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INDUCED CHANGES IN PROPERTY-RIGHTS INSTITUTIONS

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I. Introduction

Many contemporary economists have been impressed with the possibilities of reaching out and subsuming within their theoretical and empirical models elements of social structure that traditionally have been thought of as beyond the reach of standard neoclassical approaches. One of these elements consists of the institutional structure characterizing particular economies.[1/] Rather than limiting themselves to studies of economic behavior within a set of given, and predetermined, institutional constraints, some have sought to show how transformations of economic institutions can be interpreted as endogenous responses to changes in more fundamental socioeconomic variables, such as population and production techniques. Though not without its critics, this analytical perspective has substantially enriched our understandings of a variety of economic institutions both historical and contemporary.[2/] One important focus has been on the institutions of property rights; and in that literature a question of some interest has been the linkage between changes in underlying demographic and economic factors and changes in property rights institutions. It seems fair to say that the preponderance of thought, together with some evidence, is that increases in population and/or demand, as well as certain shifts in production technologies, tend to move a society away from common property institutions and toward individual property. But the precise way in which this happens, together with many interesting subsidiary

issues, such as what factors account for the rate at which the change occurs, and whether the process might be reversible, have not been adequately developed either conceptually or empirically.

The thesis that growth in population and demand would induce institutional change in the direction of individual property was first formulated in works of Alchian and of Demsetz in the 1960's. No doubt the most frequently referenced piece is Demsetz's 1967 paper on the formation of individual property rights. His primary empirical inspiration was the body of ethnographic literature dealing with Indian hunting rights, specifically the observations that in many cases open hunting regions were divided into smaller hunting territories following an increase in the market value of the animals hunted. The conceptual argument is that the increased output price produced a higher derived demand for land, which in turn made it efficient to reduce the common property externalities inherent in the open territory system; this was done by defining and defending smaller, family-based, hunting territories.

The Demsetz hypothesis has been used to organize a number of empirical studies on property rights. Pryor attempted to relate information on land rights of a large number of underdeveloped countries to their levels of economic development. While unable to get direct information on the extent to which land rights were privatized, he did show that economic development was accompanied by greater attention being given to defining property boundaries and ensuring tenure rights. Ault and Rutman conducted a study of African property rights systems using the Demsetz model as a working hypothesis. They concluded that in the last few decades, there has been a relationship between population growth and the rise of indi-

vidual property rights in many of these countries. North and Thomas used the hypothesis in a grand manner for their study of European history in the period 1000-1300. They take the position that the rising labor/land ratio of this time was responsible for moving property institutions toward individual tenures.

On the whole, however, there have been relatively few studies aimed directly at this hypothesized connection between economic growth and property rights. This is unfortunate because in many countries of the world, both developed and developing, battles still rage over property rights issues, especially on how economic growth and development impinge on these institutions and in turn are affected by them.

In this paper I present a simple conceptual model for studying the transition from common to individual property. It shows that factors such as population growth and demand increases can indeed produce the incentive for a society to move away from common and toward individual property institutions. But it shows that this is not invariably the case; in fact, plausible circumstances can be identified in which developmental pressures encourage greater use of common property. Empirical instances of this are discussed. Additionally, the model shows that changes in political institutions can lead to property rights changes even without shifts in underlying economic factors.

Section II contains a discussion of some basic concepts, especially the two forces that are seen as the driving force behind property rights changes: transactions costs among commoners and exclusion costs against outsiders. Section III contains a simple model of property-rights changes and draws out some of its implications. Section IV applies the model to a

number of real-world cases of property-rights changes; Section V is a speculation on the interaction of economic and political factors in determining property rights regimes. Section VI is a brief summary.

II. Basic Concepts[3/]

Discussions of property rights are usually characterized by their use of discrete institutional forms; groups of resource users are seen as facing clear choices among distinct systems, such as private property and common property. But studies that make use only of the taxonomic categories of property types (e.g., Wantrup and Bishop), though perhaps accurately reflecting legal doctrine, are neither flexible nor fine-grained enough to come to grips with the rich variety of property arrangements in the real world, and especially to explore changes in these arrangements. While some institutional choices are clearly discrete — among alternative procedural rules, for example — some central issues of property rights institutions can be pursued more effectively with continuous concepts.

We are concerned in this paper with common property, and the transition from common to individual tenure institutions. It is appropriate to single out, therefore, from among the many dimensions that property institutions have, the dimension of exclusivity of use, for special study. We reserve for future work the job of incorporating other property rights dimensions, e.g., alienability, into the analysis. Accordingly, think of a community containing N firms, having access to a total of R quantity units of a natural resource. Think of a group of fisherpeople on a particular fishery, landowners above a petroleum reservoir, or farmers on a given acreage of land. There are two corner solutions: the resource can

be used in common by all N firms, or it could be divided into N individual holdings. But the resource may be divided in a number of intermediate ways. Define m as the number of commons into which N and R are divided; m clearly can take on any integer value from 1 to N. For any such value, and assuming equal division, we have a set of commons in each of which r (= R/m) units of resources are used in common by n (= N/m) firms.[4/]

We treat N as a parameter and n, since it is a function of m, as a variable. Assume there are common-property externalities, in some degree, whenever n > 1. If there were no cost implications of having m at any particular level, naive efficiency would simply require m = N, i.e., individual ownership. But when transactions costs, or more broadly governance costs, are taken into account, this conclusion does not necessarily follow. In fact, changes in m produce changes in two fundamental economic factors associated with the governance of common-property resources. One of these is in n, the number of commoners on each commons. Changes in n will most likely lead to changes in the strength of common-property externalities; more importantly, however, by changing the size of the group using each commons, changes will occur in the costs of making collective decisions about using the resource available to them. Were such transactions costs the only factor involved, efficiency would seem to imply a shift to individual tenures. But there is another important cost that must be accounted for; as m increases the extent of boundaries among commons increases, leading, most likely, to an increase in governance costs associated with managing these boundaries. The approach below analyzes property tenures as growing out of the interplay of these two factors: (1) the costs of making collective decisions among groups of firms using

resources in common and (2) the costs of excluding non-commoners from access to resources used in common by the excluding groups. In effect, this approach can be thought of as a partitioning of the total governance costs associated with using a resource into two types: the intra-group costs of making decisions within groups of commoners, and the costs of arranging relations between such groups as well as between them and the rest of the world.

Among any group of firms using a resource in common there are incentives to act collectively to reduce rent dissipation. Whether, and how much, these gains from collective action are realized depends on the transactions costs of reaching and enforcing agreements to restrain use.[5/] The analysis of intra-group transactions costs has been a major focus of interest among economists for many years, from the voting analyses of Buchanan and Tullock to the new bargaining theories of the firm such as that of Aoki. Furthermore, the prisoner's dilemma that many see at the heart of the common property problem has received enormous analytical attention, not only by economists but also by sociologists, political scientists, anthropologists, psychologists, ecologists, and just about anybody else who has studied human behavior. The analytical perspectives taken have ranged widely; some have documented the resource allocation pathologies to which the problem leads; some have tried to discover or devise schemes for solving it through voluntary means; others have turned their attention to a variety of coercive social arrangements that might be used to overcome the problem; a few have argued that the prisoner's dilemma model is simply not applicable to the case of common property.

In the model below we wish to recognize the fact that the incentives for collective restraint exist without getting drawn into the details of schemes by which it is obtained. Accordingly, we will simply assume a transactions cost function, asserting that commoners can make and enforce agreements to restrain use of the commons, but only at a cost.

