Population Growth and Customary Land Law: The Case of Cordillera Villages in the Philippines*

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I. Introduction

Customary land law consists of traditions and customs that determine the use and ownership of land. It dictates both the purpose for which the land can be used and to whom particular parcels of land are available for use. It also determines outright ownership of a particular parcel of land and outlines under what conditions land is transferable. As such, customary land law is part of what D. C. North calls the informal constraints that are imposed on the members of a community in order to structure human interaction.[1] In this study, we examine the customary land law in Cordillera villages in the Philippines, a traditional society with a communal tenure system that, until recently, developed independently from other parts of the Philippines.[2] Our main goal is to trace the implications of this customary law.

Recently, several economists have studied the interaction among property rights, population pressure, and technology. S. Migot-Adholla et al. claim that population pressure has induced indigenous land tenure systems in sub-Saharan Africa to evolve from communal property toward private, individual, and heritable rights.[3] In our article we attempt to model the customary land law in the Cordillera, which provides for an automatic transition of common land into private land in the presence of population growth. This is embodied in that part of customary law that we refer to as the land accumulation rule.

In this article, we are dealing with small villages where land markets have emerged only recently and are still of minor importance as a means to acquire land. Consequently, the evolution of the distribution of

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land will be determined by another aspect of customary law: the set of rules that define inheritance practices. The more familiar inheritance rules are those of equal division and primogeniture. In the former, all property is divided equally among the children. In the latter, all property goes to the first-born child (general primogeniture). Primogeniture may be restricted to the first-born son (male primogeniture) or the first-born daughter (female primogeniture). Assuming that each family has exactly two children, A. S. Blinder and A. B. Atkinson have analyzed the influence of these inheritance rules on the distribution of wealth.[4] F. A. Cowell introduced differences in household size in the analysis of general equal division.[5] In a previous study, D. Van de gaer made assumptions similar to Cowell's regarding differences in household size and focused on a comparison of different inheritance rules and the importance of marriage patterns.[6] In this article we adopt Cowell's framework to deal with traditional inheritance practices in the Cordillera villages.

The main lesson of the institutional school in economics is that institutions matter for economic performance and development.[7] Another important lesson is that institutions, such as customary law, do not arise without a reason. Society's institutions are determined by and determine resource endowments, cultural endowments, and technology.[8] Changes in the aggregate availability of resources induce institutional change.

The following scenario describes the origin and development of Cordillera institutions.[9] Imagine an agricultural community in a mountainous region, and assume that the technology used to cultivate the land remains stable.[10] Village affairs are decided by a council of elders.[11] The members of the council are farmers, as are the other members of the community. Thus no separate class interest prevents institutions that are likely to be advantageous to the village from being readily adopted.

Rice, one of the staple crops in the Philippines, requires irrigation. Given the nature of the terrain in the Cordillera, both terraces and irrigation canals have to be constructed and, thus, wet-rice cultivation requires the input of intensive labor. Farmers are more willing to undertake such investments if they can individually reap the benefits from them.[12] The specific circumstances in the Cordillera require huge investments such that irrigated rice fields are likely to become private property that owners pass on to their offspring. In order to reduce uncertainty and encourage the maintenance of the rice fields, the village council formulates clear rules that describe who inherits what from whom. In this article we analyze the various aspects of the inheritance rules that are applicable in our study area of the Cordillera.

Land that has not been improved can be used for growing root crops, or for pasturing animals, or as forests from which people collect wood for fuel and lumber. This type of land is more likely to be common property. The village council sets clear rules that prescribe who may have usufruct rights, since misuse by one individual will affect the benefits reaped by the community.[13] Since the communities in our study are fairly small, the enforcement of these rules poses no major problems and land rights are secure.

As long as the population remains stable, there is no incentive to convert common land into private land. Once the population begins to increase, further intensification of agriculture and increased rice production become necessary.[14] These goals can only be accomplished by transforming common land into private land, that is, into irrigated rice fields. There are two reasons why the village council regulates this process. First, the land that can be converted is common land, and its use has been delimited by rules upheld by all members of the community. The transformation of common property into private property is, therefore, subject to community approval. Second, an unregulated transformation of common land into private land can have disadvantages for the whole community. Consequently, the village council will prescribe when a family can increase its land holdings and determine the amount of common land the family may convert to private property. We model this process of land accumulation in Section IV and use data from two villages to estimate the parameters of this process.

As a result of improvements in public health measures, there has been a dramatic increase in the population. The previous arrangements for transforming common land into private land appear to be no longer sustainable. Because of the mountainous nature of the terrain, not all common land can be suitably turned into irrigated rice fields; springs cannot be found everywhere, and it is costly to transport water from the river to rice fields that are located along the higher slopes of the mountain. Below, we will investigate whether the institutional arrangements for transforming common land into privately owned rice fields break down under population pressure.

Finally, recently many young people have been emigrating or finding a job outside of agriculture. To deal with this issue, we propose a straightforward adjustment of traditions and customs including inheritance practices and the land accumulation rule. We calculate how large a proportion of the younger generation must emigrate or find employment outside of agriculture for the adjusted version of customary law to be sustainable.

II. Access to Land and Customary Law

In Cordillera villages, customary land law recognizes both common and individual property rights. These rights define the use, access, and transfer of land. There are two types of common property: communal and corporate.[15] In the former, rights to use the land belong to each member of the village. In the latter, usufruct rights are restricted to members of a

TABLE 1

Mean Land Sizes by Type of Access (in Square Meters)

Types of Access	Village 1 $N = 29$	Village 1 Mean*	Village 2 $N = 48$	Village 2 Mean*
By inheritance:				
Irrigated:				
Wife's	7	4,507	24	1,295
Husband's	10	4,482	24	1,611
Other:				
Wife's	7	2,855	22	422
Husband's	11	5,750	20	1,311
By usufruct rights:				
Irrigated:				
Wife's clan	1	10,000	4	588
Husband's clan	0	. . .	4	1,018
Other:				
Wife's clan	3	550	4	2,105
Husband's clan	4	2,207	2	135
Community	0	. . .	4	122
By sharecropping	4	4,966	3	257
By rental	2	7,500	11	2,536
By purchase	2	2,166	4	562

* This is to the conditional mean, i.e., for values above zero.

descent group. The most restrictive rights apply under private individual ownership. Forest and pasturelands are communal, swiddens are corporate, and irrigated rice fields (*payew*) are private.

Table 1 shows how farmers in two Cordillera villages (Village 1 and Village 2) can gain access to agricultural land. In general, access to land can be obtained by inheritance, by conferment of usufruct rights, by sharecropping, by rent, or by purchase. The land may be irrigated or not and, as table 1 shows, access to land by inheritance through either the husband or the wife is quite important for a household. There does not appear to be any gender discrimination regarding land ownership as far as the distribution of inherited irrigated land is concerned. Nonirrigated land consists of forests, pastures, and swiddens and it appears unevenly distributed by gender with men having access to larger plots of land than women do.[16] Although the traditional means of access to land through inheritance and usufruct continue to remain dominant, access to land through purchase and rental has recently become more common. Renting occurs more frequently in Village 2, while sharecropping is more frequent in Village 1.[17]

Customary law prescribes how and when members of the village can segregate land out of commonly owned property and thereby transform its ownership. When permanent improvements are made on land, such as irrigation canals or terraces, and individuals occupy and cultivate a parcel of commonly owned land for a prolonged period of time (i.e., 5 years) without interruption, the individual will attain private ownership. In this manner, a farmer can increase his landholdings.[18] Land is passed on to a child at the time of marriage, such that the family land at that time consists of each spouse's inherited land. Two factors determine the amount by which a family can increase its holdings. On the one hand, the amount of land that a family can acquire is limited by the number of members that can contribute with their labor to the improvements of the land, but on the other hand, if a family attempts to improve more land than it needs according to the other members of the village, that action will merit village disapproval. Given both factors, it is likely that the amount of land a family can obtain in addition to the inherited land of the spouses depends on the number of children in the family.

