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REFLECTIONS ON THE ECONOMIC ORGANIZATION OF AGRICULTURE:
TRADITIONAL, MODERN, AND TRANSITIONAL*

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1. Introduction

The principal form of agricultural organization throughout much of the world is, and historically has been, the traditional owner-operated family farm, or perhaps an equivalent share-cropping arrangement, with occasional use of minimal hired labor or off-farm employment of family members. The chief exceptions to this rule, since the decline of the large feudal estates and the ending of slave-plantation agriculture, were the collectivized and state farms, now being privatized, in the former Soviet Union, eastern Europe, and other Marxist regimes, but these have been politically rather than economically motivated. In the last 20 years or so, this pattern has increasingly been broken in the U.S., where, in 1988, 45 percent of all agricultural land was leased and where 41 percent of all farmers operated at least some leased land. I argue that the traditional pattern of owner-operated family farming is the prevailing pattern in transitional and modernizing agriculture for reasons similar to those advanced by Coase (1937) in his general discussion of the nature of the firm, given the highly location-specific nature of land and managerial human capital in agriculture. This hypothesis also accounts for inheritance patterns and the thinness of agricultural land markets in the developing world. Agricultural modernization, however, breaks down the dependence of agricultural production on location-specific factors and leads to increased corporatization of agriculture and to a considerable diversity of organizational structures. Regional and commodity differences in the U.S., as revealed in the Agricultural Economics and Land Ownership Surveys and the Farm Costs and Returns Surveys, support the theory that modernization of agriculture is responsible for the decline of the traditional form of organization as an economic institution. Even large-scale farming, employing substantial amounts of leased land and machinery and, often, hired labor, remains a basically family-controlled operation even in the U.S. in the nineties.

Why is agricultural production almost always organized in "small" units in traditional and transitional agriculture? "Small" means basically a "family" operation, with perhaps a few hired hands and where possibly some of the family works off-farm, part or full time. (See Binswanger and McIntire, 1987, and Binswanger and Rosenzweig, 1985, for a description of the institutions of traditional agriculture and an analysis somewhat along the lines proposed here.) The underlying reason for this common form of arrangement is the nature of agricultural technology and the fundamental heterogeneity of land, labor and management. Soils, topography, and climate are highly variable. Intimate knowledge of their specific attributes is required for efficient production. Who has this knowledge and to what extent is also variable. Moreover, given the seasonal vagaries of climate and rainfall, timely decisions are of the essence. Because these are hard to specify in contracts, making the owners of land, of labor and of the managerial input residual claimants works best. Of course, in practice there are a variety of alternative secondary institutional arrangements such as share tenancy, rental agreements, contract labor, etc. and many varieties of rural credit markets and institutions. Concentrating control within the family, nuclear or extended, is helpful in reducing disincentive effects while at the same time allowing for sufficient scale and scope to realize economies due to factor indivisibilities by making a number of people effectively residual claimants.

When does this model fail and why? If it is basically correct, then there must be good reasons for the exceptions to the general rule. Tropical plantation agriculture is one. But the specific crops and localities for which and where it is practiced today suggest that the nature of technology or of resources is different from that posited. (See Pryor, 1982. Pryor, 1980a and 1980b, also contain useful discussions of alternative forms of agricultural organization.) Corporatized or collectivized agriculture has been practiced from time to time and place to place. It has often failed, perhaps only after some time. When it lasts, it may be for ideological or political reasons as in the Israeli kibbutzim, or the Soviet Union,

or China. The Agricultural Economics and Land Ownership Survey (AELOS) follow on to the 1987 U.S. Census of Agriculture contains extensive information on farm ownership, tenancy status, and decision-making in agricultural production and marketing. This information is supplemented by the Farm Costs and Returns Survey (FCRS) conducted by the ERS and the NASS of the USDA. In the U.S. land leasing and a great diversity of organizational forms are wide-spread. The question is whether agricultural modernization, which is far advanced in the U.S., in fact breaks down the dependence of agriculture on location-specific factors and permits other forms of agricultural organization, as hypothesized.