In fact, there is a discrete "institutional" problem that is overlooked in this formulation. Transactions costs will depend on the rules governing joint decisions of the commoners; the use of unanimity versus majority rules, for example. The choice of rules is not a part of this model. Of course, in a fully dynamic application of the model, rule changes, and their impact on transactions costs among commoners, would have to be included.

We come now to exclusion costs. Early models of jointly-used resources (e.g., Gordon) placed no extra-economic restriction on the number of firms exploiting the resource. The only restraint on entry acted via the opportunity costs of inputs necessary to exploit the resource. In more recent models (Dasgupta and Heal; Cornes and Sandler) the number of resource-using firms is a parameter. This makes it possible to address the question of what happens when n, the number of firms, takes on different values, whence it is only a short analytical step to the question of the optimal value of n (Cornes et al.). Neither open-entry with full rent dissipation, nor parametrically fixed n, are likely to be stable states of affairs. In the former there are likely to be some positive incentive for subgroups of firms to gain control of the resource by excluding the others; in the latter the n firms, assuming they have been successful in coordinating a reduced use level, will have to prevent entry by others.

The critical concept in each case is the cost of exclusion, which is simply the cost incurred by any group of commoners to exclude others from their commons.

Exclusion costs are directly related to the costs of defining and enforcing boundaries among commons. As the number of commons changes, the total length of boundaries changes. It is at a minimum when there is a single commons, at a maximum with individual property, and increases monotonically but not linearly with the number of commons into which the total resource and number of firms are divided. There is a wide variety of institutional arrangements through which exclusion can be carried out, ranging from completely individualized and unrestrained conflict among neighboring commoner groups, through such things as mutual defense pacts among groups, to sophisticated systems of socialized exclusion activities with laws, a specialized constabulary, and so on. The political development of a society consists in changes that occur in these types of arrangements; we will have more to say about these matters in Section V.[6/]

The introduction of exclusion means that there is likely to be a discrepancy between "owning," excluding, and using groups. Let n refer to the number of commoners who engage in exclusion on a particular commons. This group is not necessarily co-terminus with the group having the legal right to the commons. There are many real-world examples, one of which is cited below, where a subgroup of the legal owners have taken it upon themselves to exclude all others. This is true in "open-access" resources, where everyone in a community has a legal right to a resource, as well as resources having a more restrictive ownership. Let n^* be the number of effective users of a resource; n^* is a function of three factors: (1) n,

(2) the quantity of resources devoted to exclusion, and (3) the incentives that exist for encroachment. Perfect exclusion is where $n^* = n$, but in general we expect $n^* > n$ because of costly exclusion resources. When no resources are devoted to exclusion, and incentives for encroachment are initially positive, n^* would reach some open-access amount regardless of the size of n, assuming that the open-access level is less than the total population of the community. n is bounded below by unity.

In order to hold the analysis within reasonable bounds we have to make some fairly drastic assumptions about exclusion. One of these is that the total number of firms in the community engaging in exclusion activities stays constant; the only question is the optimal number of commons into which these firms divide. What this assumption rules out is a situation in which a subset of the firms, perhaps even just one, succeeds in effectively excluding all the others from the resource. This is clearly a matter for future work, because controversies about property rights concern not just the size of the optimal commons, but also the distribution of access to natural resources among community members.

III. A Simple Model

In this section we present a simple model incorporating some of the previous ideas, and draw out some of its implications.

Define the following terms:

R: the total quantity of a natural resource available to the community,

N: the total number of firms in the community,

m: the number of commons,

x_i: variable input applied on the i^{th} commons by the n_i firms on that commons, $i = 1,\ldots,m$,

r_i: quantity of natural resource used in common by firms of the i^{th} commons,

n_i: the number of firms engaged in exclusion on the i^{th} commons, or on whose behalf exclusion is to be carried out,

e_i: total exclusion resources provided by the i^{th} commons,

$\hat{e}$: resources devoted to excluding encroachers from the i^{th} commons,

$f(\cdot)$: production function for one commons, assumed the same for all commons,

$t(\cdot)$: transactions costs for one commons, assumed the same for all commons,

$c(\cdot)$: exclusion costs for one commons, assumed the same for all commons,

w: normalized price of the variable input.

The production function of the i^{th} commons is specified as $L(x_i, r_i, \hat{e})$. The variable input x_i is the amount applied by the n_i firms who are engaged in exclusion. Since exclusion is never perfect, the effective amount of variable input used on the commons is greater than x_i. If we were to use a production function containing this effective quantity of x as an argument, however, we would require some device to partition total output into that accruing to the firms who are doing the excluding than that accruing to encroachers. Since this is likely to be unwieldly, we use a formulation in which output depends on x_i and $\hat{e}$. Greater exclusion reduces the quantity of x applied to the resource by encroachers, and

therefore increases output for any quantity of x_i applied by the excluders.

The relationship of $\hat{e}$ to e_i depends on the governance process through which exclusion is carried out in the community. In general, we can think of $\hat{e} = g(e_i, m)$ but there are several special cases. If exclusion is strictly a matter for each commons to accomplish by itself, then $\hat{e} = e_i$. Complete socialization of exclusion, on the other hand, would give $\hat{e} = me_i$, or perhaps $\hat{e} = g(me_i)$ where $g(\cdot)$ captures the way a community spreads its collection of exclusion resources among the m commons.

Internal transactions costs are specified as $t(x_i, n_i, r_i, \hat{e})$, and are in the form of reductions from output. Most directly, transactions costs depend on the quantity of variable input in use, with $t_x < 0$; in order to achieve lower levels of x higher transactions costs are required. It seems also reasonable to specify $t_{xx} > 0$. The level of x for which $t(\cdot) = 0$ is a matter of some controversy. The first open-access models had equilibria at full rent-dissipating levels of x, that is, where $[F(\cdot)/x] = w$ (Gordon). So reductions of x from this level would entail increasing transactions costs among the commoners. But in the recent model of Dasgupta and Heal, the open access equilibrium level of x gives only partial rent dissipation as long as n is limited, implying that some limitations of x could occur through the voluntary but non-cooperative actions of the commoners. In this case the transactions cost function would begin somewhere between the above level and the level where $F_x(\cdot) = w$. On the other hand, the recent model of Cornes and Sandler leads to full rent dissipation whenever $n > 1$.

The variables r and $\hat{e}$ are included in the transactions cost function in order to shift it in proportion to shifts in the production function produced by these variables. However, the number of firms on the commons, n, has an independent effect on transactions costs; the fewer the number of commoners the lower the transactions costs. There are obviously other factors that affect transactions costs among a group of commoners; in the real world reducing the number of commoners may be neither necessary nor sufficient to reduce transactions costs. If commoners have heterogeneous economic characteristics, transactions costs might be reduced simply by reallocating specific individuals among commons. The simple transactions cost function used here is to be defended on grounds of simplicity, along with the idea that in the normal course of growth numbers of commoners are correlated with heterogeneity. It is also probably true that the size of the commons, in terms of number of commoners, is the most practical way of affecting transactions costs, even in a world where these costs are also affected by other factors.

The exclusion cost function is specified as $c(e_i, m)$, and is also in the form of reductions from output. The inclusion of m is to capture the effects of the governance costs in obtaining enforcement resources collectively; $c_m > 0$ asserts that the costs of a given quantity of resources provided by the i^{th} commons increases with the number of commons. The more efficient the collective decision process is that establishes e_i, the closer is c_m to zero.

