Some Empirical Evidence on
Property Rights of First Peoples

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Why did the Western Apache allow individuals to own land, the Tzeltal only permit household ownership, and the Yucatec Maya share access within the community? This paper seeks to test a hypothesis of access rights across indigenous peoples, asserting that the choice of private, shared, or open access rights maximizes the resource's net value, rather than reflecting innate preferences for different property systems. This empirical work contributes to the literature with observations on over 40 early American groups. The cross-sectional study reveals how access rights differed across communities in response to the property's physical characteristics and community characteristics that affected the deadweight, governance, and exclusion costs of establishing and maintaining different access regimes.

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"Along the mainland streams, which are called rivers, though not of sufficient size for such dignity, many coconut and other trees are planted. There are no visible boundaries separating holdings. A dozen or more families may be owners of trees on one stream. I asked Old Sobaca, of Ticantique, 'Don't Indians ever make mistakes about which one owns a tree?'
'No — yes, sometimes,'
'Wfiat happens then ?'
'Indian talks to friend about it; go see tree; everything all right.'
'But if one man is not satisfied?'
'Talk to chief,' he says, 'This is your tree; this is your friend's tree. Everything all right.'" [McKim (1936, p.70)J.

It is difficult to imagine the Cuna Indian's system of delineating and enforcing property rights working in North American culture today:

Along the mainland roads, which are called transitways, though not of sufficient size for such dignity, many parking spots are located. There are no visible markings identifying the holdings. I asked Old Sobaca, of the department of transportation, 'Don't drivers ever make mistakes about which one owns a parking space?'
'No — yes, sometimes.'
'What happens then?'
'Driver talks to friend about it; go see space; everything all right.'
'But if one man is not satisfied?'
'Talk to parking lot attendant,' he says, 'This is your space; this is your friend's space. Everything all right

1. Introduction

Why is the first scenario interesting, and the second questionable? Is it because the Cuna are a nicer society, predisposed to harmony-less possessive of their property? Is it because coconut trees then, were less valuable than parking spaces now?

Most social scientists seek explanations for differences or changes in behavior, rather than accepting events as random. Such explanations concerning property rights in early Indian communities have been put forth from various disciplines including anthropology, biology, psychology, sociology, and political science. Their explanations vary concerning the source of differences between groups-nature versus nurture; and what motivates behavior—group or individual welfare [e.g. Benedict (1934) and Farb (1978)] The economic perspective taken here proposes that all individuals, both the Cuna and today's

drivers, maximize their well-being subject to various constraints.[3] Differences in these constraints (or changes over time), rather than innate characteristics, explain differences (or changes) in behavior. Systems of property rights emerge reflecting the value of resources and particular constraints faced by each group.

Debates over asserting rational self-interest are unresolved.[4] For early Indian communities this postulate has usually been supported only with anecdotal evidence and case studies,[5] such as the following account by Driver and Massey (1957, p. 388):

> The Algonquins of the eastern Sub-Arctic recognized ownership of hunting and trapping territories...Trespass might be punished with death or witchcraft, the latter being more common. Not only was each family territory carefully guarded from without, but game was consistently preserved from within. Pregnant females or those with young were spared and quantities of other animals were regulated so as to prevent depletion.

Demsetz (1967) argued that private rights emerge when the benefits, due to changing relative prices, outweigh the costs of establishing and enforcing private property. Following this, Baden, Stroup and Thurman (1981) challenged the notion that Indians' resource management reflected a greater cultural value of the land. They offered evidence from four case studies of resource management that changed over time as competition for scarce goods led to the formation of rights. Recently Bailey (1992), lamenting the small samples studied to date, has delved into some anthropological data to examine rights

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[3] Although the behavioral postulate of individual maximization is not unique to economics, it is its central tenet, while in other disciplines it is one of a number of competing assertions. Hechter (1990, p. 143) writes, "Since the mid 1960's, (however), research based on rational choice theory has proliferated in political science, philosophy, law, and nearly every other social science discipline (including, of course, economics, where this theoretical tradition has a status that is canonical)."

[4] See, for example, Cohen (1967), Posner (1980) and Mueller (1992) for discussions on competing behavioral postulates. Although criticized for becoming almost tautological, alternative assertions such as group maximization would lead to a different set of outcomes.

[5] Posner (1980) mentions some case studies and argues that distinctive primitive institutions (such as the size of kinship groups and polygamy) are adaptations to uncertainty and high information costs. This work is related in that incomplete information underlies most transaction costs. See also Demsetz (1967), Pejovich (1972), Anderson and Hill (1975), and Umbeck (1977) on the formation of property rights.

across a larger number of cases.

This paper continues along that line, contributing to the literature by exploiting a unique database for observations on over 40 North American tribes.[6] Previous time series studies focused on how increasing scarcity led to the formation of rights, largely ignoring the costs associated with different property systems. This cross-sectional study allows a systematic study of access rights as responses to relative resource values and the different costs of establishing and enforcing rights. We hope, by showing that these responses support implications from a model based on individual maximization, to lend more empirical support to the assertion that private, shared, or open access rights existed as a function of relative costs and benefits under these regimes.

Section 2 discusses some dimensions of property rights, and how rights are interpreted for this empirical work. A simple model in Section 3 produces net value functions for private, shared, and open access regimes defined by the size of the group with access rights over a property. Section 4 presents some implications from the model, including predictions about a community's choice of access regime according to property type. Though the data, described briefly, preclude directly testing the implications of the model, the results in Section 5 nonetheless indicate that access rights across various tribes are consistent with predictions from a model based on individual maximization.[7]

2. Defining property rights

[6] The meaning of terms such as tribe, clan, and band, differ in important but inconsistent ways among people, and according to whether the grouping is linguistic, political, or geographic. In general, we relied on the term used by the source, and apologize to any readers who find particular terms offensive.

[7] Borrowing a caveat from Posner (1980, p. 8): "Economists (and Weberian sociologists) will not need to be reassured, but some anthropologists and lawyers may, that the purpose of such a model is not to deny the variety and complexity of primitive societies or to provide a realistic description of a particular society, but to explain those fundamental institutions and values that are common to most societies."

The growing literature on property rights includes searches for an empirically workable definition of rights. Building on Feder and Feeny (1991, p. 137), four regimes are distinguished: open, shared, private, and state. Under open access no rights are assigned. Shared rights (sometimes called communal) refers to a group of individuals owning rights over the property with access restricted. Private implies an individual owner of all rights, while under state ownership some governing body in the community retains rights over the property and determines access.

The distinction between these four categories is somewhat arbitrary. Private ownership is normally considered to be a single individual with exclusive rights, realizing profit or bearing losses from the property. Small groups able to limit access, however, can also be considered to have private rights, although incentives vary significantly with more than one residual claimant. As the number of individuals in the group holding exclusive rights increases, it approaches open access as everyone owning the property is equivalent to no one owning the property.