2. The Hypothesis: Traditional and Transitional Agriculture¹

The hypothesis advanced in this paper is a variation on the theory put forth by R. H. Coase in his famous paper, "The Nature of the Firm". In his analysis of property rights, Y. Barzel (1989) develops the idea of transactions costs and contracts on which Coase based his theory of the firm in order to explain the varied nature of land tenure arrangements. Barzel points out the key nature of incentives with respect to use or non-use of unpriced factors or attributes, also emphasized by Coase. In a series of papers, Allen and Lueck (1992, 1993, and 1994) have argued that recent explanations of the form of contractual arrangements for access to land in agriculture in terms of relative risk-aversion of landlords and tenants (the principal-agent model) is not supported vis-à-vis a pure transaction cost model. Yet, I would argue, a fundamental role for uncertainty exists even in the case of models based largely on the transactions cost approach because of the location - specific nature of human capital in traditional and transitional agriculture and sequential decision-making in all forms of agriculture.

Coase begins his argument with a famous quotation from Frank H. Knight (1921). Knight argues that the reason for the existence of the firm and of the entrepreneur

¹ The distinction among traditional, transitional and modern agriculture and a characterization of these categories is made in Nerlove(1988).

is uncertainty. But as we now know from Arrow and Debreu's analysis of risk and equilibrium (1954), uncertainty is a necessary but not sufficient condition for the existence of entrepreneurs of the sort Knight is talking about, and thus of the existence of firms in Coase's sense. This is because in the absence of transactions costs, which may preclude a full set of contingent contracts and the existence of certain markets, contractual arrangements would exist which would enable individuals to reach Knightian equilibrium on their own, thus obviating the need for firms to organize economic life, as Coase himself was quick to see. But Coase puts the matter in another way. He considers rather what determines the size of the firm, zero being one limit and the whole of the economy being the other: "Why, if by organizing one can eliminate certain costs and in fact reduce the cost of production, are there any market transactions at all?" Coase (1988, pp. 42-43). "... a firm will tend to expand until the costs of organizing an extra transaction within the firm become equal to the costs of carrying out the same transaction by means of an exchange on the open market or the costs of organizing another firm." (p. 44) Thus the same factors which lead to the existence of firms also limit their size, and moreover can explain why firms typically produce more than one product.

Transactions costs vary a great deal and are sometimes so large as to preclude any transactions of a particular type and therefore associated markets. The chief reasons for such variation appear to be heterogeneity of the characteristics of the commodity exchanged and the lack of information or uncertainty about those characteristics on the part of one or both parties to the exchange.

"Small" is defined in the context of the organization of agricultural production in terms of the size of the decision-making and ownership unit. The prevalent form of the organization of agricultural production in traditional and transitional agriculture is the owner-operated family farm in which a single extended or nuclear family both owns the principal factors of production, land and labor, and supplies the organizational and managerial function. Although there are many variations on this pattern, it is in sharp contrast to the "corporate" form of

organization in which the management function is largely separated from the ownership of factors of production or intermediate inputs. In a "corporate" form of organization, the decision-maker or manager or entrepreneur is a residual claimant and virtually frequently the sole residual claimant. That is, in corporate production almost all factors of production are purchased, rented or contracted for, and almost all products are disposed of on the market. What is it about agricultural production and the nature of agricultural factors and management in a traditional and in a transitional context which leads to a form of organization which combines ownership and management and expands residual as opposed to contractual claims, often in farms which are passed down through several generations of the same family?