The way irrigated land is devolved combines bilateral primogeniture with equal division. Bilateral primogeniture is applied to the part of the property that is inherited, and equal division is applied to land that is acquired in a manner other than inheritance.[19] We can formalize bilateral primogeniture as follows. Let k stand for the number of children in the family. Given k, the parents' inherited land is distributed to the heirs in the following manner:

1. Suppose $k = 1$: if the child is a boy, he gets his father's inherited land; if the child is a girl, she gets her mother's inherited land.
2. Suppose $k > 1$ and there is at least one boy and one girl: the eldest son gets his father's land, and the eldest daughter gets her mother's land.
3. Suppose $k > 1$ and all children are of the same sex: the eldest child inherits the land of the parent of the same sex; the second child receives the land of the other parent.

We call the children who inherit land in this way primary heirs and those who inherit acquired land secondary heirs. Secondary heirs never get any of the parents' inherited land. All the children who are not primary heirs are considered secondary heirs. Because the land that is acquired in a manner other than inheritance is divided equally among all secondary heirs, it is not necessarily an advantage to be a primary heir, as is the case when the amount of the parent's inherited land is smaller than the amount of acquired land that is distributed to the secondary heirs.[20]

Two additional factors must be considered with respect to land inheritance rules and customs. First, when no heirs exist, the land becomes common property; that is to say, the land of childless couples and that of a parent with no child of the same sex becomes community property.[21] Second, privately owned land can be lost when it is used as payment for a fine for personal offenses (such as theft) or when, owing to adverse circumstances, one is forced to sell the land (usually to one's kinsmen).[22] In these cases, the designated heir will not receive any land.

The inheritance practices described above appear to be very complex. One wonders why other practices had not been adopted. First, other inheritance practices have different consequences for the distribution of land than do the Cordillera village rules. General primogeniture leads to an increased concentration of land in the hands of increasingly fewer families. In the presence of population growth, general equal division diffuses land ownership and decreases each family's plot size. If the community has a perceived optimal farm size, neither of these rules is appropriate. In order to maintain farms of optimal size, individuals must not be allowed to inherit from both parents. Bilateral primogeniture accomplishes precisely that.[23] The complex arrangements that dictate inheritance in the absence of an eldest son or daughter guarantee that no individual may inherit from two people. Second, allowing families with children to accumulate land can be a way of adjusting farm size to the number of labor hands in the family. However, the division of this additional land among the children is not a trivial issue. Giving it to one of the siblings who already inherits land from one of the parents will increase the concentration of land and increase the expected size of that child's farm relative to his parents' farm. Dividing it equally among the other siblings is a more egalitarian option. Note that, in general, these secondary heirs will not end up with farms of optimal size. There will be a conflict between optimal parental farm size and the optimal farm size of the secondary heirs. The degree to which parents can claim additional land for each additional child will reflect this compromise. Third, in isolated villages that use primitive technology, the gains from specialization are small and owner cultivation appears to be an efficient form of social organization.[24] The Cordillera rules of inheritance, by establishing a relatively equal distribution of land, will stimulate this form of social organization.

III. The Consequences of Customary Land Law

A. Evolution of the Distribution of Land

Let the probability that a couple (married or not) has k children be given by p_k, and assume that a family can have K children at most, such that $p_0 + p_1 + \cdots + p_k = 1$.[25] The number of boys, on average, is equal to the number of girls. We assume that the population can be represented by a continuum of individuals. At time zero, we normalize the total male or female population and represent it by the interval [0, 1].[26] Expression $H^i_t[x]$, $i = m$ or w, is a measure of the number of men or women having land smaller than or equal to x square meters at time t. From the normalization above, it follows that $H^i_t[\infty] = (1 + n)^t$, where n is the growth rate of the population such that

$$n = (1/2)\sum_{k=1}^{K} p_k k - 1,\ n > -1. \tag{1}$$

Of greater interest than the evolution of the absolute number of men and women having land smaller than or equal to x is the evolution of the relative number of women or men who own no more than x. This is captured by the cumulative distribution function $F_t^i[x]$. Where defined, $f_t^i[x]$ is the corresponding density. We have that $H_t^i[x] = (1 + n)^t F_t^i[x]$.

Assuming that $K \geq 3$, there are three ways in which a male child can inherit land.[27] He could be the first-born son and inherit his father's land. Such an heir will exist with probability

$$\tilde{a}_1 = 1 - p_0 - \sum_{k=1}^{K} (1/2)^k p_k, \tag{2}$$

which is one minus the probability that there are no children and the probability that there are only daughters. He could be the second-born son and, in the absence of a sister, inherit his mother's land. The probability for this event is

$$\tilde{a}_2 = \sum_{k=2}^{K} (1/2)^k p_k. \tag{3}$$

In these two cases, he would inherit the land provided that his parents had not lost it. The probability of land loss is l. Finally, he could be one of the children in a large family ($k \geq 3$) and get his share of the land that his parents acquired during their marriage. The probability that his parents are not allowed to acquire land is q. If his parents bequeath a plot of land of size x to their children, on average $(1/2)$ $(k - 2)$ boys will inherit this land. As a consequence, the number of male children who will inherit land of size x at time t, $h_t^m[x]$, depends on the number of men and women who inherited the same amount of land in the previous period, $h_{t-1}^m[x]$ and $h_{t-1}^w[x]$, respectively, and the number of families with k children that bequeath x to their children, $h_{t-1}^k[x]$:

$$\begin{aligned} h_t^m[x] &= (1 - l)\tilde{a}_1 h_{t-1}^m[x] \\ &\quad + (1 - l)\tilde{a}_2 h_{t-1}^w[x] + (1 - q)\sum_{k=3}^{K} \frac{1}{2}(k - 2)h_{t-1}^k[x]. \end{aligned} \tag{4}$$

Our main interest is in the distribution of land. We can divide the equation above by $(1 + n)^t$, the total number of men at time t, to get an equation describing the evolution of the frequency distribution of land:

$$f_t^m[x] = \frac{1}{1+n}\Bigg[(1-l)\tilde{a}_1 f_{t-1}^m[x] + (1-l)\tilde{a}_2 f_{t-1}^w[x] + (1-q)\sum_{k=3}^{K}(1/2)(k-2)p_k f_{t-1}^{uk}[x]\Bigg], \tag{5}$$

where $f_t^m[x]$ is the density of men who, at time t, own an amount of land equal to x, given that the family has acquired a positive amount of land. The corresponding density for women is denoted by $f_t^w[x]$, and $f_{t-1}^{uk}[x]$ is the density of the inheritance x coming from the land acquired by a family with k children.

Concomitantly, a son will not inherit land in the following cases. He is the primary heir of a parent who has no land to give; a parent will have no land to pass on if he or she did not inherit land or if he or she has lost inherited land; and sons who are not primary heirs will inherit no land if they are secondary heirs of parents who did not accumulate any land. Therefore, the density of zero landholdings is given by

$$\begin{aligned} f_t^m[0] = \frac{1}{1+n}&[\tilde{a}_1 f_{t-1}^m[0] + \tilde{a}_2 f_{t-1}^w[0] \\ &+ l\tilde{a}_1(1 - f_{t-1}^m[0]) + l\tilde{a}_2(1 - f_{t-1}^w[0])] \\ &+ \frac{1}{1+n}\Bigg[(1/2)q\sum_{k=3}^{K}(k-2)p_k\Bigg]. \end{aligned} \tag{6}$$

The above equations describe the evolution of the densities of land owned by men and women as a system of first order difference equations. Therefore, the density of the distribution of land at each point x and at each point in time is a weighted average of the corresponding densities of the initial and final distribution of land (see proposition 1 in the appendix). The weights given to the initial distribution decline as time passes, while the weights attached to the equilibrium distribution increase. The steady state distribution will be completely independent of the initial distribution. Because of the symmetric treatment of men and women by both the inheritance and the accumulation rules, the steady state distribution of men and women's land is the same. Moreover, if the initial distribution of land of men and women is the same, then the distribution of land for both sexes always will be equal.

The literature analyzing the dynamics of wealth distribution pays a great deal of attention to the comparative static properties of the steady state distribution and to the speed at which the steady state distribution is approached. Both are fairly straightforward (see corollary 1).