We have made the assumption that all firms and commons have the same characteristics in terms of production, transactions and exclusion cost functions. This being the case, total rents in the community will be

equal to the rent on a representative commons times m. Accordingly we formulate the following expression for total rents in the community of N firms using a total of R natural resources divided into m commons:

$$Y = m[f(x, n, r, \hat{e}) - t(x, n, r, e) - c(e, m) - xw] \tag{1}$$

where we have suppressed the subscript i for convenience.

We examine, first, the efficient, or rent-maximizing levels of x, e, and m, under the constraint $1 \leq m \leq N$. The Lagrangian is $L = Y + \lambda_1(m - 1) + \lambda_2(N - m)$ and the first order conditions are:

$$L_x = Y_x = m(f_x - t_x - w) = 0 \tag{2}$$

$$L_e = Y_e = m\left[(f_{\hat{e}} - t_{\hat{e}})\hat{e}_e - c_e\right] = 0 \tag{3}$$

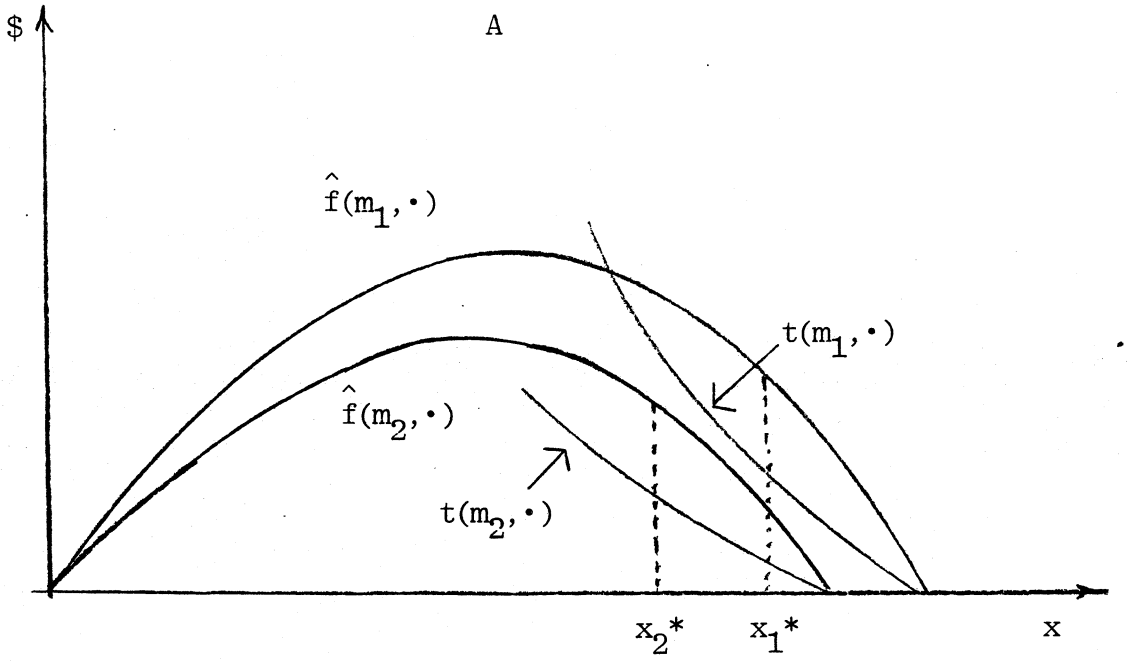
$$L_m = [L(\cdot) - t(\cdot) - c(\cdot) - xw] \tag{4}$$

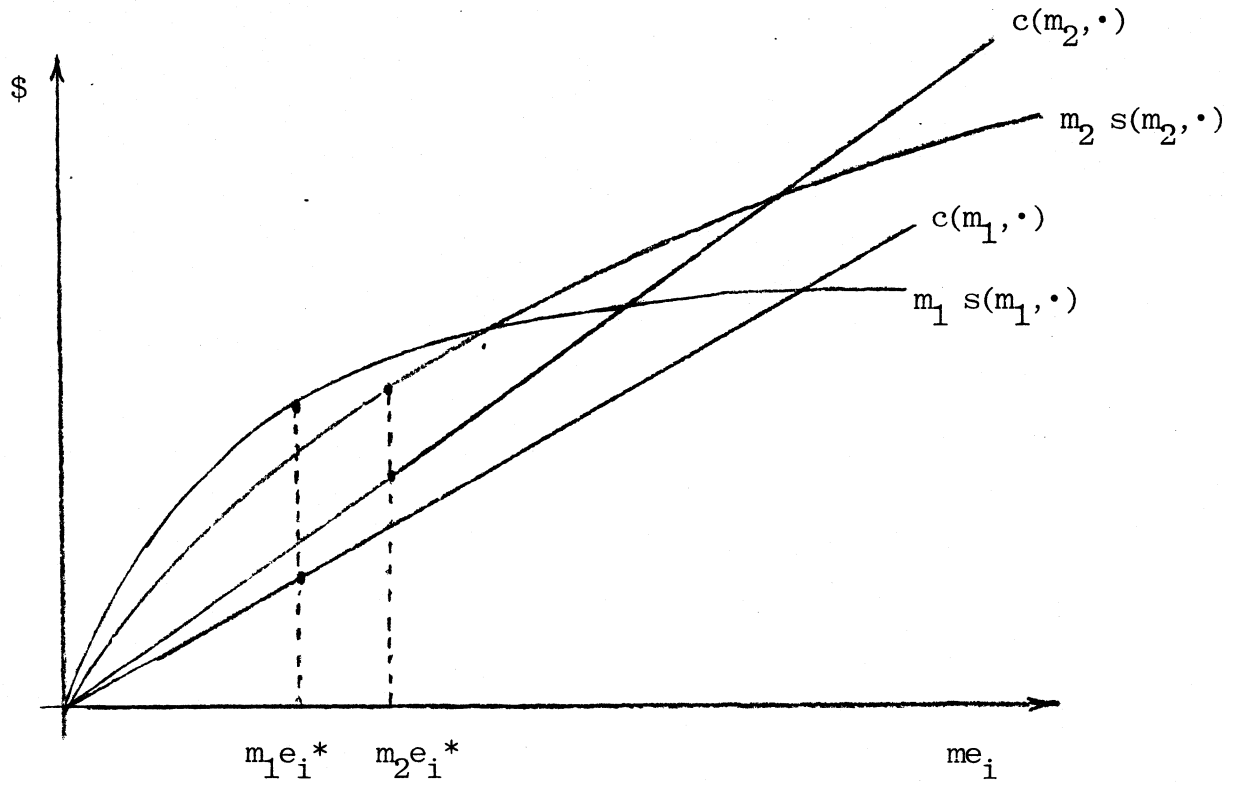
$$+ m\left[L_r r_m + f_{\hat{e}} \hat{e}_m - t_r r_m - t_n n_m - c_m\right] + \lambda_1 - \lambda_2 = 0$$

$$L_{\lambda_i} \geq 0;\ \lambda_i \geq 0,\ \lambda_i L_{\lambda_i} = 0;\ i = 1,2$$

Expression (2) shows the efficient use rate for a typical commons, and is depicted in panel A of Figure 1. Since $t_x < 0$, optimal x occurs somewhere between the open access level [$f(\cdot) = xw$] and the classic rent maximizing level [$f_x = w$]. In Figure 1, the function labeled $\hat{f}$ is $f(\cdot) - xw$, and is shown for two different values of m ($m_1 > m_2$) and constant $\hat{e}$. As x is reduced from full rent-dissipating levels, $\hat{f}$ increases but so do internal transactions costs. Assuming appropriate curvature properties rent is maximized somewhere to the right of where $\hat{f}$ reaches a maximum. If we are serious about transactions costs, this must be regarded as a full social optimum, not a second-best position.