In his discussion of share tenancy and other forms of contractual arrangements in agriculture, Barzel (1989) argues that, " In agriculture, weather, pests, and other forces affect output differently in different periods and in different locations. In addition, no two pieces of land or two workers are identical to each other. Determining the properties of each unit of input requires extensive and costly measurement. Owing to diversity in the forces that affect output, the specific contributions of individuals are extremely difficult to determine." Such heterogeneity leads to inefficiency when production is organized along textbook lines by firms which purchase, rent or contract for every input or intermediate output and dispose of all final products on the market: "Each acre of land differs from all others, even from the ones adjacent to it, in a variety of ways: in the incidence of rocks, in steepness, in the degree of soil erosion, in the amounts of various nutrients, in exposure to wind and sun. Land parcels also differ from one another in such features as access to ground water, quality and quantity of irrigation canals, availability of plumbing equipment, types of roads serving them, and distance to markets. Moreover, the ease of exploiting such features also varies. Land use would be efficient if landlords were compensated by the users of land for the exact reduction in land value. Because land is not uniform, however, the exact evaluation of these effects requires measurement at every spot. Exact and

comprehensive measurements are obviously prohibitively costly, and thus measurements are neither exact nor comprehensive. Indeed, certain features may not be measured at all. "...Tenants who can gain from exploiting those land attributes that they are not marginally charged for will use them to the point at which the net gain they yield falls to zero. ... Any land attribute that can be changed by the tenant and is not charged for by the landlord becomes a free attribute to the tenant and is then subject to overuse. Similarly, any changeable land attribute that remains under the landlord's control will be undersupplied." (pp.33-34) In the case of land, such inefficiencies can be remedied by making land the residual claimant. Some forms of share tenancy make both landlord and tenant residual claimants and may be helpful in resolving some of these problems even offer second-best solutions.

A good deal of the uncertainty which exists in agriculture arises in a sequential context, that is to say, it is potentially resolvable on the spot over time. If the rains do not come on time, something can be salvaged by planting another crop or by delaying fertilizer application. Chambers (1993), following Reid(1979), suggests that sharecropping has positive advantages when both lessee and lessor are engaged in farming in "...that it makes it in both farmers' interests to cooperate during the planting, growing, and harvesting seasons in the face of sequentially reducing uncertainty. ...Making both farmers residual claimants gives them both an incentive to operate the joint acreage [in a way] that could result in higher production than other contract forms." (p.7) Since "...it may be impossible for both parties to a contract to anticipate at a reasonable cost all possible eventualities, [share contracts are] ... probably particularly appropriate for agricultural production relations where uncertainty is sequentially reduced and actions are continuously taken in the light of new information." (pp. 17-18) Historically, share-leasing has been very important in the U.S., but declined in importance after extensive government price support programs were introduced in 1933, perhaps because these programs considerably reduced product-price

uncertainty.² Cash leasing and some forms of share leasing are exceedingly important in U.S. agriculture today, and I shall have more to say on this matter below.

Labor is also heterogeneous in an agricultural context. Quite apart from the difficulty of separating labor from management, and thus from the human capital embodied principally in decision-making agents, various ages and genders have differing comparative advantages in different tasks. It is thus of positive advantage to have the variety of labor types available in nuclear and above all in extended families. Moreover, monitoring labor is not easy in agricultural production as the numerous descriptions of slave-plantation agriculture in the Old South and of collective agriculture in the former Soviet Union and in China attest. It is clearly desirable to make a significant part of the labor input a residual claimant as well as the land input. In a study of the Zona da Mata in southeastern Minas Gerais, Brazil, Nerlove, Vosti and Basel (1994) have found that, on a significant number of farms, some family members work at least part-time off farm and some hired labor is used at the same time. Similar results are reported by Rosenzweig (1978). This fact is clearly a result of labor heterogeneity and probably of seasonality in the type of labor required as well.