B. Amount of Arable Land and Population Growth

We have now derived the steady state distribution of land under the assumption that the process can be repeated indefinitely. Implicitly, we have assumed that the amount of land that could be made suitable for wet-rice cultivation was unlimited. Generally, this type of land is limited even if villagers begin new settlements when land in their original village sites becomes scarce. Next, we describe the relationship between the land accumulation rule and the probabilities to acquire or to lose land, the size distribution of families, and the growth of the total amount of irrigated land (see proposition 2 in the appendix).

The more generous the land accumulation rule and the higher the probability that a family can accumulate land, the more land is claimed and, therefore, the faster the total amount of irrigated land needs to grow. The greater the possibility that a family loses its land, l, and the greater the proportion of families without direct heirs, $p_0 + (1/2)p_1$, the more private land becomes common. This land is already irrigated and can be assigned to a new family, so that less land will have to be taken from the commons. As a consequence, the total amount of irrigated land will grow more slowly.

It is clear that when the population grows quickly, the pressure on the amount of land increases. To assume a stable population size cannot be justified given the recent experience in the region, nor do our data indicate such stability. However, the assumption of a stable population size is unobjectionable if we redefine p_k in the model as the distribution of the number of children who take up farming. Under the assumption that children who do not take up farming do not receive any land, everything would proceed exactly as described above, provided that the distribution of the number of farmers remains constant.[28]

IV. Empirical Results

A. The Villages

The two villages we consider are Cudog (Village 1), located in the municipality of Lagawe in the province of Ifugao, and Sagada (Village 2), located in the Mountain Province.[29] In 1992, there were 174 households in Cudog and 290 households in Sagada. We have a sample of 29 families and 48 families from the two villages, respectively. Table 2 presents some characteristics of the households in our sample.

The distribution of the sources of livelihood in our sample indicates that Village 1 is more agriculturally based than is Village 2. Rice is the main crop for about half of the households. Half of all households hire labor for at least one task. Labor is mainly hired during seasonal peaks in agricultural activity, and permanent labor contracts are very rare.[30] Both husbands and wives in Village 2 have received more education on average than did those in Village 1, and the average family size is larger in

TABLE 2

Some Characteristics of the Sample

A. Agriculture

	Village 1 ($N = 29$)	Village 2 ($N = 48$)
Livelihood (%):		
Only farming	64	46
Both farming and nonfarming	36	40
Only nonfarming	0	14
Crops (%):		
Rice is primary crop	52	44
Both rice and cash crops are planted	14	8
Labor is hired for at least one task (%)	55	52

B. Households

	Mean	SD	Minimum	Maximum
Years of schooling of husband:				
Village 1	5.59	4.29	0	14.0
Village 2	7.88	4.48	0	14.0
Years of schooling of wife:				
Village 1	5.86	4.57	0	14.0
Village 2	7.79	5.46	0	14.0
Family size:				
Village 1	6.34	2.61	2.0	11.0
Village 2	7.62	2.43	3.0	13.0

Village 2 than in Village 1. However, these differences are not statistically significant.

Differences in family size are crucial for our framework. In order to take this into account, we needed data on the number of children in families that have reached their maximum size. The second column of table 3 gives the distribution of family size by number of children for those families in which the youngest child is at least 5 years old. Although the distribution has the expected feature of containing a few large families, it does not look smooth, probably because of the small number of observations. If we assume that everybody gets married, this distribution of family sizes implies a population growth of 189% from one generation to the next.[31] Since farming was the only labor activity in our sample villages, the number of farmers increased at the same rate as the population. It is difficult for farmers to maintain a steady state growth rate of 189%. In order to test the sensitivity of our results to the values for family sizes, we replicated the analysis with the Belgian distribution of household sizes in 1910. The data are given in the third column of table 3 and imply a population growth of 31% between successive generations.[32] From proposition 1, it follows that the persistence of the initial distribution depends on the p_k and l. The influence of the initial distribu-

TABLE 3

DISTRIBUTION OF FAMILIES BY NUMBER OF CHILDREN

Number of Children	Village Data ($N = 37$)	Belgian Data ($N = 1{,}370{,}878$)
0	.027	.190
1	.081	.230
2	.054	.185
3	.027	.130
4	.081	.094
5	.108	.067
6	.217	.048
7	.162	.033
8	.054	.020
9	.135	.012
10	.027	.009
11	.027	.006

SOURCE.—Belgium data: National Statistical Institute Belgium, *Statistisch jaarboek van Belgie* (Brussels, 1965).

tion decreases fairly rapidly as t increases, even if l is quite small.[33] Wet-rice cultivation was introduced in the region about 350–400 years ago. Given the scenario described in the introduction, it is not unreasonable to suppose that the system of customary law originated soon afterward. This provides a reason for looking at the steady state distribution.

B. Estimation of the Accumulation Rule

Here we consider the specification for the amount of land that a husband and wife, designated as couple s from village i, can acquire and bequeath to their secondary heirs. This amount of land, $L_{i,s}(k_s, \epsilon_s)$, depends on k_s, the number of children in the family, a stochastic term, ϵ_s, and the village where the family lives, i ($i = 1$ or 2 for Village 1 and Village 2, respectively). The stochastic term can be interpreted as reflecting differences in the quality of land. We chose the following specification:

$$L_{i,s}[k_s, \epsilon_s] = \alpha_i(k_s - 2)^{\beta_i}\epsilon_s, \ \forall k_s > 2, \tag{7}$$

where α_i and β_i are parameters, and ϵ_s is lognormally distributed with a mean of one.[34] The elasticity of the amount of land acquired by a family with respect to the number of children minus two is β_i for Village i.[35]

If we had observations on the amount of land acquired by each family, then we could estimate the parameters of the land acquisition function with linear regression techniques. These data were not available, however, and we had to follow a different procedure. What we do not know is whether the irrigated land inherited by a spouse is part of that individual's parents' inherited property or whether it was the individual's share in the land that had been acquired by the parents. We do have data on the birth order of the spouses, o_s, and the number of children in their family of origin, k_s. This allowed us to calculate the likelihood that an individual's inherited land was part of that acquired by the previous generation. We can then construct the log-likelihood for our sample. This step is performed in proposition 4 in the appendix.

Maximization of the likelihood function yielded the estimates shown in table 4.[36] The estimates are quite robust with respect to the choice of a particular distribution of family sizes. Using a log-likelihood test to test the restrictions that are imposed when we move away from the free model, it is simple to verify that only the most restrictive version of the model is rejected by our data.[37] This confirms what was already obvious from an inspection of table 1: the distribution of land sizes is quite different between the two villages and cannot have been generated by completely identical mechanisms.

We based the simulation exercises that follow on the estimates of the b1 column for the following reasons. First, there is only a very small decline in the log-likelihood when we impose the restrictions $\beta_1 = \beta_2$ and $\sigma_1 = \sigma_2$. Second, a value of $\beta > 1$ (though not significantly different from one) is more difficult to maintain. It would mean that secondary heirs of large families get a larger plot of land than those from small families. This occurs in columns v2 and b2. Third, the α_i values reflect circumstantial land characteristics that are different in the two villages, raising doubts about the hypothesis that $\alpha_1 = \alpha_2$. Finally, we preferred the estimates in the b1 column to those of v1 because the village distribution of family sizes with rapid population growth implies an implausible value for the steady state growth rate of the number of farmers. Note, however, that using either the b1 or v1 estimates does not change our qualitative results.

C. Equity Aspects of Customary Law

The estimated value for $\beta = 0.36$ indicates that husbands and wives are partly compensated for the number of children they have. Provided that the parents are allowed to accumulate land, the amount of land they can accumulate increases with the number of children they have. However, the compensation is far from complete. As a consequence, it is a big advantage to be born into a small family in the sense that, on average, secondary heirs in large families will receive a smaller amount of land than secondary heirs in small families will receive.

