locals better off. The indirect effects of increased congestion from non-locals may overwhelm the direct benefits of increased quality, leaving locals worse off than they were before. Simple analytical examples show that if locals derive more benefit from quality in both absolute and marginal terms, property rights become stronger, and vice versa. Furthermore, if locals and non-locals are homogenous, an increase in quality leaves locals no better or worse off and localism is unaffected.

Using surfing data from 86 breaks in Central and Southern California, estimates of the impact of wave quality, cleanliness, paddling difficulty, and access on the strength of property rights have been obtained. The empirical estimates find a significant positive correlation between quality and localism, such that a 10% increase in quality leads to a 7-17% increase in the strength of property rights. A significant negative correlation is found between paddling difficulty and property rights; a 10% increase in difficulty leads to a 4% decrease in property rights, which is consistent with interpreting paddling difficulty as a 'cost' of enforcing property rights.

The empirical finding shows that quality plays a powerful role in determining the strength of informal property rights. For surfers, the gains from exclusion over valuable breaks outweigh the exclusionary cost, despite the additional costs of enforcing those informal rights. This is in line with theories on the endogenous formation of property rights which suggest that users create property rights when the benefits outweigh the exclusion costs. While the empirical study only considers one particular common property resource, the similarities between it and other common property resources suggest that caution should be exercised in assigning causality of high resource quality to stronger property rights. Locals may be responding to the benefits of high quality resources and endogenously creating stronger property rights to capture them.

Despite the presence of localism, many surf breaks still suffer from heavy congestion and overcrowding. The success of Individual Transferable Quotas in fisheries and Exclusive Surf Resorts where individuals pay to surf uncongested waves has led some to speculate about privatization of surf breaks - a proposition that leaves many surfers colder than a winter swell on the Central Coast.

References

Acheson, J. M. (1988). *The Lobster Gangs of Maine*. University Press of New England.

Acheson, J. M. and J. Brewer (2000). Capturing the commons: Social changes in the territorial system of the maine lobster industry. Eighth Conference of the International ssociation for the Study of Common Property: Digital Library of the Commons. Conference paper.

Coase, R. H. (1960). The problem of social cost. *Journal of Law and Economics 3*, 1–44.

Cole, D. H. (2002). *Pollution and Property Comparing Ownership Institutions for Environmental Protection*. Cambridge.

Demsetz, H. (1967, May). Towards a theory of property rights. *American Economic Review (Papers and Proceedings) 57*(2), 347–357.

Ellickson, R. C. (1986). Of coase and cattle: Dispute resolution among neighbors in shasta county. *Stanford Law Review 38*(3), 623–687.

Gordon, H. S. (1954). The theory of a common property resource: The fishery. *Journal of Political Economy 62*, 124–142.

Hardin, G. (1968). The tragedy of the commons. *Science 162*, 1243–1248.

Libecap, G. D. (1989). *Contracting for Property Rights*. Cambridge: Cambridge University Press.

Ostrom, E. (1990). *Governing The Commons*. Cambridge: Cambirdge Universtiy Press.

Rider, R. (1998). Hangin ten: The common-pool resource problem of surfing. *Public Choice 97*, 49–64.

Scott, A. (1955). The fishery: The objectives of sole ownership. *Journal of Political Economy 63*, 116–124.

Sydsaeter, K., A. Strom, and P. Berck (1999). *Economists' Mathematical Manual* (3 ed.). Springer.

Umbeck, J. R. (1981). Might makes right: A theory of the foundation and initial distribution of property rights. *Economic Inquiry 19*, 38–59.