In agriculture the most heterogeneous factor of all is management because of the location-specific human capital embodied in human agents engaged in production. Intimate knowledge of soil types and topographies of a particular farm in relation to the vagaries of weather, temperature, sunlight, water, and of pests, and of different plants' and animals' responses is required for successful farming and is not easily or instantly acquired. While this is particularly true in traditional agriculture, it remains true to some extent in modern agriculture, since modern inputs and techniques free one somewhat from location-specific responses and the vagaries of weather and of pests and knowledge of them can more readily be acquired

² Share leasing includes sharecropping, which involves direct transfer of a portion of the crop from tenant to landlord, and transfer of a portion of the proceeds from the sale of the entire crop. The latter is common in modern agricultural settings in which little or no farm output is consumed directly.

by formal schooling. Selection of types of modern inputs, of particular techniques, and of what varieties of what crops to grow and what breeds of what animals to raise is still highly location specific. Griliches (1957) study of the spread of hybrid corn varieties in the U.S., shows that the spread of such varieties depended significantly on the development of location-specific varieties by individual state experiment stations. Presumably, such dependence was the result of the judgments of individual farmers who were acutely aware of the nature of their localities and who made the effort through experimentation or other means to ascertain the suitability of newly developed varieties before putting them into use. Reyes (1990) has obtained similar results in a study of the spread of high-yielding rice varieties in the BICOL region of the Philippines which has a highly variegated typography and a variety of soil and water availability conditions.

The kind of location-specific human capital required for successful and efficient farm management is acquired only in a time-consuming process and is not easily transferable to distant locations and/or different types of agriculture. It is doubtful that an agent would be willing to make the investment required were he or she not a long-term residual claimant. It would be virtually impossible for an outside owner of one of the principal factors of production to know the specifics of the human capital embodied in a hired manager or to monitor the management function except at great cost. The problem is exacerbated by the considerable production uncertainty in agriculture. Again there appear to be strong reasons for making management a residual claimant. But agricultural modernization may result in management being the only residual claimant, as is prevalent in the corporate industrial sector. The same reasoning may be used to account for the prevalence of family farming in which some family members in subsequent generations inherit the farm. And like language, location-specific agricultural human capital is most easily acquired by growing up with one's teacher. Rosenzweig and Wolpin (1985) advance essentially the same rationale for the thinness of land markets and farm inheritance patterns in LDC's.

Because agricultural production is subject to great uncertainty and requires an abundance of location-specific knowledge, there is a need for timely decisions made on the spot. Thus labor and management functions are frequently combined in one or more individuals living on the farm. In Nerlove (1974), I characterized the "new home economics" in terms of the assumption of a single household or family utility function. The validity of such a utility function together with traditional modes of inheritance and of some initial increasing returns to scale goes a long way toward explaining the prevalence of *family* farming in traditional agriculture as opposed to one-man operations, on the one hand, and to corporate organization, on the other. The role of this form of organization and economic institution in the modernization of traditional agriculture is explored in Nerlove (1988).

The hypothesis I have advanced here is couched largely in terms of heterogeneity of factors of production in agriculture and of the large information costs and other inefficiencies associated with the hire of a substantial portion of the principal factors of production, land, labor and management in traditional agriculture. (Capital is less of a problem although the high information costs associated with credit make finance more problematic in agriculture than in other sectors of the economy.) But my arguments could be rephrased in terms of sharply decreasing returns to scale for some appropriate definition of scale. This suggests also considering the lower limit of size as well as the upper limit.

I have already alluded to one source of "scale economies" in my discussion of how relevant human capital is acquired in agriculture and the importance and prevalence of family farming. But there are other sources, some of which may be achieved by cooperative or other institutional arrangements while still leaving production in the hands of small units, and some of which positively constrain the lower limit of the optimal size of the production unit in agriculture. I deal with some of these in the next section of this paper in which I discuss alternative, viable organizational forms. Many problems associated with lumpy capital inputs can be resolved by rental arrangements but some cannot. For example, farm structures

such as barns and silos cannot easily be rented in part because they have to be of a certain size and to be located near the locus of production. Certain types of farm machinery have to be under the sole control of a decision-maker and located where they are used in order to be utilized in a timely fashion due to the common vagaries of weather and of the seasons across many farms in a given region. But the prime indivisibility in agriculture is associated with the managerial function. One farmer and his family can certainly manage efficiently more than a tiny enterprise and better managers can manage more than poorer ones. Moreover, larger units may have readier access to credit, particularly if they are larger in terms of some easily collateralizable asset such as land. There are thus lower limits to the optimal size of farms as well as upper limits and these scale economies will tend to be even more location specific than the diseconomies which are the principal reason for the prevalence of owner-operated family farms.