We have the ability now to calculate the steady state distribution of irrigated land that follows from the application of the inheritance rule and the land accumulation rule embodied in the customary law of the Cordillera villages. Taking the observed frequencies of zeros as the steady state number of zeros in the two villages, the expression for the steady state number of zeros (see corollary 2) implies a restriction between the values of q and l for each village. Assuming l to be the same

TABLE 4

Estimation Results

Parameter	Village Data: Free Model	Village Data: v1 $(\beta_1 = \beta_2)$ $(\sigma_1 = \sigma_2)$	Village Data: v2 $(\alpha_1 = \alpha_2)$ $(\sigma_1 = \sigma_2)$	Village Data: v3 $\alpha_1 = \alpha_2$ $\beta_1 = \beta_2$ $\sigma_1 = \sigma_2$	Belgian Data: Free Model	Belgian Data: b1 $(\beta_1 = \beta_2)$ $(\sigma_1 = \sigma_2)$	Belgian Data: b2 $(\alpha_1 = \alpha_2)$ $(\sigma_1 = \sigma_2)$	Belgian Data: b3 $(\alpha_1 = \alpha_2)$ $(\beta_1 = \beta_2)$ $(\sigma_1 = \sigma_2)$
α_1	14,576	19,715	5,598	7,073	12,691	14,828	3,875	8,234
	(19,445)	(16,171)	(3,369)	(6,326)	(12,309)	(9,503)	(2,789)	(2,904)
α_2	4,005	3,559			3,139	2,894		
	(3,674)	(2,698)			(2,330)	(1,784)		
β_1	.44	.31	1.09	.33	.39	.36	1.39	.01
	(.86)	(.50)	(.43)	(.60)	(.80)	(.46)	(.62)	(.20)
β_2	.25		.02		.33		.16	
	(.61)		(.37)		(.56)		(.52)	
σ_1	1.27	1.34	1.34	1.54	1.24	1.33	1.33	1.45
	(.23)	(.12)	(.12)	(.14)	(.25)	(.13)	(.13)	(.15)
σ_2	1.37				1.36			
	(.15)				(.15)			
Log-likelihood	−545.86	−545.95	−546.21	−554.51	−545.93	−546.04	−546.38	−553.66

Note.—Standard errors are in parentheses.

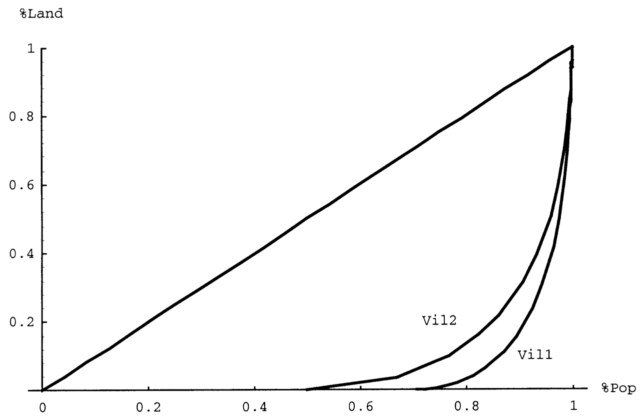

FIG. 1.—The Lorenz curve for the steady state distribution of irrigated land

in both villages and setting $l = 0.05$, we can calculate the values of q for both villages ($q_1 = 0.69$ and $q_2 = 0.47$). In figure 1 we compare the Lorenz curves of the steady state distribution of irrigated land for the two villages. The Lorenz curve for Village 1 lies below the Lorenz curve for Village 2 at all points.[38] Thus, land is more unequally distributed in Village 1 than it is in Village 2.[39]

D. Population Growth and the Land Constraint: Some Simulations

As noted in Section III, our model can only reach a steady state when the total amount of irrigated land grows as fast as the population does. Given the dramatic increase in the population (see table 3) and the natural and geographical limits to the amount of land that can be made suitable for intensive cultivation, this assumption is hard to maintain.[40] Therefore, we will consider the following scenarios.

Suppose that population dynamics can be described by the Belgian p_k and that land is abundantly available. Then, at a certain point in time, the geographical limits to the amount of land that can be transformed into irrigated rice fields are reached. How customary land law can adjust at the moment that the geographical limits are reached so that it can be sustained during that period is described in the first simulation exercise. The second scenario also starts from a steady state, but in addition to the land constraint, the population grows much faster: the Belgian p_k are replaced by the Village p_k. The second simulation exercise describes how customary law can adapt to these simultaneous changes.

Given the structure of our model, there are four ways in which customary law might adjust: q or l might increase, or α or β might decrease. An increase in q or l increases the number of landless people without changing the sizes of land holdings of those who are able to acquire land. As a result, for each change in q, there exists a change in l that has ex-

TABLE 5

Simulation Results

Parameter	Base Case Values	New Parameter Values	Frequency of Zeros	Conditional Mean Land Size
A. Land constraint:				
q	.47	.72	.61	1,391
l	.05	.46	.61	1,391
α	2,894	1,481	.5	1,078
β	.36	−.34	.5	1,078
η	1.00	.74	.56	1,233
B. Land constraint and population explosion:				
q	.47	.97	.83	1,063
l	.05	2.08		
α	2,894	157	.5	367
β	.36	−1.98	.5	367
η	1.00	.29	.86	1,327

actly the same effect on the Lorenz curve for the distribution of irrigated land provided q and $l \in [0, 1]$. The way this shift occurs in the Lorenz curve will be very different depending on whether this change is brought about by q or l. An increase in q allows fewer people to acquire land, while an increase in l increases the proportion of families who lose their land.

Changes in α or β do not affect the number of landless individuals. Instead, changes in these parameters alter the average amount of land available to landholding families. For example, a decrease in α or β lowers the average amount of land that a family can actually obtain. A decrease in α decreases the amount of land for all families in the same proportion, while a decrease in β will accomplish this decline at the expense of larger families.

Assuming that only one of the parameters adjusts, the expression in proposition 2 allows us to calculate the exact adjustment necessary for each parameter in each of the two scenarios that we consider.[41] We can calculate the adjustment necessary in the period in which the shocks occur to maintain the other aspects of customary land law and meet the land constraint. Since the necessary adjustments are similar for both villages, we only give the results for Village 2. The values and their effects on the number of landless individuals are given in the first four rows, respectively, of parts A and B of table 5.

It is clear that the adjustments of the parameters, necessary to sustain customary law under the scenarios we considered, are very severe. The first scenario already implies dramatic changes. The number of families allowed to accumulate land must be reduced by 50%, the probability that a family loses its land must be multiplied by a factor of nine, the amount of land that a family is allowed to accumulate must be cut in half, or large families must be given less land than small families. Matters are even worse in the second scenario. Let us take the value of l, which becomes greater than one. This indicates that, even if we could expropriate all current private land holdings, we would not have enough land to give to families that are entitled to acquire land. The changes in the values of the other parameters are equally severe and imply that customary law, as it has been practiced in the past, ceases to exist. Combinations of parameter changes will not alter this conclusion.

In the preceding discussion, we assumed that customary law adjusted. This leads to an increase in the number of landless farmers or to a decrease in the size of the plots of those who own land. One might wonder if these scenarios are at all sustainable. It must be stressed that if the total amount of land remains fixed, then any inheritance rule deals with a trade-off between the number of landless individuals, on the one hand, and the average size of plots of landowners, on the other. Indeed, when the size of the population grows, equal division of inheritances will lead to a decrease of the size of the plots of those who have land. Primogeniture, on the other hand, either decreases the absolute size of the landowning class or keeps it constant. In the presence of population growth, primogeniture increases the relative number of landless people. What may be remarkable about the inheritance rule practiced in the Cordillera villages is that it permits the community a certain flexibility that allows for a compromise. It is as if, by changing one particular parameter rather than another, the village can choose whether to change the number of landless people or the average size of land owned by individuals or it can choose both.

Finally, we attempt to incorporate the increased emigration out of the region in our analysis of customary law. We assume that customary law adjusts to this phenomenon by limiting inheritance of land to those farmers' children who also want to take up farming. Let there be a nonzero probability that a child will not take up farming. Taking this into account, the inheritance rule will now be as follows. The eldest of the sons (daughters) who takes up farming inherits his (her) father's (mother's) land. The other children who take up farming get an equal share of the land that had been acquired by their parents. The total amount of land that a husband and wife can acquire is based on how many of their children will take up farming. For our analysis, this implies that the distribution of families according to size has to be adjusted. Let η be the probability that a child will take up farming. Formally, the p_k will have to be redefined in the following way:

$$\hat{p}_k = \sum_{i=k}^{K} \binom{i}{k} \eta^k (1 - \eta)^{i-k} p_i, \ \forall k = 1, \ldots, K. \tag{8}$$

Indeed, the probability that there will be exactly k farmers in a family with i ($i > k$) children is binomially distributed. Multiplying this binomial probability with p_i and summing all i results in equation (8). We can now insert the resulting $\hat{p}_k$ in the equation of proposition 2 and search for a value of η such that $g_t = 0$. The result is given in the last row of table 5. We interpret this result to indicate that if customary law adjusts in the way we indicate, then, given the current rate of population growth and the geographical limits, seven out of ten children cannot become farmers in their village of origin. If the village were only confronted with the land constraint, one out of four children cannot farm in his or her village of origin. These children will either have to migrate or take up a nonfarm job. Given the poor performance of the Philippine economy with respect to job creation outside of farming, this constitutes a considerable challenge for government policy.[42] Finally, note that the transformation of probabilities described above decreases the frequency of families in which many children become farmers. Since compensation for family size is incomplete, the average plot size inherited by secondary heirs increases, thereby increasing the conditional mean land size.