In addition to who holds the rights, which rights are held is also important. Property rights include the right to sell or transfer ownership of the property (alienable rights), the right to earn income from the property (usufruct or withdrawal rights) and the right to exclude others from your property (access rights). An even finer analysis is possible considering that goods are composed of a number of attributes, so that types of ownership such as private and state, may apply to different attributes of a single good. For example, hunting territories for the Hidatsa and Mandan Plains Indians were controlled by the tribal village, although individual ownership was allowed over eagle pits [Driver (1969, p. 277)]. In many villages, although individuals privately owned their catch it was assumed they would share certain parts, such as the meat, while retaining other parts, such as the skin, for themselves. Further, some attributes privately held may not contain all the rights of ownership. Songs were often privately owned in the sense that others were not allowed to sing them, although the song owner did not have the right to sell the song.

In theory therefore, solving for the optimal form of ownership would recognize these finer distinctions of which rights are held and over which attributes. In practice, sources inconsistently report the array of rights and property characteristics.[8] For empirical purposes, therefore, only access rights over broadly defined property types were considered. This is sufficient to examine some basic propositions from the model and does not seem unreasonable given that access rights in these communities tended to be held jointly with other property rights.[9]

3. A model of access

Following other common property approaches [Gordon (1954), Cheung (1970), Mason *et. al.* (1988), Lueck (1994)], let $Y = \epsilon f(\Sigma^n_{i=1} x_i)$ describe the group's total production of good Y, where $\epsilon > 0$ is a randomly distributed input and x_i is individual i's effort producing Y. The usual conditions of positive but diminishing marginal product of effort are assumed, $f_{xi} > 0$, $f_{xixi} < 0$ implying there is a fixed asset in production. Standard production costs are $c(X) = c(x_1,\ldots,x_n)$, with $c_{xi} > 0$, and $c_{xixi} \geq 0$ reflecting increasing marginal costs of effort and congestion costs.

With zero transaction costs and Y's price normalized to one, the property owner's objective is to maximize profit $V = \epsilon f(\Sigma^n_{i=1} x_i) - c(X)$. Assuming risk-neutrality, this produces effort levels $X^* = x^*_1, x^*_2, \ldots, x^*_n$, satisfying the standard result that the marginal product equals the marginal cost of effort:

$$f_{x_i} = c_{x_i}, \ \forall i. \qquad (1)$$

Substituting the effort levels that solve equation (1) into the maximand gives the indirect value function,

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[8] Anderson and Hill (1975) in their study of the American West have circumvented some of these difficulties by using "activities aimed at defining and enforcing property rights." They concede, however, that efficient resource allocation is really determined by the level of property rights, which is difficult to measure, and not these activities.

[9] One exception is transfer rights which were often restricted through inheritance or other customary rules.

$V^* = f(X^*) - c(X^*)$.

Since transaction costs are never zero, this solution provides a benchmark only. Individuals and groups also spend resources establishing and enforcing the system of rights. Considering the types of access regimes in these communities and the limitations of the data, these costs were collapsed into exclusion and governance costs [Ostrom (1989)] which includes sanctioning and monitoring costs. Since the physical characteristics of property similarly affect all the transaction costs of interest here, little is lost with this simplification. Choosing the size of the group with access rights involves tradeoffs between effort levels (output), exclusion costs, and governance costs as determined by the physical characteristics of the property. To study those tradeoffs, exclusivity rights over property are classified into two regimes: restricted access, which includes private access, shared output and shared input access; and open access.

3.1. Restricted Access Regimes

Conferring any exclusivity rights on property implies restricted access. Private access, to be denoted with the superscript P, refers to those cases where the group size is I.[10] For shared access, the optimal group size n is greater than one but less than the population, and the group is able to exclude nonmembers. Within shared access the superscript S will represent regimes where output is shared equally among group members, while C refers to sharing access to a resource.

3.1.1 Shared Output Access

In a shared output access regime members provide inputs to production, such as laboring on a garden plot, and every member acquires an equal share of the output. Each individual chooses a level of effort to maximize individual gain, yielding the first-order condition:

[10] This is simply shared access with n= 1. It differs from Lueck's (1994) fixed payment contract with wage labor, which was unusual in these economies.

$$\frac{1}{n} f'\left(\sum_{i=1}^{n} x_i\right) = c_{x_i}, \ \forall i, \qquad (2)$$

implying $f_{xi} > c_{xi}$ rather than the optimal marginal net value of effort given in equation (1). An incentive to shirk arises under shared access with $n > 1$ because individuals are not the sole residual claimants of profit.

Recognizing these individual incentives, group size n is chosen to:

$$maximize_n \ V = f\left[\sum_{i=1}^{n} x_i(n)\right] - c[x_i(n)] - e(n/pop) - g(n,t), \qquad (3)$$

where e refers to exclusion costs, g refers to governance costs, pop is the population and t represents the physical characteristics of different property types.

Restricting access leads to exclusion costs: the costs of enforcing limited access if the optimal size of the group is less than the number of potential users and sanctioning non-compliance with the access rules. As access becomes more restricted more individuals will be outside of the group, and exclusion costs rise with $e_n < 0$. Governance costs arise within the group[11], such as monitoring to ensure equitable input efforts and division of output.[12] This monitoring component of governance (and

[11] For simplicity, all within group costs are defined as governance, while costs outside the group are defined as exclusion. Although sanctioning applies to both types of cost, we assume that part of governance costs include group member sanctioning.

[12] Division costs are not considered separately as in some models [Allen and Lueck (1992), Lueck (1994)] since the implications from division and monitoring costs are identical here and there is no distinction between shared input and output access regimes in our data.

exclusion) costs will vary with the physical attributes of the property.[13] Here t refers to the size, and how amorphous [Ostrom (1989, p. 20)] the property is, such that $g_t > 0$.

Differentiating equation (3) with respect to n yields an implicit function for the optimal group size, n^S, and the corresponding net value function: $V^S = f[X^S(n^S)] - c[X^S(n^S)] - e(pop/n^S) - g(n^S,t)$.

When output is equally shared among n homogeneous users regardless of individual effort, the aggregate level of effort, $X^S = x_1^S, x_2^S, \ldots x_n^S$, will be less than X^*. Directing effort into governance will reduce, but not eliminate, the under-incentive for effort given by equation (2), $f_{xi} > c_{xi}$. The greater is each individual's share of the output (i.e. the smaller is n) the more the marginal product of effort (MP) will approach the marginal cost of effort (MC). In the limit, if n = 1, the benchmark results of equation (1) return. In this case, there is no distortion in effort levels and $X^* = X^P > X^S$, where X^P refers to private access effort levels. Because of exclusion and monitoring costs, however, net value is lower such that $V^P < V^*$.