Those characteristics of agriculture which make relatively small scale production by factors which are largely residual claimants optimal are: (1)The uncertain, varied and location-specific nature of agricultural technology. (2)Great heterogeneity of the principal factors of production, land, labor and management. (3)The considerable investment in location-specific human capital required to achieve efficient agricultural production under conditions of climatic variability and the prevalence of pests. Moreover, the efficient mode of accumulation of the required human capital and the complementarity of different family members in the productive and seasonal processes which characterize agriculture lead to a pattern of family farming and inheritance.

3. The Evidence for Pre-Modern Agriculture

In their comprehensive survey of agricultural land relations and policy, H.P. Binswanger, K. Deininger, and G. Feder (forthcoming) list four main types of

agricultural organization currently prevalent in both pre-modern and modern agriculture.

Family Farms. Such farms have already been described in detail above in conjunction with the hypothesis that they are by and large the most efficient form of productive organization in traditional and transitional agriculture. Nonetheless, family farming is characterized by great diversity and many second-best solutions which may involve land rental, both in and out, and hiring of labor and/or full- or part-time employment of family members off farm. In some cases, input purchases or rentals or marketing of final products may be performed cooperatively in order to achieve economies of scale not otherwise available.

Collective and State Farms. Collectives are farms jointly owned and operated under a single management ostensibly for the benefit of those supplying the labor input. State farms are those belonging to the state and operated under a single management like a large commercial farm, producing a variety of products with a largely resident labor force paid in wages and sometimes in profit shares in cash or in kind. In both cases, workers or families are allocated small areas for housing, garden plots or on which to raise a small number of animals. Such farms at one time characterized much of Eastern Europe and the former Soviet Union.

Collectivized agriculture and state farms have persisted in large parts of the world for long periods and persist to this day, principally in China. It is generally agreed that such forms of agricultural production are extremely inefficient. Frederic L. Pryor (1992) gives an extremely detailed account of the varieties of collectivized agriculture and the ideological basis for the imposition of such organizational forms in socialist regimes worldwide. Pryor (Chapter 8) compares agricultural performance in Marxist and non-Marxist regimes in order to disentangle the effects of agricultural policy from those of the organizational structure of agriculture. Comparisons of the rates of growth of total factor productivity in agriculture show that in the period 1970-1987 this measure of performance grew more slowly in Marxist countries, both industrialized and

developing. The wide-spread belief that per capita agricultural output fell in all Marxist countries, however, did not stand up; distributional problems characterized all Marxist nations but per capita agricultural output declines were found for many developing countries and did not appear related to whether agriculture was collectivized or not. On the other hand a declining rate of growth of per capita agricultural output was observed in the majority of Marxist states. A rapid flow of labor out of agriculture, which has characterized non-Marxist agricultural development and many of the problems associated with it, does not appear to have been a major feature of Marxist development. What one can conclude from all of this is that agricultural modernization occurs at a slower pace in collectivized agriculture than in non-collectivized agriculture. But this difference could be due to other policies with respect to agriculture and other sectors of the economy pursued under Marxist regimes rather than to the inherent inefficiency of the corporate organization. In general, in both the West and under socialist governments price, market and trade policies have been much more important determinants of agricultural performance than has the collectivized/non-collectivized distinction. While Pryor's results do not contradict the hypothesis that collectivized agriculture is inherently inefficient in general, his results do support the hypothesis that agricultural modernization is adversely affected.