Many different patterns of adjustment are possible. In Sagada (Village 2), there is evidence that the bilateral feature of the inheritance rule comes under severe pressure. As shown in table 1, the plot size of inherited irrigated land has become very small. Probably to accommodate this, the first-born has the option of receiving the inheritance of both parents. If the individual so chooses, this will be considered by the village as greed and a lack of concern for other siblings. We have here a conflict between the bilateral norm and an emerging pattern of general primogeniture.[43] If general primogeniture were to become dominant, more children would become landless adults. Thus, our results should be viewed as identifying a lower boundary on the number of children who should migrate or take a nonfarm job.

V. Conclusion

The institutional school of economics states that customary law incorporates and interacts with changes in the environment. This observation stands out clearly in the case of the Cordillera villages. Population pressure necessitated an intensification of agriculture thereby requiring the transformation of common land into privately owned land. The land accumulation rule is an institutionalized arrangement that transforms common, unimproved land into private, irrigated rice fields. Because our aim was to study the evolution of the distribution of irrigated land, we needed to investigate the inheritance rules practiced in the locality. The inheritance rule applies bilateral primogeniture for a husband and wife’s inherited land and equal division among the other children for their accumulated land. The resulting distribution of land at each point in time is a weighted average of the initial and steady state distribution. This unique, globally stable steady state distribution is itself a weighted average of the distribution of the inheritances that result from the land acquired by families of different sizes. Hence, both the inheritance practices and the land accumulation rule are crucial for the steady state distribution of land, which, in turn, determines the social organization of production. In an economy where technology is stable and primitive, and where economies of scale are absent, self-ownership cultivation is likely to be efficient. By opting for a fairly equal distribution of land, the existing customary law stimulates this efficient form of social organization.

We used data on two villages to estimate the land acquisition function. Although far from conclusive, our results indicate that families with more children are better able to increase the number of their rice fields through transforming parcels from commonly owned land. However, compensation is far from complete. It is important to stress that though irrigated land is the most valued, it constitutes only part of the total amount of land to which family members have access. There are other mechanisms in the property rights system (i.e., usufruct rights to communal or corporate land) that provide for the matching of family resources with family needs. The transformation of commonly owned land into private ownership will influence the role of these channels.

Since it appears that the geographical limits to the land transformation process have been reached and yet the population continues to grow rapidly, one wonders how the traditional property system can adjust to these new circumstances. Customary law in the villages we studied has more channels of adjustment than do the inheritance practices—such as primogeniture and equal division—traditionally analyzed by economists. We have used the estimation results to investigate how customary law might adapt to population pressure. Our simulation results suggest that with the current rapid growth of population, these adjustment possibilities will not suffice.

There are many ways in which the village institutions might adjust to increased population pressure and to all the other recent changes such as technological change, emerging land markets, and developing labor markets. Migration and creation of nonfarming jobs are two possibilities. The effects on the customary land law are uncertain. In one of the villages, general primogeniture has become accepted, though not yet approved, as an alternative to the bilateral inheritance rule. If this adjustment persists, the implications for the number of children who can take up farming are more severe than those in our suggested alternative. In our scenario, customary law only accounts for children of farmers who also become farmers. For this adjusted version of customary law to be sustainable, given the recent demographic developments in the region and the exhaustion of the amount of land suited for intensive cultivation, we estimated that 71% of the children should find a nonfarm job or emigrate. This represents a considerable challenge for public policy at both the regional and national levels.

Appendix
Propositions and Corollaries

PROPOSITION 1. Provided that the way land is accumulated by families remains unchanged, the evolution of the densities of men's and women's land can be expressed as

$$f_t[x] = E\langle b\rangle^t E^{-1} f_0[x] + (1 - E\langle b\rangle^t E^{-1}) f_\infty[x], \ \forall x \geq 0,$$

where

$$A = (1 - l)\begin{bmatrix} \tilde{a}_1 & \tilde{a}_2 \\ \tilde{a}_2 & \tilde{a}_1 \end{bmatrix} \equiv \begin{bmatrix} a_1 & a_2 \\ a_2 & a_1 \end{bmatrix},$$

$$E = \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}, \langle b\rangle = \begin{bmatrix} b_1 & 0 \\ 0 & b_2 \end{bmatrix}, \iota = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$b_1 = (1 + n)^{-1}(a_1 + a_2) \text{ and } b_2 = (1 + n)^{-1}(a_1 - a_2),$$

$$\forall x \geq 0, f_t[x] = \begin{bmatrix} f_t^m[x] \\ f_t^w[x] \end{bmatrix}, t = 0, 1, \ldots, \infty,$$

$$f_\infty[x] = [I - (1 + n)^{-1}A]^{-1}(1 + n)^{-1} f^u[x], \ \forall x \geq 0,$$

and $f^u[\cdot]$ is defined as follows:

$$\text{if } K \geq 3, f^u[x] = (1 - q)\left[\sum_{k=3}^{K} (1/2)(k - 2)p_k f^{uk}[x]\right]\iota, \ \forall x > 0,$$

$$\text{if } K < 3 \ f^u[x] = 0, \ \forall x > 0;$$

$$\text{if } K \geq 3, f^u[0] = \left[l(\tilde{a}_1 + \tilde{a}_2) + (1/2)q \sum_{k=3}^{K} (k - 2)p_k\right]\iota;$$

$$\text{if } K < 3 \ f^u[0] = l(\tilde{a}_1 + \tilde{a}_2).$$

Proof. For $x > 0$, we know from the preceding discussion that the following system of difference equations describes the distribution of inherited land:

$$f_t[x] = (1 + n)^{-1}(Af_{t-1}[x] + f_{t-1}^u[x]).$$

Assuming that $f_{t-1}^u[x]$ remains unchanged over time, this equation is just a system of first order difference equations, a particular solution of which is given by $[I - (1 + n^{-1})A]^{-1}(1 + n)^{-1} f^u[x]$. In order to find the complementary functions, we have to find the roots of the equation $|bI - (1 + n)^{-1}A| = 0$. This characteristic equation has two roots, b_1 and b_2. Hence, the complementary function can be written as $z[t] = E\langle b\rangle^t c$. Here c is a vector of arbitrary constants that has to be determined by the initial conditions of the system. Then we get $c = E^{-1}\{f_0[x] - [I - (1 + n)^{-1}A]^{-1}f^u[x]\}$. Keeping in mind that $AE = E\langle b\rangle$, it is straightforward to verify that the solution to the system of difference equations can be written as

$$f_t[x] = E\langle b\rangle^t E^{-1}f_0[x] + (I - E\langle b\rangle^t E^{-1})[I - (1 + n)^{-1}A]^{-1}(1 + n)^{-1}f^u[x].$$

Note that $0 < b_2 < b_1 < 1$. Both roots are positive and smaller than one and therefore there exists a globally stable asymptotic solution for each density, a solution that does not depend on the initial conditions of the system. Hence, as t goes to infinity, $\langle b\rangle^t = 0$, and the asymptotic or equilibrium distribution is given by $f_\infty[x] = [I - (1 + n)^{-1}A]^{-1}(1 + n)^{-1} f^u[x]$. The solution can be rewritten in terms of the initial and the asymptotic distribution:

$$f_t[x] = E\langle b\rangle^t E^{-1}f_0[x] + (I - E\langle b\rangle^t E^{-1})f_\infty[x].$$

For $x = 0$ note that, given the definition of $f^u[0]$, the equation for $f_t[0]$ has exactly the same form as the equation we started from above. Q.E.D.