3.1.2. Shared Input Access

Shared access can also refer to a group sharing access to an input, such as land for hunting, rather than to an output. Since each member's share will be determined by his/her input use, to which the member's effort is proportional, the distortion from the benchmark marginal conditions results from excessive effort and use. Individual i chooses his/her effort level to:

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[13] Since exclusion costs are also affected by property types, but in the same manner as monitoring costs, t was excluded from exclusion costs for simplicity.

$$maximize_{x_i} \left(\frac{x_i}{x_i + \sum_{j \neq i=1}^{n} x_j} \right) f\left(x_i + \sum_{j \neq i=1}^{n} x_j \right) - c(x_i).$$

The Nash solution for each individual is[14]

$$\frac{(n-1)}{n} \frac{f\left(\sum_{i=1}^{n} x_i\right)}{\sum_{i=1}^{n} x_i} + \left(\frac{1}{n}\right) f'\left(\sum_{i=1}^{n} x_i\right) = c_{x_i}, \ \forall i. \qquad (4)$$

indicating that $f_{xi} < c_{xi}$ when input access is being shared. As before governance efforts can reduce, but not eliminate the deadweight loss from excessive use.

Recognizing these incentives, the optimal group size n^C is chosen that maximizes net value, $V^C = f[X^C(n^C)] - c[X^C(n^C)] - e(pop/n^C) - g(n^C,t)$, with the resulting total effort level $X^C > X^*$ and net value $V^C < V^*$.

3.2. Open Access

The unrestricted rights regime is open access. Since each individual appropriates a share of output proportional to his/her effort, individual incentives are identical to shared input access. But since no one is excluded, group size is determined by the number of individuals for whom their average output share in this activity exceeds or just equals the marginal value of their effort elsewhere. *Ceteris paribus*, without governance efforts under open access, the resulting total effort levels X^O will exceed X^C, though net value may still be higher under open access since there are no governance or exclusion costs. As with restricted access, with $n=1$ there is no distortion and equation (4) collapses to equation (1). Otherwise, when $n > 1$, deadweight costs arise since $X^O > X^*$.

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[14] Lueck (1994), Cheung (1970), Mason, Sandler and Cornes (1988).

Ostrom (1990), Lueck (1994) and others have argued how shared access regimes emerge as a wealth maximizing contract. These models endogenize the operational rules for resource allocation, but not necessarily the constitutional rules — the public choice framework. But the model here suggests that observed group behavior will be as if some leader or group is setting access rules in these communities to maximize the net value of the resource. Implicit, therefore, is some assumption that explains how a set of rules that maximizes the collective net value of the resource emerges from a model premised on individual maximization. Developing a theory of the state is not the objective of the paper, but the efficiency of the implied political organization can be defended by appealing to the "filter of competition" [Eggertsson (1990, p. 57)]. Following North (1981), we suggest that in these communities there were at least three competitive constraints on leaders' behaviour that would lead, on average, to joint welfare maximizing decisions: subsistence survival, warfare, and the council of elders. First, in subsistence communities such as the Great Basin, individual and group welfare were largely inseparable for ensuring survival, and decisions were often at the level of the extended family [Driver (1969, p. 288)]. In societies where personal wealth accumulation was possible, such as the Sub-Arctic, Northwest Coast, Plateau, California, and Southwest [Driver (1969, p. 290)], leaders were often the greatest warriors, whose authority was both derived from and constrained by warfare. In some of the communities with the most complex organizations, such as the Cheyenne, Sioux, and Iroquois, competitive constraints appeared in the form of the voting mechanism of the village council, who appointed the civil chiefs. These chiefs were distinct from war leaders, and obligated to "stress peace within their own societies." If they failed to perform they could be impeached by a council of elders. Hence we are presuming that inefficient political institutions or tribal laws would simply not survive, in the sense of Alchian's (1950) evolutionary selection process for profit-maximizing firms.

4. Implications for Access Choice

The community's or leader's objective is to choose the access regime and optimal group size to maximize the net value of the resource. Their optimal choice depends on the ranking of the net value functions: V^P under private access where n=1; V^S or V^C under shared access where $1 < n <$ population; and V^O under open access.

Under restricted access:

$$V^i = f[X^i(n^i)] - c[X^i(n^i)] - e(pop/n^i) - g(n^i,t), \quad i = P, S, C;$$

$$e_{ni} < 0, \; g_{ni} > 0, \; g_t > 0.$$

Under open access:

$$V^O = f[X^O(n)] - c[X^O(n)];$$

$$\text{where } X^O > X^C > X^* = X^P > X^S.$$

In this model, differences in regime choice are driven by exclusion costs, governance costs, the marginal product of effort, and the marginal cost of effort. We can determine the change in the value of each access regime by partially differentiating the net value functions with respect to changes in each of these costs.

For example, the effect of an increase in the marginal product of effort, f_x, on the choice between private access and shared output access can be found by partially differentiating each net value function. Using the envelope theorem for the first partial derivatives and X as a shift parameter for the marginal product of effort:

$$\frac{\partial V^P}{\partial \chi} = X^P > 0, \quad \frac{\partial^2 V^P}{\partial \chi^2} = \frac{1}{c_{xx}} > 0; \text{ and}$$

$$\frac{\partial V^S}{\partial \chi} = X^S > 0, \quad \frac{\partial^2 V^S}{\partial \chi^2} = \frac{1}{nc_{xx}} > 0.$$

The second partial derivatives indicate that the increase in the net value of the private access regime exceeds that of the shared output regime.

A similar comparison was calculated for each net value function in response to a change in each parameter, with the results given in Table 1, which indicates the pairwise comparison of changes in net value functions.[15] For the increase in the marginal product of effort calculated above, the plus sign in the third row under $V^P - V^S$ indicates that the net value of private access (V^P), increases relative to shared output access (V^S).

Table 1

Table 1's results are quite obvious from the model. Recall equation (2), indicating that individual incentives in the shared output regime resulted in too little effort, $f_{xi} > c_{xi}$. It should not be surprising, therefore, that a further increase in the marginal product of effort, f_{xi}, would decrease the net value of a shared output regime relative to the others. The minus signs in the third row indicate that $V^S - V^C$ and $V^S - V^O$ are both negative, that is, the net value of shared output regimes (V^S) decrease relative to shared input and open access regimes with an increase in the marginal product of effort.

The remaining results in the third row of Table 1 are likewise apparent by recalling that individual incentives under the shared input and open access regime resulted in excessive effort, with $f_{xi} < c_{xi}$ (equation (4)). Though individual incentives are the same under both regimes, effort levels are greater under open access, because there are no resources spent on governance. This implies an increase in the relative value of open access with an increase in the MP of effort, as shown by the minus sign for $V^C - V^O$. An increase in the marginal product of effort increases the net value of shared input and open access regimes relative to private access regimes, so $V^P - V^C$ and $V^P - V^O$ are both negative.