If, indeed, the corporate organization of agriculture is highly inefficient in the early stages of agricultural modernization, why then has it persisted over such a long period under Marxist regimes? I think we have to look to a political and ideological basis for the institution of collectivized agriculture at enormous cost in terms of human lives and suffering and despite great resistance, and its maintenance for more than half a century in the former Soviet Union and Eastern Europe and its continuance in China. While Marx and Engels had little to say about agriculture, the historical fact that Marxist revolutions have occurred and Marxist regimes come to power largely in countries predominantly agricultural and only semi-industrialized, had a great deal to do with the subsequent evolution of ideology by

Lenin, Stalin and Mao. It is largely this ideology which has influenced the policies of Marxist regimes towards agriculture. There may be other political factors involved as well.

Large Commercial Farms. These are large ownership holdings producing a relatively small number of related products and operating under a single management, often with a high degree of mechanization and using a variety of purchased inputs, frequently with a few long-term employees who may reside on the farm and with seasonally hired workers who do not. They are largely to be found in modern agriculture, but may exist among other organizational forms in transitional agriculture. They are of growing importance in areas in which agricultural modernization, in the sense of using modern inputs and technology, has proceeded the furthest because such modernization frees agriculture to some degree from the location-specific technology and management human capital and climate-dependent uncertainties which generally make small scale family farming more efficient. Such farms often evolve under conditions of agricultural modernization from particularly efficient or well-managed family farms and are frequently essentially family managed and owned. Agriculture in the United States in the nineties contains many examples of this type of agricultural organization, which differs little from that found elsewhere in the economy. U.S agriculture, nonetheless, contains a great variety of organizational forms and is not so easily characterized. I turn to a discussion of modern agricultural organization as exemplified by the U.S. in the next section.

Plantation or Contract Farming. Plantations are large ownership holdings specializing in a single, usually tropical crop, operating under a single management and using wage labor, a large fraction of which reside on the plantation but do not receive more than a small garden plot as partial remuneration. Such plantations often resulted historically from economies of scale in processing or marketing but are increasingly being supplanted by cooperative organizations of individual growers or by contract farming in which individual growers contract with the processor and/or distributor in advance of the growing season, which may in some cases be

continuous, to supply specific quantities and qualities of product on certain dates and at prices fixed in advance. The contract provides the farmer assured sale at an assured price and sometimes also for technical assistance, credit, services or other inputs from the purchaser. Plantations remain in existence largely for a number of highly specialized tropical crops such as rubber and tea in Sri Lanka and rubber and palm oil in Malaysia. Historically, they have been important in sugar production (Brazil and Cuba), coffee (Java), bananas (Central America and Ecuador), and cotton and tobacco (ante-bellum U.S.), as well as rubber, tea, and palm oil. Attempts to establish cocoa and peanuts as plantation crops in Africa have failed.

In his definitive study of *Plantation Agriculture*, P.P. Courtenay (1965, 1980) characterizes the modern plantation "...as an economic enterprise that specializes in the raising and immediately necessary processing of crops, whose harvest is largely free of seasonal rhythm, by a uniform system under central management and that makes use of scientific methods and efficient production techniques." (1980, p.83) Historically, Courtenay argues plantations arose from the overriding need to use labor efficiently in areas where there would otherwise be no labor supplied. To do so requires that labor be used more or less continuously. Timely processing requiring a large capital investment (sugar, rubber, palm oil, tea) originally required a continuous flow of the raw material to ensure full utilization of expensive equipment. Contract farming for many such crops now resolves this problem, however, without the necessity of a plantation organization. Large poultry enterprises in the U.S. (Perdue, 1989) operate on a similar principle. Plantation production of bananas originated in the development of refrigerated steam ships in the 1880's. United Fruit Co. had a monopoly of the transportation and marketing infrastructure; integration of the actual production of bananas served to ensure timely arrival after harvest at the point of refrigeration. Such coordination is now largely accomplished by producer cooperatives. Thus plantation and estate agriculture not only occur under rather special circumstances which do not characterize agriculture generally, but seem to be giving way to other institutions

which resolve some of the problems such organizations were designed to cope with and at the same time permit production to be organized more efficiently.