Corollary 1. The speed at which the equilibrium distribution is approached is increasing in l and n.

Proof. It is immediate from the facts that $b_1 = (1 + n)^{-1}(1 - l)[1 - p_0 - (1/2)p_1]$, $b_1 = (1 + n)^{-1}(1 - l)\{(1/2)p_1 + \sum_{k=2}^{K}[1 - 2(1/2)^k]p_k\}$, and that increasing the population size requires an increase in p_k accompanied by a decrease in the frequency of smaller families p_1, with $l < k$. Q.E.D.

Corollary 2. The steady state distribution has the following comparative static properties:

$$\frac{\partial f^z_\infty[0]}{\partial q} > 0,$$

$$\frac{\partial f^z_\infty[0]}{\partial l} > 0,$$

$$\frac{\partial f^z_\infty[0]}{\partial p} < 0,$$

$$\frac{\partial f^z_\infty[0]}{\partial(\tilde{a}_1 + \tilde{a}_2)} > 0$$

where $p = \sum_{k=3}^{k} (1/2)(k - 2)p_k$, the expected number of male or female secondary heirs per family,

$$\forall x > 0\colon \frac{\partial f^z_\infty[x]}{\partial q} < 0, \frac{\partial f^z_\infty[x]}{\partial l} < 0, \frac{\partial f^z_\infty[x]}{\partial p_k} <> 0, \frac{\partial f^z_\infty[x]}{\partial(\tilde{a}_1 + \tilde{a}_2)} < 0, (z = m, w).$$

Proof. The proof follows from proposition 1 and noting that

$$[I - (1 + n)^{-1}A]^{-1}(1 + n)^{-1}\imath = [p + l(\tilde{a}_1 + \tilde{a}_2)]^{-1}\imath,$$

such that we can rewrite the steady state densities as

$$f^z_\infty[x] = \frac{(1 - q)}{p + l(\tilde{a}_1 + \tilde{a}_2)} \sum_{k=3}^{K} \frac{k - 2}{2} p_k f^{uk}[x],\ \forall x > 0,$$

and

$$f^z_\infty[0] = \frac{l(\tilde{a}_1 + \tilde{a}_2) + qp}{p + l(\tilde{a}_1 + \tilde{a}_2)}.$$

The results from differentiation of the above formula. Q.E.D.

PROPOSITION 2. Let L_t be the amount of irrigated land at time t. The rate of growth of L_t is $g_t \equiv (L_t - L_{t-1})/L_{t-1}$. Then

$$1 + g_t = (1 - q)\frac{(1 + n)^{t-1}}{L_{t-1}} \sum_{k=3}^{K} (k - 2)p_k \int_0^\infty f^{uk}_{t-1}[x]x dx - l - (1 - l)[p_0 + (1/2)p_1].$$

Proof. The amount of privately owned irrigated land can decrease for two reasons. First, some persons may lose their land. This will diminish the area of privately owned land in period t by lL_{t-1}. Second, some will have no heirs. This will also decrease the amount of privately owned land in period t by $(1 - l)[p_0 + (1/2)p_1]L_{t-1}$. At the same time, the amount of irrigated land increases, since some families will acquire land. Therefore, the amount of privately owned irrigated land increases by $(1 - q)N_{t-1}\sum_{k=3}^{K}(k - 2)p_k\int_0^\infty f^{uk}_{t-1}[x]x dx$, where N_{t-1} is equal to the total number of couples at time $t - 1$. The expression following the integral sign is the average amount of land left to each of the secondary heirs of families having k children. There will be $(1 - q)p_k N_{t-1}$ such families, bequeathing, on average, this amount to $(k - 2)$ children. The equation describing the evolution of the total amount of irrigated land can be written as

$$\begin{aligned} L_t = {} & \{1 - l - (1 - l)[p_0 + (1/2)p_1]\}L_{t-1} \\ & + (1 - q)N_{t-1} \sum_{k=3}^{K} (k - 2)p_k \int_0^\infty f^{uk}_{t-1}[x]x dx. \end{aligned}$$

Deriving the condition in the proposition is now straightforward when we use the fact that $N_{t-1} = (1 + n)^{t-1}$. Q.E.D.

COROLLARY 3. Provided that the way land is accumulated by families remains unchanged, the steady state growth rate of the total amount of irrigated land is equal to the growth rate of the population.

Proof. The last equation in the proof of proposition 2 can be written in the form:

$$(L_t/N_t)(N_t/N_{t-1}) = \kappa(L_{t-1}/N_{t-1}) + c,$$

where $\kappa = (1 - l)[1 - p_0 - (1/2)p_1]$. Since $N_t/N_{t-1} = 1 + n$ and we have that

$$\kappa/(1 + n) = (1 - l)\left\{\left[(1/2)p_1 + \sum_{k=2}^{K} p_k\right]\Big/\left[(1/2)p_1 + \sum_{k=2}^{K} p_k k\right]\right\} < 1,$$

A steady state solution for (L/N) exists, which implies that, in steady state, L and N grow at the same rate. Q.E.D.

PROPOSITION 3. Let $\epsilon \approx LN[1, \exp[\sigma_i^2] - 1]$. Then

$$f_i^u[x_s, k_s; \alpha_i, \beta_i, \sigma_i] = \frac{1}{\sqrt{2\pi}\cdot\sigma_i}\exp\left[\frac{-1}{2\sigma_i^2}\left[\nu[x_s, k_s; \alpha_i, \beta_i] + \left(\frac{\sigma_i^2}{2}\right)\right]^2\right]$$
$$\left[\frac{1}{\exp[\nu[x_s, k_s; \alpha_i, \beta_i]]}\right]\lambda_{i,s},$$

where

$$\begin{cases} \nu[x_s, k_s; \alpha_i, \beta_i] = \ln[x_s] + \ln[k_s - 2] - \ln[\alpha_i] - \beta_i \ln[k_s - 2], & \forall k_s > 2. \\ \lambda_{i,s} = \dfrac{(k_s - 2)^{1-\beta_i}}{\alpha_i}, & \forall k_s > 2. \end{cases}$$

Proof. The amount of land x_s, inherited by a child in village i, is related to the realized value of the stochastic term ϵ_s in the following way:

$$x_s = \alpha_i(k_s - 2)^{\beta_i - 1}\epsilon_s.$$

The distribution of land sizes is, therefore, a monotone increasing transformation of the distribution of the stochastic term ϵ_s, which is lognormally distributed with parameters γ_i and σ_i. The density of ϵ_s is given by

$$g_i[\epsilon_s] = \exp\left[-\frac{(\ln[\epsilon_s] - \gamma_i)^2}{2\sigma_i^2}\right]\frac{1}{\sigma_i\sqrt{2\pi}}\frac{1}{\epsilon_s}.$$

The mean of ϵ_s is $\exp[\gamma_i + (\sigma_i^2/2)]$. Since we assumed that this mean is one, $\gamma_i = (-\sigma_i^2/2)$. The variance of the distribution is given by $\exp[2\gamma](\exp[2\sigma^2] - \exp[\sigma^2])$, which in our case reduces to $\exp[\sigma^2] - 1$. To obtain the density of the distribution of land, we have to multiply this density with $[\partial x_s/\partial\epsilon_s]^{-1}$. This factor is equal to $\lambda_{i,s}$. Then, using the relationship between x_s and ϵ_s to define $\ln[\epsilon_s] \equiv \nu[x_s, k_s; \alpha_i, \beta_i]$, the proposition follows. Q.E.D.