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[15] This compares with Lueck (1994, p. 101), who derives the comparative statics for a similar model and discusses them in terms of the curvature properties of the value functions. Since monitoring costs as a function of wage labor effort are not relevant without a fixed payment contract, m_{xx} does not appear in any first order conditions, allowing each pair to be signed. A table of second partial derivatives for each net value function and parameter used here is available from the authors.

In row four an increase in marginal effort costs, c_x, can be expected to have the opposite results and increase the net value of shared output regimes relative to the others. There is a decrease in the value of open access relative to shared input access, but the net value of private access increases relative to both regimes because marginal effort costs already exceed marginal product as given in equation (4).

Since there are no exclusion costs with open access and likewise no sanctioning costs for nonmembers not complying with the access rules, an increase in this cost will increase the value of open access regimes, all else constant, relative to all of the restricted access regimes. The minus in row one ($V^p - V^s$) indicates that an increase in marginal exclusion costs, all else equal, increases the net value of shared output access regimes relative to private access regimes. Likewise for $V^p - V^c$, and $V^p - V°$, since private access regimes have the highest exclusion costs. The zero in column four ($V^s - V^c$) indicates that an increase in marginal exclusion costs does not change the net value of shared input access relative to shared output access, but it will decrease the net value of both of these restricted access regimes relative to open access, indicated in the fifth and sixth columns with minus signs for $V^s - V°$ and $V^c - V°$.

Governance costs only arise under the shared access regimes. There are no group monitoring costs to ensure equitable effort levels when a single owner is the producer under private access, or under an open access regime, indicated in Table 1 with a zero under $V^p - V°$. The change in the relative value of $V^s - V^c$ is also zero, since there is nothing in the model to differentiate the effect of an increase in marginal governance costs on those two regimes. In the first two pairwise comparisons with $V^p - V^s$ and $V^p - V^c$ the plus sign indicates that an increase in marginal governance costs decreases the net value of shared access regimes relative to private access regimes. This is also true relative to open access in the last two columns, although the minus sign reflects the reverse ordering of the pairs in the comparison.

Since the ranking of optimal access regimes is different for the different costs, when all costs are considered the net value functions cannot be consistently ranked. In practice, the choice of regime will depend on tradeoffs between these costs and their relative magnitude. For example an open access regime

may maximize the net value of the resource if exclusion and governance costs are relatively high and deadweight costs from overuse are not. An example might be a large area of grazing land. Restricted access may be preferable when exclusion costs fall, however, with the choice of private or shared access depending on the relative magnitude of exclusion versus governance and deadweight costs.

5. Support from the Data

If the behavioral assertions of the model are correct, varying access rights across communities should be observed that conform to the model's predictions given different exclusion, governance, and deadweight costs. Since these costs are not directly measurable, two physical environment[16] and four community variables were used as proxies, respectively: the extremity of winter, a coastal location, the community's tendency to warfare, the ability to sanction non-compliance through expulsion, nomadism, and population density.

Ceteris paribus, the harsher the winter, the greater the consequences of expulsion, lowering exclusion costs which in turn lowers the cost of limiting access. Likewise, many Northern communities lived in small private dwellings in winter which increased monitoring and governance costs, and therefore the cost of shared access regimes. Hence, communities with extreme winters are expected to have more limited access regimes.

In contrast to the almost subsistence living of many inland tribes, coastal communities, particularly in the West, tended to have relatively abundant food supplies. The relatively hospitable environment reduces the consequences of expulsion, *ceteris paribus,* increasing the exclusion costs of

[16] An attempt to capture information about the presence of mountains or wooded areas which would have been related to exclusion or monitoring costs was not successful. It was not possible to determine from the HRAF narratives whether a community was located in the mountains (or forest) where exclusion costs would be high or in a valley near mountains (or in a clearing near the woods) where exclusion costs would not be affected. In addition, HRAF data on extremely warm climates and aridity were incomplete or unavailable, but these variables are presumably closely proxied by nomadism.

limiting access. On the other hand, the abundance of food allowed individuals the time to improve their production technologies, trade, and accumulated wealth, increasing the value of limiting access.[17]

For the community variables, *ceteris paribus*, regular warfare is expected to increase exclusion costs by increasing the possibility of theft. Expulsion, by serving as a credible threat of sanctioning is expected to lower exclusion costs. Nomadism is expected to increase exclusion costs, since movement and changing property increases the cost of enforcing that nonmembers remain outside the group.[18] Population density increases exclusion and deadweight costs as the number of people to exclude rises and their incentive to shirk or the damage from excess effort rises. A number of complexities arise, however, using these community characteristics as proxies and reconciling the theoretical and empirical model. These complexities are themselves interesting, and are discussed with the empirical results.

Since many of these proxies can be argued to affect both the choice of access rights and be a result of that choice, any assumptions of causality in a regression analysis will encounter simultaneity problems. For example, it is unclear whether a community's willingness or ability to use expulsion as a credible form of sanctioning decreases the cost of limiting access, or that limited access necessitates more sanctioning devices. Only the community's physical environment and the physical characteristics of the property are easily defensible as exogenous variables, and it would require heroic assumptions to identify individual equations in a simultaneous equation model.[19] We are trying to establish whether associations exist, which can be considered a first step to unravelling the causal relationships. Hence we focus on partial correlations between access rights and other variables, estimated by ordinary least

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[17] The literature supports an empirical correlation between economic growth and property rights, but causality is debated. See Alesina and Perotti (1994, p. 356).

[18] Nomadism could also be argued to affect group member's governance costs for these same reasons.

[19] See Alesina and Perotti (1994, p. 356) for similar debates on the causality question in the literature.

squares.[20]

The data set consists of observations across more than 40 North American Indian tribes. The primary source was the Human Relations Area Files (HRAF), a data archive comprised of books, journal articles, and manuscripts covering several hundred world cultures. Information is classified by culture, and by subject area within each culture. The data archive is discussed in Appendix A.

Although the observations on each tribe spanned many years, in general they pertain to tribal organization prior to significant contact with Europeans. To control for time would have required asserting some relationship between the passage of time and the development of the tribe, and development and the choice of access rights. Since this relationship is still being debated, and all forms of access rights are still observed hundreds of years later, no assumption was imposed.

Rights were ranked according to the proportion of the community with access: 0 for private (individual) access: 1 for access restricted to the nuclear family; 2 for access restricted to the extended family; 3 for access restricted to a group larger than the extended family but smaller than the entire community; and 4 for open access. If access rights over the same property type varied between seasons, the group was removed from the sample. For example, South Alaskan Eskimo families lived apart in the winter, but in the summer families joined to form larger communities. If the social group differed but rights across property types were largely consistent regardless of community size, they were included. Although theoretically important, it was not possible with shared access to regularly distinguish between shared input and output regimes. Both are coded as 1 through 3.