Figure 1. First-Order Conditions





Expression (3) shows the condition for the efficient level of exclusion expenditures. It perhaps bears repeating that e_i is the exclusion cost of the i^{th} commons, but this does not imply that these are determined solely by private decision of that commons. This would be the case if exclusion was completely privatized, but if it is partly or completely socialized then e_i is partly a collectively determined expenditure, or contribution, of the i^{th} commons. Thus $\hat{e}_e$ is a highly simplified manifestation of a complex social process that ties together the exclusion costs made by each commons and the exclusion resources that materialize to impact on the production function of each commons. Panel B of Figure 1 shows the solution for optimal e_i inherent in expression (3). The functions $s(m, \cdot)$ depict $[L(\cdot) - t(\cdot) - xw]\hat{e}_e$, also for two different values of m ($m_2 > m_1$). In the diagram these have been aggregated up through multiplication by m. Note that $\partial(f_e - t_e)/\partial m > 0$; a system incorporating a larger number of relatively small commons implies less rapidly diminishing returns to exclusion resources. This seems reasonable as a first approximation since that system contains more boundaries than a system with a few large commons. By assumption c_{e_i} is constant and $c_m > 0$.

Expressions (2) and (3) hold for any m; combining them gives:

$$\frac{f_x}{t_x + w} = \frac{f_e - t_e}{c_e/\hat{e}_e} \tag{5}$$

This shows the tradeoff between what might be called internal and external means of increasing rents from a commons. Internally, returns on the commons can be increased by devoting more resources to securing and enforcing x-limiting agreements; the left side of (5) is the return per dollar of cost in this activity. Externally, rents can be increased by devoting

more resources to exclusion; the right side of (5) is the return to this activity.

Expression (4) gives optimal m for given e. The efficient number of commons is where the marginal rent on a typical commons, multiplied by the number of commons, equals average rent per commons. For this to be interior it must be the case that:

$$\left[(f_r - t_r)r_m - c_m\right] + \left[f_{\hat{e}}\,\hat{e}_m - t_n\, n_m\right] < 0$$

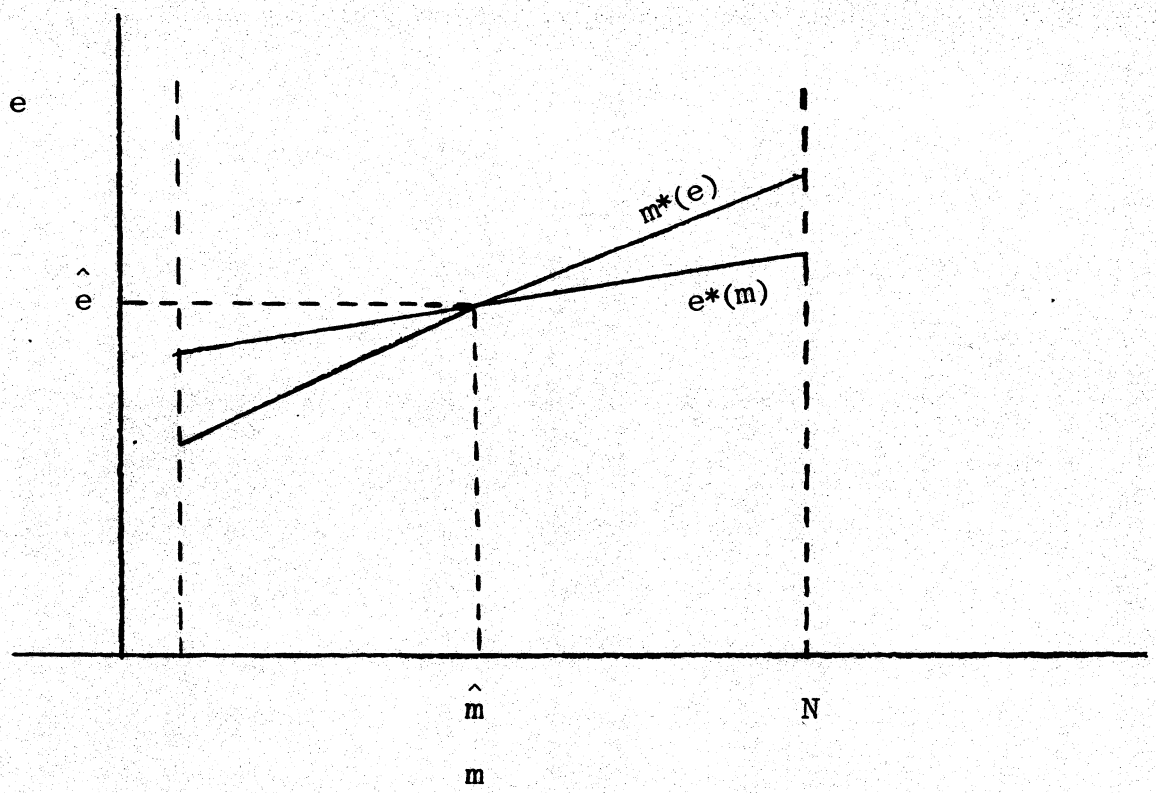
The terms in the first set of square brackets show how changes in m affect changes in rent (because of reductions in resources per commons) and in the costs of exclusion resources; the sum of these is negative, since $r_m < 0$ and $c_m > 0$. The terms in the second set of square brackets show how changes in the number of commons affect transactions costs (through reductions in n) and in the total availability of exclusion resources; the sum of these is positive. For interior solutions of m, the former sum must outweigh the latter.

Expressions (3) and (4) each involve a relationship between e (or me) and m; these are pictured explicitly in Figure 2.[7/] The function $e^* = e^*(m)$ is from (3) above, and shows the efficient level of exclusion resources for any particular number of commons. The function $m^* = m^*(e)$ is from (4), and gives the optimal number of commons for a given level of e. Overall efficiency is accomplished with $\hat{m}$ and $\hat{e}$.

The intersection of $m^*(e)$ and $e^*(m)$ is stable as long as the slope of the latter is less than that of the former. The functions are shown as linear, but in fact there is no necessary reason why this has to be true.

Figure 2

Optimal m and e



Reductions in the exclusion cost function have the effect of shifting $e^*(m)$ upwards, implying an increase in the optimal number of commons. When exclusion costs become small enough we reach a corner solution at $\hat{m} = n$. With low exclusion costs there are relatively low cost penalties attached to obtaining the lower transactions costs that smaller commons permit. Thus when exclusion costs are relatively low, pure individual property is the optimal institutional arrangement.

The opposite is the case when transactions costs become small relative to exclusion costs. With no penalties in the form of higher transactions costs, larger commons give higher returns to exclusion costs. In panel B of Figure 1, the effect of transactions costs that approach nil is to change the family of yield functions $[m_i\ s(m_i, \cdot)]$ so that those for larger commons never fall below those for smaller commons.[8/] Then for any given level of exclusion costs, returns would always be higher on larger commons. In Figure 2 this is an upward shift in $m^*(e)$, which eventually produces a corner solution at $m = 1$. Thus in the absence of transactions costs, but positive exclusion costs, pure common property is the optimal system.

In the case where both transactions costs and exclusion costs are zero, the optimal commons is governed strictly by the production function; with constant returns the size of the optimal commons is indeterminate within the model.

The rate at which the optimal commons changes obviously depends both on the rate at which $e^*(m)$ and $m^*(e)$ change, and on their shapes. If they both are very elastic, small shifts in one or both can imply large changes in the optimal commons. On the other hand, if $m^*(e)$ is very inelastic

relative to $e^*(m)$, assuming positive slopes for both, shifts will produce relatively little change in the optimal commons, but substantial changes in the optimal quantity of resources devoted to exclusion, and so on.