PROPOSITION 4. The loglikelihood is given by

$$\sum_{i=1}^{2} \sum_{s \in S} \ln[f[x_s, k_s, o_s; \alpha_i, \beta_i, \sigma_i]],$$

where

$$f[x_s, k_s, o_s; \alpha_i, \beta_i, \sigma_i] \equiv p^a[o_s, k_s] f_i^u[x_s, k_s; \alpha_i, \beta_i, \sigma_i] + (1 - p^a[o_s, k_s]) \sum_{k=3}^{K} \left(\frac{k-2}{2p}\right) p_k f_i^u[x_s, k; \alpha_i, \beta_i, \sigma_i],$$

$$p^a[o_s, k_s] = 0 \text{ if } o_s = 1,$$

$$p^a[o_s, k_s] = 0 \text{ if } o_s = k_s = 2,$$

$$p^a[o_s, k_s] = (1/2) - (1/2)^{k_s - 1} \text{ if } o_s = 2, \text{ and } k_s > 2,$$

$$p^a[o_s, k_s] = 1 - (1/2)^{o_s - 1} \text{ if } o_s > 2.$$

Proof. If $o_s = 1$, then the land was definitely inherited by the parent. When $o_s = 2$, there are two possibilities. If $k_s > 2$, then the land was part of the parents' inherited land when this child is of a different sex from that of the first-born child or when the child has the same sex as all of his or her siblings (i.e., they are all boys or all girls). The former happens with a probability of $1/2$, the latter with a probability of $2(1/2)^k$. Otherwise, the land comes from the parents' acquired land. The probability of the latter event is $(1/2) - (1/2)^{k_s-1}$. For $o_s > 2$, the probability that the land was part of the parents' inherited land equals the probability that all previous children are of the same sex and the o_s-th child is of the other sex. This probability is $(1/2)^{o_s}$, and there are two cases in which this might occur: one where all previous children are boys followed by a girl and the other, where all previous children are girls followed by a boy. Hence, in this case, the probability that the land comes out of the acquired pool is $1 - 2(1/2)^{o_s}$. We can now reformulate the likelihood to take this into account. Define $p^a[o_s, k_s]$ as the probability the individual s, being the o_s-th child out of k_s, inherited his land from the acquired pool. These probabilities are given in the proposition.

As we have already noted, all land is acquired, and, therefore drawn out of one of the distributions of $\{f_i^u[x_s, k; \alpha_i, \beta_i, \sigma_i] | k = 3, \ldots, K\}$. If the land is not acquired by the parents in period $t - 1$, then it must have been aquired by one of the more distant ancestors. Reconstructing this tree, it is easy to see that the probability that the land came out of $f_i^u[x_s, k; \alpha_i, \beta_i, \sigma_i]$ given that the land is not acquired in $t - 1$, equals $[(k - 2)p_k/2p]$. We now have established $f[x_s, k_s, o_s; \alpha_i, \beta_i, \sigma_i]$.

Estimation of the parameters of the land acquisition function can be now done by a maximization of the likelihood of our sample S, with respect to the parameters α_i, β_i, and σ_i. The sample contains those observations for which $x_s > 0$. Hence, the log-likelihood.

Notes

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1. See, e.g., Douglass C. North, *Institutions, Institutional Change and Economic Performance* (Cambridge: Cambridge University Press, 1990), and ''Economic Performance through Time,'' *American Economic Review* 84 (1994): 359–68.

2. For a brief discussion of the communal tenure system, see, e.g., Hans P. Binswanger, Klaus Deiniger, and Gershon Feder, ''Agricultural Land Relations in the Developing World,'' *American Journal of Agricultural Economics* 75 (1993): 1242–48. The social organization in the Cordillera is very different from the social organization in the lowland Philippines. Compare, for instance, the land tenure system in the Cordillera with the one described in most of the literature on the Philippines (see, e.g., Masao Kikuchi and Yujiro Hayami, ''Inducements to Institutional Innovations in an Agrarian Community,'' *Economic Development and Cultural Change* 29 [1980]: 21–36). Absentee landlordism is pervasive in most of the lowland Philippines. In the villages we consider, this form of rural organization is almost absent (see table 1), possibly because while the Spanish rule was strictly imposed in the lowlands, in reality it was nonexistent in the Cordillera.

3. Shem Migot-Adholla, Peter Hazell, Benoit Blarel, and Frank Place, ''Indigenous Land Rights Systems in Sub-Saharan Africa: A Constraint on Productivity?'' *World Bank Economic Review* 5 (1991): 155–75. See also Jean-Philippe Platteau, ''The Evolutionary Theory of Land Rights as Applied to SubSaharan Africa: A Critical Assessment,'' discussion paper (Facultés Universitaires Notre-Dame de la Paiz, Namur, Belgium, 1995). Platteau finds that the part of the ''evolutionary theory of land rights'' that we refer to here is essentially valid (p. 36).

4. Allan S. Blinder, ''A Model of Inherited Wealth,'' *Quarterly Journal of Economics* 87 (1973): 608–26; Anthony B. Atkinson, ''Inheritance and the Distribution of Wealth,'' in *Public Policy and the Tax System*, ed. Gordon A. Hughes and G. M. Heal (London: George Allen & Unwin, 1980).

5. Frank A. Cowell, ''Inheritance and the Distribution of Wealth,'' discussion paper (London School of Economics, London, 1998).

6. Dirk Van de gaer, ''Remarks on Inheritance and Marriage'' (National University of Ireland, Maynooth, 1997, mimeographed).

7. See, e.g., North, *Institutions, Institutional Change and Economic Performance*; David Feeny, ''The Demand for and Supply of Institutional Arrangements,'' in *Rethinking Institutional Analysis and Development*, ed. Vincent Ostrom, David Feeny, and Hartmut Picht (San Francisco: Institute for Contemporary Studies Press, 1988); Vernon W. Ruttan and Yujiro Hayami, ''Toward a Theory of Induced Institutional Innovation,'' *Journal of Development Studies* 20

(1984): 203–23; Yujiro Hayami and Vernon W. Ruttan, *Agricultural Development: An International Perspective* (Baltimore, Md.: Johns Hopkins University Press, 1985). Jean-Philippe Platteau uses a similar framework in ‘‘Behind the Market Stage Where Real Societies Exist—Part I: The Role of Public and Private Order Institutions,’’ *Journal of Development Studies* 30 (1994): 533–77, and ‘‘Behind the Market Stage Where Real Societies Exist—Part II: The Role of Moral Norms,’’ *Journal of Development Studies* 30 (1994): 753–817.

8. Here we use the conceptual framework of Ruttan and Hayami.

9. Douglass North remarks that ‘‘we do not recreate the past; we construct stories about the past. But to be good history, the story must give a consistent, logical account and be constrained by the available evidence and the available theory’’ (North, *Institutions, Institutional Change and Economic Performance*, quotation on p. 131). Our study has some similarity to Japan’s experience in the premodern period—see, e.g., Ruttan and Hayami, p. 211; and Hayami and Ruttan, pp. 103–4. To us the important difference is the institutionalized transition of common land into private land in the two villages we studied. No such mechanism is mentioned in the texts cited above.

10. A detailed account of changes in technology that took place in the region during the past 30 years can be found in Lorelei Crisologo-Mendoza, ‘‘Essays on Decision Making in Rural Households: A Study of Three Villages in the Cordillera Region of the Philippines’’ (Ph.D. diss., Katholieke Universiteit te Leuven, 1997). There is no mechanization of agriculture in the villages. Fertilizer adoption and modern rice varieties were first introduced in the 1970s. Even today a large proportion of farmers does not use these new technologies. As a consequence, the assumption that the customary laws on land originated in an environment with a stable technology is acceptable.

11. See, e.g., June Prill-Brett, ‘‘A Survey of Cordillera Indigenous Political Institutions,’’ Working Paper no. 5 (University of the Philippines College Baguio, Cordillera Studies Center, 1992). The exact composition of the council differs from one village to the other. In Sagada, for example, the council consists of the representatives of the different neighborhood associations, while in Cudog, the kinship groups are the basic decision-making unit, and their representatives constitute the council. In both cases, the council decides by consensus.

12. See Migot-Adholla et al.; Gershon Feder and David Feeny, ‘‘Land Tenure and Property Rights: Theory and Implications for Development Policy,’’ *World Bank Economic Review* 5 (1991): 135–53, and ‘‘The Theory of Land Tenure and Property Rights,’’ in *The Economics of Rural Organization: Theory, Practice and Policy*, ed. Karla Ruth Hoff, Avishay Braverman, and Joseph E. Stiglitz (New York: Oxford University Press, 1993); see also Gershon Feder and Raymond Noronha, ‘‘Land Rights Systems and Agricultural Development in Sub-Saharan Africa,’’ discussion paper (World Bank, Agricultural and Rural Development Department, 1987).