Property types used in the correlation analyses were hunting territories, undeveloped land, fishing areas, regular food, joint food, shelter, personal items, tools, weapons, and incorporeal. All property

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[20] There are precedents for this approach. Deacon (1994) uses correlations and some ordinary least squares regressions to establish associations between the extent of deforestation and property rights, while conceding that two-way causality exists. Becker and Posner (1993, p. 430) who use Human Relations Area Files (the same empirical source that we use) to investigate propositions about sexual practices use ordinary least squares, but acknowledge they are reduced-form regressions.

types were measured against a base of hunting territories. The community characteristics were: active warfare (1 = warring, 0 = otherwise), sanctioning through expulsion (1 = yes, 0 = otherwise), nomadism (1 = regularly nomadic, 0 = otherwise), and population density (1 = above 150 per hundred square kilometres, 0 = otherwise). Finally, the physical environment were: harsh winter (1= winters below freezing, 0 = otherwise) and coastal (1 = community located on a coastal area, 0 = otherwise). The partial correlations are presented in Table 2.

Table 2

Of the community characteristics, only the signs on warfare and harsh winters were significant. War is predicted to be positively correlated with access rights, since the greater the incidence of warfare, the higher the exclusion costs of restricting access over all property types. This holds regardless of the motivation or whether the community was the victim or the aggressor (since retaliation was routine). War undertaken for recreation or status, such as the Plains Indians who gained great prestige through "counting coup" (touching their enemy without killing them), tended to involve a subset of the same groups who fought for territory or other economic gain. For a tribe regularly engaged in war, the cost of enforcing private rights would be high given the possibility of theft or destruction. The negative sign of harsh winters implies that the cost of group monitoring with private winter dwellings and the threat of expulsion in a frigid climate reduce exclusion costs sufficiently to support limited access.

The strongest results are on access rights over different property types, holding constant the characteristics that differ across communities. A statistically significant relationship is indicated for regular food, joint food, undeveloped land, personals, tools, weapons and shelter compared to the reference group of hunting territories.

Property that is smaller, more easily delineated and contained relative to hunting territories is expected to have lower exclusion and governance costs and therefore more restricted access. This is supported by regular food, personals, weapons, tools, and shelter having a negative sign, indicating more

exclusive rights than hunting territories.

The larger and more amorphous the property, the higher the exclusion and governance costs and the less restricted access is expected to be. For joint goods (goods most efficiently produced or captured by a group such as whales and buffalo) the production technology may dictate more access. For example, "...the most efficient way to hunt rabbits, which were the most important single species of game, was for all the men of the Pueblo to join in a great drive." [Driver and Massey (1957, p. 387). This is strongly supported for joint food, which has significantly greater access than hunting territories, *ceteris paribus*, while regular food, for example, has significantly less.

When the production technology favors group ownership, output due to individual effort is often difficult to measure. Therefore, incentives to minimize shirking under shared access can provide additional examples of optimizing behavior.[21] An example of this occurs with the Chugach Eskimo's rules for division of whales and otters, which provide an incentive for the hunters to commit their efforts to the task. While all meat was common property, there were special rules for the baleen and skins:

> The whaler who first struck a whale with his lance had the right to the greater part of the baleen. The skin of a sea otter belonged to the man who hit it, and if several hunters struck the same animal, the skin went to the person whose arrow was nearest the tail [Birket-Smith (1953, p. 96)].

Incorporeal property (songs, stories, rituals, chants, spells, and other knowledge) did not exhibit significantly less access, though the negative sign is consistent with relatively low exclusion costs. Although some incorporeal property allows non-rival consumption, in many of these communities rituals and spells did not have public good characteristics. The power and value bestowed on the owner of this property, such as the shaman, would be weakened with common knowledge. Anecdotally, there are several examples of private rights over incorporeal property, which may reflect its value in these communities. The Western Basin Tubatulabal and Californian Porno tribes both had private property over

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[21] Alchian and Demsetz (1972), Jensen and Meckling (1976), and Barzel (1982), among others discuss the effect of monitoring on organizational choice.

songs, although they could not be sold, only inherited. For the Nootkas, it depended on the song: "Many songs, including practically all gambling songs...may be used by anyone, but many others, including all wealth - display songs, are the exclusive property of different chiefly families." [Roberts and Swadesh (1955, p. 201B)]. For the Southwest Tewa, songs were not for sale, but individual curing techniques were.

As the model would predict, unimproved land, which has both a low deadweight cost and possibly high governance costs, has less restricted access than hunting territories. Access rights to fishing areas, which were not significant, would be expected to be similar to hunting territories, with potentially high deadweight costs from overuse, and medium governance costs. Although fairly restricted access might be expected, there are instances such as for many Plains Indians, where abundant streams were ignored in favor of the buffalo [Driver (1969, p. 57)].

Considering the number of influences ignored in a simple analysis such as this, and given the variety of communities in their stages of development, history, location, etcetera, there are some surprisingly strong results. Two additional considerations may explain some of the remaining indeterminacy. First, there is a discontinuity in the model's prediction of the optimal access regime that is not captured by the empirical ranking of access rights, and second, exclusion and governance costs (as proxied by the community characteristics) can be expected to affect access regimes differently for different types of property. Looking at some of the raw data, and estimating partial correlations for subsets of property types may provide additional support for the model.

Table 1 indicates the model's discontinuity between the two shared access regimes in response to changes in deadweight costs, and a ranking with governance costs positive, but zero for both private and open access. This makes it impossible to get a continuous group size ranking from private, to shared, to open access. For example, for two communities with high governing costs, one may choose private access rights and another may choose open. All else equal, neither is likely to choose shared

access. But the two choices of private and open do not preserve the empirical ordinality imposed by the correlation.

Table 3 presents the data for access regime over different property types, and casually confirms some of the correlation results: regular food tends to be privately owned while joint food has less restricted access. Likewise, tools, weapons, and personals, with low exclusion costs, tend to be most often privately owned.

Table 3

For some property types, however, the regimes are quite mixed. Hunting territories, undeveloped land, and incorporeal property all tend to have either private or open access, consistent with the governance cost discontinuity described above. These properties would all be associated with relatively high division and monitoring costs given their size and/or lack of definition, making shared access with high governing costs the least attractive regime. It may be that the exclusion or deadweight costs then become the deciding factor for open or private access.

The mixed regimes suggest that the physical characteristics of the property alone do not determine the access rights to a property. This is not surprising, otherwise the model should only include governance costs. But the effect of the community characteristics proxying exclusion, governance and deadweight costs should not be expected to be the same for different property types. For example, the relationship between population density and the access rights is expected to differ for property types that differ in value or ease of exclusion.

To capture these differences partial correlations were run for subsets of property types. The results in Table 4 show a more significant correlation between community and environmental characteristics and access regimes could be determined when a particular property type was considered.[22]

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[22] Since we are simply trying to reveal further relationships within the data, only the significant results are displayed.