As mentioned above, much attention has been focused on the question of how increases in population and demand affect property rights institutions. We deal with demand first, because it is the simplest. What has to be sorted out is the likely effect of an increase in demand on the $e^*(m)$ and $m^*(e)$ functions. Suppose there is an increase in demand that is materialized in an increase in output price. The effect of that is to shift up the rent function for any commons; the slope of the transactions cost function remains unchanged, though its origin is shifted to the new full rent-dissipating level of x. The implication of this is to increase the optimal amount of exclusion for any commons, thus to shift $e^*(m)$ to the right in Figure 2. But the shiftup in rent functions, at least a multiplicative shift like this one, also implies an increase in m for any particular level of e; in Figure 2 $m^*(e)$ shifts downward. Under the assumption that c_m is relatively small, these changes would lead unambiguously to a reduction in the size of the optimal commons, together with an increase in resources devoted to exclusion. In effect the increase in value of output justifies a reduction in size of commons to capture decreased transactions costs, with an accompanying increase in exclusion costs to obtain the higher returns possible in a system of smaller commons.

This analysis is incomplete, however, because it has proceeded under the assumption that output price has no connection with exclusion activities. But the effectiveness of resources devoted to exclusion depends on

the incentives that exist for encroachment, which are related to the derived value of the resource. If the resource has no value, there would be little incentive to encroach, and thus it would be relatively easy to exclude, other things equal. So an increase in value of output could be expected to increase the potential for encroachment, which implies that additional resources are required to achieve the same effective level of exclusion that pertained before. One way of modeling this is through an increase in the price of exclusion resources. By itself this would shift $e^*(m)$ downwards, and if the effect is particularly strong could lead to that result even when combined with the effects mentioned in the previous paragraph. This could actually lead to a reduction in m, i.e., an increase in the size of the optimal commons. We will see in the next section that cases like this have actually occurred.

Population growth also has an ambiguous impact on the size of the optimal commons. Under most circumstances increased population would presumably imply an increase in output price, leading to the impacts noted above. But population growth would have several additional effects. By increasing the number of commoners it would increase transactions costs; this would lead to reduced rents on larger commons relative to smaller ones, and if this were the only additional effect of population growth, we could conclude that it would more likely lead to smaller optimal commons than was the case for output price changes. Again, however, we must consider the effects of population growth on exclusion costs; and here we have a very substantial ambiguity. In line with our previous reasoning, small populations would imply less likelihood of encroachment and therefore lower exclusion costs. But to the extent that exclusion resources

involve labor, lower population would tend to make exclusion more costly in real terms. Thus the effect of population growth on exclusion costs is difficult to determine a priori. However, since the impact of population growth is more strongly in the direction of smaller commons, than was the case with price increases alone, we may be justified in concluding that population growth would more likely lead to reductions in the size of the optimal commons.

IV. Applications

In the preceding sections we focused on identifying the efficient size of commons and the major economic factors that would account for changes therein. In this section we take a plunge and try using the model to interpret some empirical cases of property rights changes. Does it make sense to use a normative property rights model in a positive analytic mode? Property rights institutions are perhaps the most controversial element of any society's institutional structure. Changes in those rights normally occur within complex processes of social conflict and cooperation, ranging from reasonably sedate Pareto-efficient adjustments to all-consuming, revolutionary redistributions. The question is whether economic efficiency is a sufficiently dominant factor in enough of the real world for the model to give useful predictions.

There is a wide body of opinion, even if not much evidence, that economic efficiency is one of the main forces driving change in economic institutions. Evolution of the common law in directions that permit more efficient resource use, and evolution of contractual forms that permit greater gains from trade, are two cases in point [Priest, Williamson,

1979]. There is no reason to think that the drive to capture efficiency gains, in the value-maximizing sense not the Pareto sense, would be any less powerful a force in the evolution of property rights institutions. But the precise way in which it may happen is unclear. There are few institutional changes that are not connected to political activity of one sort or another, and few political institutions that do not reflect in some degree a society's current distribution of income. All of which means that income distribution will also be a most important factor in determining institutional patterns and changes. Indeed there is a substantial body of literature on economic development that documents this fact. The phenomenon of rent seeking is also grounded on this idea. Having said all this, it still seems reasonable to press on empirically with an efficiency-based model. We can take the position either that efficiency will have its way in the long run, or that we can shed some light on the extent to which efficiency considerations, relative to other factors, drive institutional change.

Although there has developed a substantial empirical literature on property rights, much of it is difficult to interpret with our concepts, primarily because the studies have used discrete concepts of property rights regimes. The most straightforward empirical implications of the model are that intermediate size commons should exist and that in situations where economic factors are changing we should see commons becoming larger or smaller over time. A number of property rights studies give reasonably clear evidence of intermediate size commons, the size of which depends on the balance between transactions and exclusion costs. In studies of grazing in the American west Anderson and Hill show that groups of

ranchers often formed grazing units on defined geographical areas, taking it upon themselves to exclude outsiders by means of the common roundup. These common grazing areas were usually based on areas where geographical characteristics, mountain ranges, etc., could be used to reduce substantially the costs of exclusion [Dennen]. A major factor in the eventual reduction in size of these grazing commons was an innovation that reduced exclusion costs, i.e., barbed wire.9/

In their study of Navajo grazing practices Libecap and Johnson note the existence of intermediate sized commons, areas within the general range that have been fenced off by groups of families. They note that the average size of family herd in these smaller commons was greater than the average size of herd on the unfenced portions of the range. This implies that families with larger herds found it easier to form smaller commons and fence against the rest of the range. Another implication is that after forming the smaller commons, those commoners would find it easier to reduce the size of their herds to maximize rents on the commons; this means that their herds would be smaller, on a per acre basis, than they were before forming the commons. From the data in the paper it is impossible, unfortunately, to tell if this was the case.

In a study of the inshore Maine lobster fishery Acheson studies in detail the way in which fishermen divided into groups based primarily on home port, and defended boundaries around their own commons areas. This led to a situation in which the total lobstering region was subdivided into a large number of intermediate size commons, maintained by exclusion activities that were technically illegal.

When the first European settlers began agricultural operations in 17th century New England, they chose to use much of their land in common. This applied both to grazing areas as well as cultivated fields and natural meadows. The fields of each community were not open to all residents on an equal basis, however. Rather, the town lands were organized into series of common fields, with designated commoners granted rights in each field [Field and Kimball, and Field].10/

In the Hong Kong agricultural village studied by Potter in 1961-63, a large portion of the land was held in common; not in one large common, but in a number of smaller commons, the numbers of each being based on ancestral kin groups. Decisions among commoners were made through the hierarchical structures of these groups. He shows that, whereas this can lead to relatively low transactions costs in static economic conditions, the complex web of family connections can actually inhibit their ability to respond in changing circumstances.

In a study of traditional grazing areas in Botswana, Peters describes clearly a system consisting of a large number of small commons, each centered on a watering place, and each subject to governance procedures stemming from traditional tribal political structures. Boundaries were managed even though herd mobility was relatively high. This ease is interesting also because it shows the difficulties that can arise when planners attempt to impose a property-rights system without regard to the factors affecting relative governance costs and the size of the efficient commons.

These studies provide reasonably convincing evidence for the existence of intermediate-size commons, and there is every expectation that a more exhaustive search of the empirical property rights literature would

uncover many more examples. A more rigorous test of the model, however, hinges on whether there is evidence that commons have changed in size in response to shifts in the explanatory factors as specified.