13. As the population increases, these externalities will become more severe for two reasons: there will be more people trying to appropriate any unregulated benefits derived from the common land, and monitoring the compliance with the rules will become more difficult. That people will attempt to appropriate those benefits is one of the central elements of the economic theory of property rights. See, e.g., Yoram Barzel, *Economic Analysis of Property Rights* (Cambridge: Cambridge University Press, 1989). The reaction of the community will be to impose more restrictions on the use of the common land. As long as these restrictions are effectively imposed, no tragedy of the commons will occur. Common resource management is fundamentally different from open access. See, e.g., David Feeny, Susan Hanna, and Arthur F. McEvoy, ‘‘Questioning the

Assumptions of the 'Tragedy of the Commons' Model of Fisheries,'' *Land Economics* 72 (1996): 187–205.

14. See, e.g., Ester Boserup, ''Environment, Population and Technology in Primitive Societies,'' *Population and Development Review* 2 (1976): 21–36.

15. See, e.g., June Prill-Brett, ''Common Property Regimes among the Bontok of the Northern Philippine Highlands and State Policies,'' Working Paper no. 21 (University of the Philippines College Baguio, Cordillera Studies Center, 1993).

16. James B. Davies and Junsen Zhang (''Gender Bias, Investments in Children, and Bequests,'' *International Economic Review* 36 [1995]: 795–818) find evidence of a fairly strong gender preference for males. They use the data on the lowlands from Agnes R. Quisumbing, ''Intergenerational Transfers in Philippine Rice Villages,'' *Journal of Development Economics* 43 (1994): 167–95. Perhaps a similar mechanism is at work in our region for nonirrigated land. Since customary law is less rigidly applied to this other type of land, there is more opportunity for parental gender preference.

17. There is a huge literature on contract choice, such as Kejiro Otsuka, Hiroyuki Chuma, and Yujiro Hayami, ''Land and Labor Contracts in Agrarian Economies: Theories and Facts,'' *Journal of Economic Literature* 30 (1992): 1965–2018; and Yujiro Hayami and Keijiro Otsuka, *The Economics of Contract Choice* (Oxford: Clarendon, 1993).

18. As Prill-Brett (''Common Property Regimes,'' p. 14) puts it: ''Another condition under which common land transforms into individual property with restricted rights of use, is the construction of irrigated rice fields . . . the channeling of water from a nearby water source, the construction of an irrigation canal to transport water to the field, the construction of retaining stone walls, the transporting of soil nutrients into the constructed pond field, and the sustained production of rice through continuous cropping, transforms the land use system.''

19. The bilateral part of the inheritance rule analyzed here (also referred to as homoparentalism) has to be distinguished from the rule of general primogeniture that most wet-rice agricultural societies in the central Cordillera traditionally practiced (personal communication with June Prill-Brett, October 15, 1996).

20. In our sample, the mean land size inherited by first-born children who are primary heirs was not different from the mean land size inherited by later-born children.

21. We adopt this interpretation in consonance with the idea that ''should a couple fail to produce an offspring, and one of the spouses dies, the property of the deceased reverts to his/her natal family, to be reassigned to another heir'' (see Prill-Brett, ''Common Property Regimes,'' p. 20). In our model, we assume that the procedure by which the land is reassigned follows that by which a family is allowed to acquire land.

22. See Prill-Brett, ''Common Property Regimes,'' p. 19.

23. In the case of bilateral primogeniture, optimal household farm size will be better maintained the more egalitarian the distribution of land is. Provided nobody inherits from two families, male and female primogeniture always conserve optimal farm size, since only the husband or wife has land.

24. See, e.g., Barzel (n. 13 above), p. 41; Otsuka, Chuma, and Hayami; and Hayami and Otsuka.

25. We follow Cowell (n. 5 above) in assuming that fertility is independent of the amount of land owned by each family and that the distribution of the parents on the basis of the number of children remains constant. For a traditional economy, this assumption is not unreasonable (see, e.g., Boserup [n. 14 above]). Frederic L. Pryor (''Simulation of the Impact of Social and Economic Institu-

tions on the Size Distribution of Income and Wealth,'' *American Economic Review* 63 [1973]: 50–72) simulates, among others, the influence of differences in fertility between rich and poor people under general primogeniture and equal division.

26. The large-population assumption has the advantage that the number of men is equal to the number of women. The proportion of men and women who do not get married is included in p_0, the proportion of couples that do not produce children.

27. The problem for the evolution of women's land is symmetric. For now we focus on the problem of men's land.

28. Children who do not receive land might receive a higher human capital stock than those that do receive land. As the population size increases and farm plots become smaller, farming becomes a less attractive option. This should promote the role of human capital investments in the intergenerational transmission channel. See, e.g., John Knodel, Apichat Chamratrithirong, and Nibhon Debavalya, *Thailand's Reproductive Revolution: Rapid Fertility Decline in a Third World Setting* (Madison: University of Wisconsin Press, 1987). More children will be able to find jobs outside of farming. The rate of increase in the number of farmers will be less than the rate of increase of the general population. The case where the distribution of the numbers of farmers remains constant is an interesting limiting case.

29. The data described here are part of a larger data set collected in a survey of rural households from two villages in the Cordillera region. Using community census data (1992) and field work carried out by the Natural Resource Management Research Program (NRMP) of the Cordillera Studies Center, UP College Baguio, Crisologo-Mendoza constructed a structured questionnaire with which she conducted interviews in April and May of 1994 to obtain a data set for her dissertation research. Finally, note that our data from Sagada come from the two barangays of Patay and Suyo and not from the whole municipality of Sagada.

30. In these respects, the situation is quite similar to the one of a typical peasant economy. Otsuka, Chuma, and Hayami (n. 17 above) explain this pattern of agricultural organization by high enforcement costs of labor and limited economies of scale.

31. The population growth in the Cordillera region was 2.53% in 1994 (National Statistics Office, Manila). If you take one generation to be 30 years, this amounts to about 112% of population growth per generation. However, because of the emigration out of the small villages, population growth in our two villages might be much higher than indicated by the average for the Cordillera region.

32. This number is more in line with Boserup's contention (p. 23) that ''the most reasonable assumption about past demographic trends seems to be that some unfortunate peoples, decimated by disease and war, had negative rates of population growth and disappeared, while other more fortunate ones had positive, but fairly low, rates of growth over long periods.''

33. Assume for simplicity that the initial distribution of land for men and women is the same. The influence of the initial distribution on the distribution $f_t^m[x]$ is given by $(1 - l)^t(0.544)\ {}^t f_0^m[x]$ if we take the Belgian p_k and by $(1 - l)^t(0.322)^t f_0^m[x]$ if we take the Filipino p_k.

34. The specification of the land acquisition function for $k_s \leq 2$ is not relevant to our problem. Since families with fewer than three children have no secondary heirs, they cannot pass on the accumulated land. If they accumulate land, it becomes the parents' land, but it will never be individually owned. When both spouses are no longer living, the land becomes common again or a new heir is

assigned on the basis of the procedures by which the village determines who is allowed to accumulate land.

35. Proposition 3 describes the distribution of inherited land out of a couple's acquired land using this specification (see appendix).

36. The estimates where obtained using Gauss with the help of Denis Fougères.

37. We also tested the restrictions separately. None of them had to be rejected.

38. This conclusion is not sensitive with respect to the particular value chosen for *l*.

39. This is the case in the traditional sense. See, e.g., Anthony B. Atkinson, ''On the Measurement of Inequality,'' *Journal of Economic Theory* 2 (1970): 244–63.

40. These villages are located in mountainous and rugged terrain; even where the slopes become less steep, the landscape remains hilly.

41. A Mathematica program was used to calculate the roots of this equation.

42. See, e.g., Arsenio M. Balisacan, ''Agricultural Growth, Landlessness, Off-Farm Employment, and Rural Poverty in the Philippines,'' *Economic Development and Cultural Change* 41 (1993): 533–62.

43. The new practice itself might be a consequence of rapid population growth. An increasing number of parents are secondary heirs from large families. Consequently, they did not inherit very much land. With poorly developed land markets, the only way for the eldest child of such parents to obtain a farm of sufficient size is to claim the land of both parents.