Table 4

Population density, which is hypothesized to be positively associated with access rights considering exclusion costs, but negatively associated considering deadweight costs, was not significantly correlated with access for the pooled sample (Table 2). The denser the population, the higher the exclusion costs, but also the higher the deadweight costs by increasing alternative uses for property and damage from overuse. On net, therefore, the more valuable or contained the property, the more deadweight costs would be expected to outweigh exclusion costs and favor more restricted access. When the sample is broken down by property types, Table 4 indicates that the partial correlation between population density and access rights becomes significant for undeveloped land, hunting territories, and joint food. Not surprisingly, more access is permitted on undeveloped land where exclusion costs are high and value is low, compared to joint food. But recall that when population density was held constant (Table 2) joint food had more open access than hunting territories, i.e. joint food had higher governance costs. The results from considering population density are opposite: population density is correlated with more restricted access for joint food, and less restricted access for hunting territories. This suggests that the deadweight costs dominate governance costs, and explains why population density was not significantly related to access rights in the pooled sample (across property types).

For communities with harsh winters, Table 4 indicates that hunting territories had limited access while fishing tended toward more shared or open access. One possible explanation arises from the seasonally of these two food sources. Fishing occurred predominantly in the summer, while hunting and trapping (with easily demarcated private trapping lines) was primarily a winter pursuit. As mentioned, individuals in Northern communities lived in more private dwellings in the winter, increasing monitoring and hence shared access costs for winter food staples. For example, the South Alaskan Eskimo shared food in common during the summer when they cooked outdoors. In the winter, when indoor cooking

was the rule and choice cuts of food could be concealed, food was private property.

A simple contingency table (Table 5) for joint food across the population density dichotomy confirms that there is a significantly greater proportion of restricted access for dense populations. It may be that when the population exceeds the minimum group size necessary to produce the good, some exclusive rights are assigned to reduce governance costs. In particular, *ceteris parihus,* a larger population is expected to increase output division costs [Allen and Lueck (1992)], not separately modelled here because the data does not distinguish between shared access regimes. It seems reasonable to suggest that joint goods were often governed by shared output regimes (with division costs), whereas hunting territories were governed by shared input regimes.

Table 5

Nomadism is also expected to be positively correlated with exclusion costs and hence access rights assuming that it is harder to delineate and enforce rights when the group moves regularly, especially over property such as land only inhabited seasonally. Oddly, Table 4's partial correlations suggest that, *ceteris paribus,* more nomadic tribes have more restricted access to undeveloped land. Perhaps for nomadic groups, often moving because they were without valuable hunting territories, undeveloped land represented the primary food gathering area.

In the partial correlations by property type, nomadism was positive and also significant for fishing areas and regular food, indicating more open access over this property for mobile groups. Again this is particularly significant given that holding community and environmental characteristics constant, access rights to regular food were more restricted than hunting territories, reflecting relative governance costs. Considering the exclusion costs of nomadic tribes, access rights over regular food are more open. The data for regular food in Table 6 across the nomadism dichotomy reveals the pattern behind these results in more detail.

Table 6

Sanctioning through expulsion is significantly negatively correlated with access rights over fishing streams and regular food (Table 4). This sign is consistent with the model's predictions, since the ability to sanction and thereby enforce exclusivity lowers exclusion costs. The indeterminacy on other property types may simply reflect the variety of sanctioning methods, which include stripping the individual of their reputation or status through public sanctioning, appropriating non-human wealth (fines), and physical punishment or expulsion from the group [Hechter (1990, p. 138)].[23]. For example, the Ojibwa used the fear of disease; and for the Iroquois the severest punishment for the most despicable of crimes was public humiliation. Since all fines were coded with a one, no distinction was made reflecting graduated penalties. In some cases, such as with the Iroquois, the severity of the fine may have led to almost total compliance so no relationship would have been revealed.

The sign on warfare for regular food and shelter is consistent with the results from the full sample: the higher the incidence of warfare, the less restricted the access. Not surprisingly perhaps, some of the most aggressive tribes such as the Comanche, Crow, and Arapaho of the Plains were also nomadic, suggesting multiple (not unrelated) reasons against trying to establish exclusive rights.

6. Future Research

The partial correlations here are intended as some initial larger sample evidence of property rights that support a model based on a behavioral assertion of rational maximization. Additionally, we hope that some of the practical difficulties of empirical property rights work has been revealed. Despite the

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[23] Assuming that all peoples, on average, have the same propensity for theft, groups responded differently to enforcement efforts according to Heckewelder's (1819, p. 182) account of a 1771 encounter with an Indian trader. The trader was describing his "indian lock" , which consisted of a large hominy pounding block and a few sticks of wood to keep the door closed: "See my friend, this is an Indian lock that I am putting to my door." I answered, "Well enough; but I see you leave much property in the house, are you not afraid that those articles will be stolen while you are gone?""Stolen! by whom?"—"Why, by Indians to be sure." "No, no," replied he, "no Indian would do such a thing, and unless a white man or white people should happen to come this way, I shall find all safe on my return."

complications, some significant results were obtained that could be extended with more observations and better proxies.

For example, Hechter (1990) argues that shirking and similar costs are economized on by increasing visibility and sharing the monitoring burden. Visibility is a function of the natural physical environment, whether the architecture of the group limits privacy, and public rituals, what Coleman (1991) refers to respectively as the constructed physical and social environment, and Ostrom (1989) refers to as the technology or facilities and community norms. Likewise, sharing the monitoring burden is facilitated by greater visibility, rewards to informants, and gossip.

Unfortunately, consistent data were unavailable to measure the social or constructed physical environment in these communities. To capture the social environment the importance of public rituals was examined. Every community, however, had some public ceremony, and while some such as the Aztecs in Meso-America had highly organized rituals, it does not necessarily follow that the lower-key practices of the Mescalero Apache were any less effective at monitoring behavior.[24] The construction of dwellings was researched as a proxy for the physical environment. But it seemed an arbitrary judgement to suggest that monitoring was easier with the rectangular plankhouse of the Nootka that housed several families, compared to the Hopi Pueblos of the Southwest with a single family per room, but up to 200 rooms per dwelling.[25]

Choosing a proxy for sanctioning by removing social status was likewise difficult. Often no information was available on how rank status was obtained, whether through war feats, other merit, wealth acquisition, or heredity, and therefore no way of determining which could be taken away. For

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[24] The same argument holds for ranking the openness of the natural environment. While the Mandan Indians on the Plains seemed to have a more open environment than the woodlands of the Montagnais tribes, we cannot know if monitoring costs were significantly affected.

[25] Another problem was that information was mostly available by region, not community. In general, the "more sedentary peoples tend to have multi-family houses, the more nomadic tribes to live in single family structures." [Driver and Massey (1957, p. 312)].

example, the Pawnee acquired status with wealth or through heredity. Fines are a relevant sanction in the first case, but no stripping of prestige is possible in the second. Furthermore, while crimes of murder were often punished with elaborate public humiliations, little information was available on whether this type of sanctioning was applied to property crimes. Often elaborate spiritual guidelines were in effect warning offenders that while their crimes may go unpunished in this lifetime, they would suffer in another. Perhaps the threat of future penance was a sufficient deterrent for minor crimes. Including a social hierarchy variable, therefore, would not capture its relevance as a method of reducing sanctioning costs for violating property rules.