As mentioned above, one implication of the model is that relatively low exclusion costs lead to individual property. The most likely situation producing low exclusion costs is one of low population density together with few natural threats. It could be argued that this characterizes reasonably well many of the first small human settlements, leading in turn to the conclusion that these "communities" would have begun with something approaching individual property. This clearly runs counter to the widespread notion, amounting almost to a matter of faith, that the first human settlements held property, or at least the natural resources portion of it, in common.[11/] There is not the space here to sift through a mountain of anthropology literature in order to test this proposition. There is some supporting evidence, however, for individual property as the original tenure form. According to Hoffman, early medieval agriculture in transalpine Europe was pursued by families on reasonably consolidated farms, organized in small hamlets, each composed of three or four families. Then as population grew, a shift occurred toward common use of agricultural land. The trend from individual holdings to common fields as a result of population growth in a medieval England has also been noted (Thirsk).

We seem to have a situation in which population growth produced a trend from individual to common property in one historical circumstance, but from common to individual property (as noted by Demsetz) in other circumstances. In terms of the present model, the explanation is that

population growth in the early period shifted exclusion costs up proportionately more than transactions costs, while in the later period the reverse was the case. It is this second case that occupies center stage in modern institutional economics.

Conclusions about property rights changes over the broad sweep of history are speculative at this point; further work is required. We turn now to examination of some micro cases of property rights changes from the perspective of the model.

In "New England" in the 16th through 18th centuries there were two cases in which population and demand growth produced pressure for smaller commons. The first was the well-known case of certain Indian tribes moving toward smaller commons as a result of increases in the value of the beaver they hunted. There is a large literature on this topic and no good reason to expand on it here [Harper-Fender]. The other case has not yet been studied to any great extent. It is the shift that occurred among the early white farmers from the large amounts of common field agriculture with which they began to individual land holdings. As discussed in Field, and Field and Kimball, this transition took the form in many cases of progressively subdividing larger commons into smaller ones. In some communities this transition took well over a century to complete.

The combination of relatively low population, substantial numbers of livestock, and an underdeveloped enforcement system, made exclusion costs relatively high in the first few decades of New England. Furthermore, transactions costs were relatively low because of the common cultural backgrounds of settlers and their strong community religious institutions that could sanction agreements among commoners. All of these factors en-

couraged common field agriculture in these early years. But these factors changed as the region grew. Growing population led to reduced costs of fencing and substantially larger common property externalities. Most importantly, an efficient public system of exclusion was developed, with courts and constabulary. These factors produced a trend toward individual land holdings. As mentioned above, though, the evidence so far does not indicate a once-and-for-all jump to completely individual holdings; rather, a move to progressively smaller commons as tenures were adjusted to changes in the underlying economic, political and demographic factors.

In the previous case population growth led to a move toward individual property, because it both increased transactions costs and lowered exclusion costs. Acheson's study of Maine lobster territories shows the opposite trend. In the portion of his study area more open to economic growth (the western part), lobstering commons have tended to become larger over time. Greater demand for lobsters produced substantially increased incentives to encroach. At the same time the technology of exclusion, highly primitive in any case,[12/] was not sufficient to maintain the borders of the original areas. Under these circumstances we would expect an increase in the size of the commons, as indeed has happened. This case is interesting because exclusion has not been socialized but is left up to individual commons. This is likely to have a couple of effects; first, relatively high marginal costs of exclusion for individual commons; and second, a degree of interaction between transactions and exclusion activities. Acheson showed, for example, that in those areas where commoners were able to solve their transactions problems more effectively they were also able to exclude more effectively.

Petroleum reservoirs are another case where rising demand apparently increases the size of the optimal commons. When the number of wells on a reservoir is relatively low, little is lost by uncoordinated extraction; the costs of trying to organize joint action presumably outweigh the gains that would be forthcoming from reducing the modest levels of external costs. Small, perhaps individual, commons are efficient. All of this changes when demand for contents of the reservoir increase, leading either to substantially increased drilling activity by existing owners and/or the encroachment of new wells. Rising transactions costs, together with high exclusion costs, are likely to increase the size of the efficient commons, perhaps to complete unitization. The recent papers of Libecap and Wiggins show, however, the very high transactions costs that often make unitization difficult or impossible [Libecap and Wiggins, 1984, 1985; Wiggins and Libecap]. In fact, their work shows that in the face of very high transactions costs but substantial common-property externalities, intermediate-size commons will often develop over single petroleum reservoirs; that is, subsets of firms will often form commons on the reservoir, taking advantage of natural features that reduce exclusion costs around their part of the reservoir, or perhaps engaging in rather costly artificial exclusion operations. Libecap et al. take the position that these intermediate-size commons are inefficient, which is to say that if one could find a way to reduce transactions costs among large numbers of commoners, the optimal number of commons in this case would be one.[13/]

IV. Political Institutions and Property Rights

The material in the previous sections was all based on efficiency

concepts. There is fairly widespread adherence, however, to the proposition that ". . . the formulation and regulation of tenurial arrangements is an expression of the political order of society" [Kemp]. What, then, is the use of models based solely on economic efficiency? The answer is that by casting the problem into a form that will reveal with great clarity the primary economic relationships involved, we reveal also the pressure points whose resolution will be determined by the nature of the available governance structures. Paradoxically, the elucidation of the important economic relationships show the points where the quality of the governance institutions will be most important.

In the model presented above it is very clear where governance processes enter the picture. Both exclusion of non-commoners and transactions among commoners are carried out by making and enforcing collective agreements among groups of people. One implication of this is that a move in either direction on the commons continuum involves a change in coercive sanctions on individual behavior and therefore calls into play certain governance procedures. A move towards larger commons implies greater costs of coordinating behavior among larger groups of commoners, using whatever means — economic, moral, social — are available to the groups. But if a move toward smaller commons is to achieve efficiency gains, it must be accompanied by more resources being devoted to the coercive activity inherent in the exclusion function.

The interesting question is whether collective decision making in the two cases — transactions among commoners and exclusion of non-commoners — is facilitated by different types of political institutions and practices. As an example, Campbell has argued that feudal institutions could

be thought of as relatively more efficient at solving collective decision problems within groups of commoners than between such groups. Thus, he noted a relationship between regions in England that relied more on common fields and regions having stronger manorial institutions.[14]

Another vivid example of the influence of governance institutions is provided by Jodha's observations on land reform in a part of India. Prior to the reform, relatively large grazing commons were viable because of the existence of authoritarian political structures that could achieve reasonably efficient commons use rates with relatively low transactions costs. Part of the reform was to break up these political structures and replace them with more representative councils to manage the commons. But these councils functioned in a way that led to much higher transactions costs among the commoners, the result being a rapid shift to over-exploitation of the remaining commons.

The notion that a shift from hierarchical to decentralized political institutions, other things equal, could decrease the size of the optimal commons obviously has to be regarded as highly speculative. The general point is, however, that in addition to the changes in economic factors that clearly affect the efficient size of commons, we can look on political innovations as also having a distinct role to play in determining efficient property institutions in a society.[15] And innovations in institutions of internal commons governance may occur distinct from, and at a different rate than, innovations in the institutions through which are carried out the function of boundary maintenance and exclusion.

Not only are such large-scale political factors important, but also relatively modest shifts in legal doctrine may affect the evolution of the

actual commons through time. For example, when a community uses a single large commons, its legal ownership may be seated in the whole community as a corporate body, or its ownership status may simply be unspecified in any formal way. But when commons get smaller they will be owned "privately" by smaller groups of people; this would normally be accompanied by evolution in legal doctrine (e.g., evolution of a concept of tenants in common), that facilitates the change. Perhaps some of this political and legal change could be subsumed in the transactions and exclusion cost functions of the model, but in part they may also affect the rate at which the optimal commons changes from one equilibrium to another.

There is one other way in which political institutions may have an impact. Most societies are likely to have what might be called ideological commons, tenures that are considered to be morally superior in some sense. It is no doubt possible to produce clever myths that are capable of reconciling differences between actual commons and ideological commons. Nevertheless, we should be alerted to the possibility that evolution of the actual commons will often be accompanied by evolution of the ideological commons, and there would seem to be no reason why these ideological factors might not have their own impact on the shift in the optimal, or actual, commons. The ideological commons may frequently play a larger role in public policy than does the optimal commons. It has been asserted, for example, that in many African countries national policy regarding resource tenures is often affected by ideological commitments to relatively large commons [Ault and Rutman]. It is equally true that strong ideological commitments to one-person commons are a fact of life in American politics.

The relationships among economic factors and political factors in the study of institutional change obviously have to be worked out in greater analytical detail. It is important to know, for example, how exogenous political innovations affect tenure relationships, at levels far short of the cataclysmic revolutionary changes that attract most of the attention. We need to know also the extent to which governance institutions may adapt themselves to shifts in fundamental socioeconomic factors. Some recent work in anthropology, for example, suggests that the effect running from demographic change to property rights changes may be transmitted via political institutions; population growth leads to restructuring of political institutions which leads to changes in efficient property rights institutions [Shipton].

V. Conclusion

Property rights institutions are a critically important, and usually highly controversial, dimension of any society's developmental history. There is advantage in knowing how shifts in fundamental economic factors create pressures for changes in property rights institutions. The writings of the "new institutional economics" are strongly committed to the notion that economic and demographic growth produce incentives for a shift toward individual property, primarily to reduce the losses of common property externalities. The model presented above depicts changes in the size of the optimal commons as resulting from differential changes in transactions costs, the costs of making and enforcing agreements among commoners, and exclusion costs, the costs of excluding non-commoners from a resource. When the former increase faster than the latter a move toward

individual property is efficient; when the relative movement of these factors is reversed, efficiency calls for a move toward common property.

It is to be emphasized that the problems of transactions costs among groups of commoners, and the problem of developing efficient procedures for exclusion, are essentially matters of collective decisions. This being so, it is impossible to separate the topic of efficient ownership tenures from the topic of the collective governance institutions of a society.

Footnotes

1/ The other things that usually take as given in neoclassical models are factor endowments, production technologies and tastes. Population growth, central to the matter of factor endowments, has often been studied as an endogenous response to a variety of economic variables; see Esterlin, Becker (Part 6), and recent fertility models such as that of Rosenzweig and Schultz. Induced technological change has also been a topic of some popularity among researchers; see the review of Binswanger and Ruttan. There have been fewer attempts to view tastes as endogenous (not simply as manipulated by advertising), but see Gintis.

2/ Induced institutional change is the distinguishing concept of the "new institutional economics," the founders of which include North and Thomas, Posner, Alchian, Demsetz, and Williamson. For a critic, see Alexander Field.

3/ Of course many of the conceptual elements used in the paper have been foreshadowed in the work of others. Reference to Dahlman's work on English common fields is especially appropriate. He does not, however, try to develop an integrated model out of these elements, perhaps because conceptually he uses an ideal-type approach; that is, he concentrates on forms which in the present model are just two points on a continuum. The same is true of Umbeck's treatment of property rights in the California gold rush.

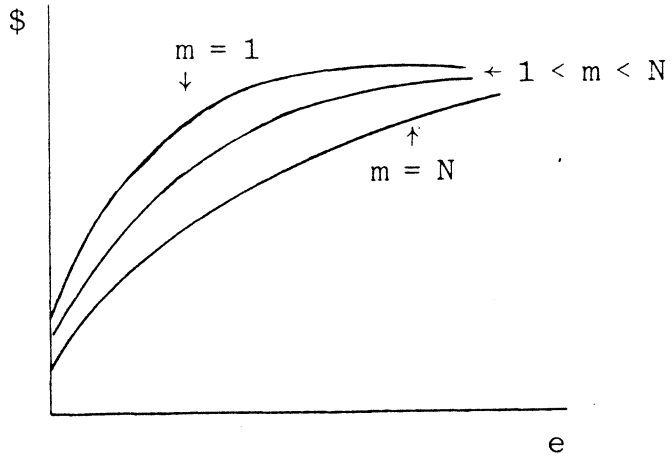
4/ The "approximately" is obviously necessary because N/m is not always a whole number. I assume some procedure for distributing the remaining commoners among the m commons.

5/ Transactions costs often have been narrowly defined to include the costs of transferring a good or service across a technologically separable interface [Williamson, 1981, p. 1544]. This puts the focus on intermediate good and output transactions, neither of which is at issue in the commons phenomenon. We require an expanded notion of transactions costs, to include the costs of coordinating all economic performance, including that which occurs at the same technological level.

6/ There are likely to be connections between intra-commons transactions costs and inter-commons exclusion costs. A commons that can make internal decisions effectively may also be more effective at excluding outsiders. But however much there is complementarity in the functional use of resources, there is clear substitution between boundaries and size of commons in the organizational sense, so it seems useful to proceed with an analysis on the balancing of these forces. Indeed the balancing of internal and external organizational factors underlies several different strands of economic analysis that have been followed in the last few decades. Coase's seminal analysis on the firm proceeds by balancing the costs of organizing activities within a firm with those of coordinating the same activities across firms' boundaries. Some of the work in the theory of clubs is oriented to locating efficient boundaries among public-goods supplying groups; some have introduced exclusion costs explicitly (e.g., Oakland).

7/ cf. the similar construction in the review of club theory by Sandler and Tschirhart.

8/ As in:



9/ Another vivid case of the impact of lower exclusion costs is the recent privatization of neighborhood streets in St. Louis. By giving homeowners title to the streets and the power to exclude, substantial reductions apparently occurred within these neighborhoods in the traditional types of common-property externalities that characterize most large urban areas. This case also underlines the importance of reducing transactions costs among these neighborhood commoners [Nelson].

10/ I have not yet attempted to use this model to examine the institutions of common fields in Europe. The scholarly literature on that institution is vast and warrants extensive study. One theoretical problem suggested by that institution, however, is the question of the factors — economic, political, or whatever — that would make it efficient for individual firms to operate in more than one commons.

11/ According to Maine: "It is more likely that joint-ownership, and not separate ownership, is the really archaic institution, and that the forms of property which will afford us instruction will be those

which are associated with the rights of families and of groups of kindred" [Maine, p. 259].

12/ Exclusion was carried out by trashing the equipment of encroachers. I have been told, in conversations with a lobsterman from Maine, that a similar system is used in parts of the inshore herring fishery.

13/ An identical situation exists in the use of freshwater aquifers in the eastern U.S. Because of relative water abundance, individual, uncoordinated extractions have been reasonably efficient. As water becomes more scarce in the future, however, the value of the externalities among individuals pumping from the same aquifer will increase. Because of extremely high exclusion costs, this will act to increase the size of the optimal commons over each aquifer. It remains to be seen whether innovation in governance institutions will also take place.

14/ This connection is disputed by others, however (Thirsk).

15/ We are assuming, of course, that political systems are allowed to have a life of their own, at least in part. They are not completely the results of the same fundamental economic and demographic factors as are property rights.