The database was constructed requiring behavior such as sanctioning by expulsion to be clearly denied, rather than interpreting its omission in diary entries as evidence that it did not occur. One possibility for future work is to recode the data with 1 on a variable indicating the behavior was observed (such as aggressive warfare), and a 0 implying the behavior was not observed, or not mentioned. The recoding would bias the results towards estimates not significantly different from zero, hence strengthening any positive results. This would also allow the database to be expanded to more communities.

Ideally, better proxies can be found with continued culling of the HRAF files, including constructing some index of property rights that reflects more than access. Our intent here was to offer a sample of what is available, and to begin responding to laments that property rights empiricism has to date been anecdotal.

7. Conclusion

The President in Washington sends word that he wishes to buy our land. But how can you buy or sell the sky, the land? The idea is strange to us. If we do not own the presence of the air and the sparkle of the water, how can you buy them?

Such words from Chief Seattle in 1855 provide insights into the nature of people, but are also

the source of myths.[26] While many of these communities had unique relationships with the land, sky and sea, we have tried to show in this paper that individuals, nonetheless, behaved consistently with a model of rational self-interest—maximizing the value of resources subject to certain constraints. Even if another behavioral axiom better described motivation in these communities, the results here indicate responses are consistent with optimizing behavior.

[26] The myth may be that these are even the words of Chief Seattle. What is important is that he could have said them.

DATA APPENDIX

The Human Relations Area Files (HRAF) codes information by cultural unit, and by subject matter within each cultural unit. Thirty-eight units were examined (for eg. the Tlingit), and four subject codes of property: Property System (#421), Property in Movables (#422), Real Property (#423), and Incorporeal Property (#424). A brief description of each category as it appears in the HRAF follows:

421 Property System -- principles of property law; rights, privileges, and powers commonly involved in property relations (e.g. rights that others shall not use or destroy, privileges of enjoyment powers of alienation and of transmission after death); recognized types of title or tenure; recognized types of ownership (e.g. individual, joint, corporate, collective, public)...

422 Property in Movables -- culturally defined categories of movables (e.g. food stores, personal clothing and ornaments, artifacts, domestic animals, ceremonial objects)...

423 Real Property — culturally defined categories (e.g. land, trees, growing crops, buildings)...

424 Incorporeal Property -- extent to which property is recognized in intangible things (e.g. names, titles, songs, dances, visions, recipes, rituals, inventions)...

Data on tribal characteristics such as location, nomadic behavior, and warfare were obtained from other subject classifications.

HRAF's also classifies each source according to the nature of the data and an author identification. Data is coded according to quality (poor, fair, good, or excellent), and whether it is primary or secondary. The majority of the sources used here are coded as excellent secondary data ("compilations and/or interpretations of original data and primary documents), or primary data ("original fieldwork from a trained researcher"). The authors are primarily ethnologists, but entries also appear from geographers, linguists, missionaries or clergymen, indigens, and travellers.

Despite this extraordinarily careful and detailed classification, for empirical work textual entries must be subjectively interpreted for coding. Often, little interpretation was required as indicated by these sample entries for the different ownership of incorporeal property for the Nahane and Nootkas:

> Aside from one's name, ownership did not attach toward intangible goods. Nobody exercised individual control over songs or folk tales but it is likely that every man enjoyed some exclusive rights over the magical songs which he had dreamed on the vision quest [Honigmann (1949, p. 89)].
>
> The Nootkans carried the concept of ownership to an incredible extreme. Not only rivers and fishing places close at hand, but the waters of the sea for miles offshore, the land, houses, carvings on a house post, the right to marry in a certain way or the right to omit part of an ordinary marriage ceremony, names, songs, dance, medicines, and rituals, all were privately owned property [Drucker (1951, p. 247)].

Where more judgement was required, interpretations were verified by a second reader. In cases where a clear coding was unavailable or different sources reported conflicting information, the observation was removed from the dataset.

REFERENCES

Alchian, Armen A, 1950, Uncertainty, Evolution and Economic Theory, *Journal of Political Economy* 58, No. 3,211-221.

Alchian, Armen A. and Harold Demsetz, 1972, Production, Information Costs, and Economic Organization, *American Economic Review* 62, 777-95.

Alesina, Alberto and Roberto Perotti, 1994, The Political Economy of Growth: A Critical Survey of the Recent Literature, *World Bank Economic Review* 8, 351-71.

Allen, Doug and Dean Lueck, 1992, Contract Choice in Modern Agriculture: Cashrent versus Cropshare, *Journal of Law and Economics* 35 (2), 397-426.

Anderson, Terry L., and Peter J. Hill, 1975, The Evolution of Property Rights: A Study of the American West, *Journal of Law and Economics* 12, 163-79.

Baden, John, Richard Stroup, and Walter Thurman, 1981, Myths, Admonitions and Rationality: The American Indian as a Resource Manager, *Economic Inquiry* XIX, 132-43.

Bailey, Martin J., 1992, Approximate Optimality of Aboriginal Property Rights, *Journal of Law and Economics* 35 (1), 183-98.

Barzel, Yoram, 1982, Measurement Costs and the Organization of Markets, *Journal of Law and Economics* 25, 27-48.

Becker, Gary S and Richard A Posner, 1993, Cross-Cultural Differences in Family and Sexual Life, *Rationality and Society* 5, 421-31.

Benedict, Ruth, 1934, *Patterns of Culture* (Houghton Mifflin Company, Boston).

Birket-Smith, Kaj, 1953, *The Chugach Eskimo* (Copenhagen National museets Skrifter, Etnografisk Raekke, 6: Kobenhaun, National museets publicationsfond).

Cheung, Steven N.S, 1970, The Structure of a Contract and the Theory of a Non-Exclusive Resource, *Journal of Law and Economics* 13, 49-70.

Coleman, James, 1991, *Foundations of Social Theory* (Harvard Press, Massachusetts).

Cohen, Percy S, 1967, Economic Analysis and Economic Man—Some Comments on a Controversy, in *Themes in Economic Anthropology*, edited by Raymond Firth (Tavistock Publications, London).

Deacon, Robert T, 1994, Deforestation and the Rule of Law in a Cross-Section of Countries, *Land Economics* 70, 414-30.

Demsetz, Harold, 1967, Toward a Theory of Property Rights, *American Economic Review* 57, 347-59.

Driver, Harold E and Massey, 1957, *North American Indians* (The American Philosophical Society, Independence Square, Philadelphia).

Driver, Harold E, 1967. *Indians of North America* (The University of Chicago Press, Chicago).

Drucker, Philip, 1951, *The Northern and Central Nootkan tribes* (Government Printing Office, Washington D.C.).