References

Acheson, James E. "Variations in Traditional Inshore Rights in Maine Lobstering Communities," in Raoul Anderson, ed., North Atlantic Maritime Cultures, New York, Mouton Publishers, 1979, pp. 253-276.

Alchian, Armen A. Some Economics of Property, Rand Corporation, 1961.

Anderson, T. L. and Hill, P. J. "The Evolution of Property Rights: A Study of the American West," J. Law and Econ., 18, April 1975, pp. 163-179.

Aoki, Masahiko. The Cooperative Game Theory of the Firm, Clarendon Press, 1984.

Ault, David E. and Rutman, Gilbert L. "The Development of Individual Rights to Property in Tribal Africa," J. Law and Econ., 22, April 1979, pp. 163-182.

Becker, Gary S. The Economic Approach to Human Behavior, University of Chicago Press, 1976.

Binswanger, Hans P. and Ruttan, Vernon W. Induced Innovation, Johns Hopkins Press, 1978.

Buchanan, James M. and Tullock, Gordon. The Calculus of Consent, University of Michigan Press, 1962.

Campbell, Bruce M. S. "Population Change and the Genesis of Common Fields on a Norfolk Manor," Econ. History Rev., 2nd Ser., 33, 2, May 1980, pp. 174-192.

Ciriacy-Wantrup, S. V. and Bishop, Richard C. "'Common-Property' as a Concept in Natural Resources Policy," Natural Resources Journal, 15, October 1975, pp. 713-727.

Coase, Ronald. "The Nature of the Firm," Economica, 4, November 1937, pp. 386-405.

Cornes, Richard, Mason, Charles F., and Sandler, Todd. "The Commons and the Optimal Number of Firms," Quarterly J. Econ., 101, 3, August 1986, pp. 641-646.

Cornes, Richard and Sandler, Todd. "On Commons and Tragedies," Amer. Econ. Rev., 83, 4, 1983, pp. 787-792.

Dasgupta, P. and Heal, G. M. Economic Theory and Optimal Resources, Cambridge University Press, 1979.

Davis, Lance E. and North, Douglass C. Institutional Change and American Economic Growth, Cambridge University Press, 1971.

Demsetz, Harold, "Toward a Theory of Property Rights," Amer. Econ. Rev., 57, 2, May 1967, pp. 347-359.

Dennen, R. Taylor, "Cattlemen's Associations and Property Rights in the American West," Explorations in Econ. History, 13, October 1976, pp. 423-436.

Esterlin, Richard A. Population and Economic Change in Developing Countries, University of Chicago Press, 1980.

Field, Alexander James. "The Problem with Neoclassical Institutional Economics: A Critique with Special Reference to the North/Thomas Model of Pre-1500 Europe," Explorations in Economic History, 18, 1981, pp. 174-198.

Field, Barry C. "The Evolution of Individual Property Rights in Massachusetts Agriculture, 17th-19th Centuries," Northeastern Journal of Agricultural and Resource Economics, 14, 2, October 1985, pp. 97-109.

Field, Barry C. "The Evolution of Property-Rights Institutions: Common Lands in Early Massachusetts Agriculture," paper presented at the annual meeting of the Economic History Association, September 1985.

Field, Barry C. and Kimball, Martha A. "Managing Common Property Resources: Agricultural Land in Colonial New England," paper presented at the annual meeting of the Northeastern Agricultural Economics Association, Cornell University, 1984.

Gintis, H. "Welfare Criteria with Endogenous Preferences: The Economics of Education," International Economic Review, June 1974.

Gordon, H. Scott. "The Economic Theory of a Common Property Resource," J. Pol. Econ., 62, April 1954, pp. 124-142.

Harper-Fender, Ann. "Discouraging the Use of a Common Resource: The Crees of Saskatchewan," J. Econ. History, 41, 1, March 1981, pp. 163-170.

Hoffman, Richard C. "Medieval Origins of the Common Fields" in William N. Parker and Eric L. Jones, European Peasants and Their Markets, Princeton, New Jersey, 1975, pp. 23-71.

Jodha, N. S. "Population Growth and the Decline of Common Property Resources in Rajasthan, India," Population and Development Review, 11, 2, June 1985, pp. 247-264.

Kemp, Jeremy H. "Legal and Informal Land Tenures in Thailand," Modern Asian Studies, 15, 1, 1981, pp. 1-23.

Libecap, Gary D. and Johnson, Ronald N. "Legislating Commons: The Navajo Tribal Council and the Navajo Range," Economic Inquiry, 18, 1, January 1980, pp. 69-86.

Libecap, Gary D. and Wiggins, Steven N. "Contractual Response to the Common Pool: Prorationing of Crude Oil Production," Amer. Econ. Rev., 74, 1, March 1984, pp. 87-98.

Libecap, Gary D. and Wiggins, Steven N. "The Influence of Private Contractual Failures on Regulation: The Case of Oil Field Unitization," J. Pol. Econ., 93, 4, August 1985, pp. 690-714.

Maine, Henry Sumner. Ancient Law, 5th ed., London, 1874.

Nelson, Robert H. "Private Neighborhoods: A New Direction for the Neighborhood Movement," in Land Reform, American Style, ed. by Charles C. Geisler and Frank J. Popper, Rowman and Allanheld, 1986, pp. 319-338.

North, Douglass C. and Thomas, Robert Paul. The Rise of the Western World, Cambridge University Press, 1973.

Oakland, William H. "Congestion, Public Goods and Welfare," J. Pub. Econ., 1, 3-4, November 1972, pp. 339-357.

Peters, Pauline E. "Embedded Systems and Rooted Models: The Grazing Lands of Botswana and the 'Commons' Debate," Harvard University, Institute for International Development, Development Division Paper No. 203, June 1985.

Posner, R. Economic Analysis of the Law, 2nd ed., Little, Brown, 1973.

Potter, Jack M. Capitalism and the Chinese Peasant, Social and Economic Change in a Chinese Village, University of California Press, 1968.

Priest, George L. "The Common Law Process and the Selection of Efficient Rules," J. Legal Studies, 6, 1977, p. 65.

Pryor, Frederic. "Property Institutions and Economic Development: Some Empirical Tests," Economic Development and Cultural Change, 20, 3, April 1972, pp. 406-437.

Rosenzweig, Mark R. and Schultz, T. Paul. "The Demand for and Supply of Births: Fertility and its Life Cycle Consequences," Amer. Econ. Rev., 75, 5, December 1985, pp. 992-1015.

Sandler, Todd and Tschirhart, John T. "The Economic Theory of Clubs: An Evaluative Survey," J. Econ. Lit., 28, 4, December 1980, pp. 1481-1521.

Scott, Anthony, "Property Rights and Property Wrongs," Canadian J. Econ., 16, 4, November 1983, pp. 555-573.

Shipton, Parker M. "Strips and Patches: A Demographic Dimension in Some African Land-Holding and Political Systems," Man, 19, 4, December 1984, pp. 613-634.

Thirsk, Joan. "The Common Fields," Past and Present, 29, 1964, pp. 3-25.

Umbeck, John R. A Theory of Property Rights with Application to the California Gold Rush, Iowa State University Press, 1981.

Wiggins, Steven N. and Libecap, Gary D. "Oil Field Unitization: Contractual Failure and the Presence of Imperfect Information," Amer. Econ. Rev., 75, 3, June 1985, pp. 368-385.

Williamson, Oliver. "Transaction-Cost Economics: The Governance of Contractual Relations," J. Law and Econ., October 1979, pp. 233-261.

Williamson, Oliver E. "The Modern Corporation: Origins, Evolution, and Attributes," J. Econ. Lit., 19, 4, November 1981, pp. 1537-1568.