Eggertsson, Thrainn, 1990, *Economic Behavior and Institutions* (Cambridge University Press, Cambridge).

Farb, Peter, 1978, *Man's Rise to Civilization: The Cultural Ascent of the Indians of North America* (E.P. Button, New York).

Feder, Gershon and David Feeny, 1991, Land Tenure and Property Rights: Theory and Implications for Development Policy, *The World Bank Economic Review 5,* 135-54.

Gordon, H.S., 1954, The Economic Theory of a Common Property Resource: The Fishery, *Journal of Political Economy* 62, 124-42.

Hechter, Michael, 1990, The Attainment of Solidarity in Intentional Communities, *Rationality and Society* 2, 142-55.

Heckewelder, John, *1819, An Account of the History, Manners and Customs of the Indian Nations, Who Once Inhabited Pennsylvania and the Neighboring States.* (Transactions of the Historical and Literary Committee of the American Philosophical Society 1, Abraham, Philadelphia) 1-348.

Honigmann, John Joseph, 1949, *Culture and Ethos of Kaska Society* (Yale University Press, New Haven).

Steffens, Joan, and Timothy O'Leary (prepared by), 1986, *Human Relations Area Files,* (Human Relations Area Files, Inc., Connecticut).

Jensen, Michael C, and William H. Meckling, 1976, Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure, *Journal of Financial Economics* 3, 305-60.

Josephy Jr., Alvin M., 1968, *The Indian Heritage of America* (Alfred A. Knoff Inc., New York).

Lueck, Dean, 1994, Common Property as an Egalitarian Share Contract, *Journal of Economic Behavior and Organization* 25, 93-108.

Mason, Charles F., Todd Sandier, and Richard Comes, 1988, Expectations, the Commons, and Optimal Group Size, *Journal of Environmental and Economic Management* 15, 99-110.

McKim, Fred, 1947, San Bias: An Account of the Cuna Indians of Panama, *The Forbidden Land: Reconnaissance of Upper Bayano River, R.P., in 1936,* edited by Henry Wassen. Goteborg, Etnografiska Museet

Mueller, Dennis C, 1992, On the Foundations of Social Science Research, unpublished manuscript.

North, Douglass C, 1981, *Structure and Change in Economic History*, (W.W. Norton, New York).

Ostrom, Elinor, 1990, *Governing the Commons* (Cambridge University Press, Cambridge).

Ostrom, Elinor, 1989, Microconstitutional Change in Multiconstitutional Political Systems." *Rationality and Society* 1, 11-50.

Pejovich, Svetozar, 1972, Towards an Economic Theory of the Creation and Specification of Property Rights, *Review of Social Economy* 3, 309-25.

Posner, Richard, 1980, A Theory of Primitive Society, with Special Reference to Law, *Journal of Law and Economics* 23, 1-54.

Roberts, Helen Heffron, and Swadesh, Morris, 1955, *Songs of the Nootka Indians of Western Vancouver Island* (American Philosophical Society, Philadelphia).

Umbeck, John R., 1977, A Theory of Contract Choice and the California Gold Rush, *Journal of Law and Economics* 14, 421-37.

Table 1 Pairwise Comparison of Contract Choice

Increases in:	V^P-V^S	V^P-V^C	V^P-V^O	V^S-V^C	V^S-V^O	V^C-V^O
Marginal Exclusion Costs	-	-	-	0	-	-
Marginal Governance Costs	+	+	0	0	-	-
Marginal Product of Effort	+	-	-	-	-	-
Marginal Cost of Effort	-	+	+	+	+	+

P = Private ; S = Shared Output ; C = Shared Input ; O = Open

(+, -, 0) indicates a (higher, lower, equal) net value for the first regime in the difference

Table 2
Partial Correlation of Community Characteristics and Property Type with an Ordinal Index of Access Rights

VARIABLE	COST OR BENEFIT AFFECTED	PREDICTED PARTIAL CORRELATION	ACTUAL PARTIAL CORRELATION
Warfare	Exclusion Cost	+	.116*
Expulsion		-	-.015
Nomadism		+	.026
Population density	Exclusion Cost Deadweight Cost	- +	.086
Harsh winters	Exclusion Cost Governance Cost	- -	-.120*
Coastal	Exclusion Cost Deadweight Cost	- +	-.005
Property Type Ref = Hunting Territories	Governance Cost Deadweight Cost		
Undeveloped land		+	.161**
Fishing areas		-	-.074
Regular food		-	-.153**
Joint food		+	.371**
Shelter		-	-.191**
Personals		-	-.316**
Tools		-	-.169**
Weapons		-	-.182**
Incorporeal		+	-.064

**significant at 5% for a two-tailed test
*significant at 10% for a two-tailed test
(38 communities, 268 total observations)

Table 3
Access Regimes by Property Types

	Restricted				Open
	Private	Nuclear	Extended	Clan	Open
Fishing	8	1	1	1	1
Regular food	21	5	5	2	1
Joint food	0	0	0	16	15
Hunting Terr	19	4	3	0	13
Undeveloped land	14	4	3	1	21
Personals	41	4	0	0	0
Tools	14	0	1	0	1
Weapons	9	0	2	0	0
Shelter	20	4	6	0	0
Incorporeal	9	0	0	1	3

Table 4
Partial Correlation Of Access Rights and Community Characteristics By Property Type

	Jnt food n = 30	Hnt Terrs n = 38	Undv lnd n = 42	Fishing n = 12	Reg food n = 34	Shlter n = 30	Weapns n = 11
Population density	-.504***	.387***	.384***	n/s	n/s	n/s	n/s
Nomadism	n/s	n/s	-.303**	.853***	.287*	n/s	n/s
Expulsion	n/s	n/s	n/s	-.880***	-.291*	n/s	n/s
Warfare	n/s	n/s	n/s	n/s	.335**	.518***	.612*
Harsh Winters	n/s	-.263*	-.255***	.777***	n/s	n/s	n/s
Coastal	-.550***	n/s	n/s	n/s	n/s	n/s	n/s

*** significant at 5% for a two-tailed test
** significant at 10% for a two-tailed test
* significant at 15% for a two-tailed test
n/s: not significant
Note: No partial correlations of access rights and community characteristics were significant for personals, tools, and incorporeal property.

Table 5
Access Regimes for Joint Food

	Restricted	Open
Dense	8 (36.4%)	14 (63.6%)
Not Dense	7 (87.5%)	1 (12.5%)

Row differences are significant at 5% for a chi-square test

Table 6
Access Regimes for Regular Food

	Private	Nuclear	Extended	Clan	Open
Nomadic	8 (53.3%)	4 (26.7%)	2 (13.3%)	1 (6.7%)	0(0.0%)
Not nomadic	13 (68.4%)	1 (5.3%)	3 (15.8%)	1 (5.3%)	1 (5.3%)

Row differences are insignificant