4. Organization of Modern Agriculture: The Case of the United States

Specialization and Diversity

U. S. agriculture is an extraordinarily diverse set of enterprises, specialized along commodity lines and regionally. Using data from the 1987 *Census of Agriculture*, Sommer and Hines (1991) classify farms into 12 primary "clusters" (see the Appendix). Some types of farms are organized along more-or-less traditional lines, operated by autonomous family owners. Other agricultural enterprises are more like firms in the nonagricultural sector of the economy. Some sectors are highly vertically integrated (such as poultry) while others depend heavily on the nonfarm sector to supply modern inputs such as chemicals, machinery, and seed. Before World War II, individual farms and regions were much less specialized than now, but modern agricultural technology has acted to increase the advantages of a single commodity type of farming. At the same time, improved long-distance transport, product-handling and storage, and marketing infrastructure has led to increased regional specialization by facilitating concentration in areas with the greatest comparative advantage (e.g., poultry and vegetables). U.S. agriculture really consists of many different industries, organized in ways largely dictated by the production and/or marketing technology of the commodities in which each specializes, which affect both the concentration of production among farms and regions and the extent of vertical coordination and integration with other sectors. (Reimund and Gale, 1991.) To illustrate, I examine three types of farming in more detail: cash grain, beef cattle, and poultry.

Cash Grain. The nearly half million farms in 1987 that fit this classification look more, in some ways, like the farms I described above in traditional and transitional agriculture. They are operated by individuals and families who own a significant part of the land they farm. On the other hand, these operators also tend

to lease a good deal of land (54%) which they farm as well. Both the ownership holdings and area farmed tend to be rather large and are increasing over time while the number of farms in this category is falling over time. The major source of these changes has been technical innovation in machinery and in cultural practices, which has reduced labor requirements, increased capital requirements and has facilitated increased specialization. According to Reimund and Gale (1991, p. 43) these farmers tend to lease rather than purchase land "...as a strategy to conserve capital resources and limit their debt exposure while allowing them to enlarge their farming operations." While these operators are almost always full-time farmers, limiting their income from off-farm employment, they are heavily dependent of government programs (in 1987, 59% of all direct payments to all farmers went to cash grain farms and 23% of this sector's receipts from commodity sales was accounted for by such payments; Reimund and Gale, 1991, p. 42). They are heavily dependent on the nonfarm sector of the economy for the inputs other than land which they use in production.

Beef Cattle. The picture that many of us have from Western movies of a large cattle ranch consisting of several thousand acres of rangeland, hundreds of freely roaming longhorns, worked by a dozen cowboys on horses, simply does not correspond to reality. Although such large-scale cattle ranches exist (cluster 12, Appendix), they are the exception rather than the rule. Cattle raising (clusters 4 and 6, Appendix) is carried out on more than half a million very small farms by mostly part-time farmers or in combination with the growing of wheat and sorghum on larger spreads in the Great Plains and Mountain states, in which the land is primarily devoted to crop production. Small operations (85% had less than \$25,000 in annual sales in 1987) specializing in cow-calf and feeder cattle production sold to cattle feedlots for finishing supply the bulk of U.S. beef today (Reimund and Gale, 1991, p. 43). These farms are concentrated in the eastern parts of Texas and Oklahoma, along the Gulf Coast, and in Appalachia. Nearly 60% of the operators of such farms reported in 1987 that farming was not their principal occupation and 60% reported

that they worked 200 days or more off-farm (Reimund and Gale, 1991, p.44). Cattle raising lends itself very well to small-scale production; land labor and capital requirements are low per head; and operations can be carried out on marginal land. In contrast to cash grain farming, most of the land used to raise cattle is owned by the farm operator (38% overall was leased in 1987, much of this Federally owned grazing land); 70% of beef cattle producers reported in 1987 that they owned all of the land they used (Reimund and Gale, 1991, p. 44). Off-farm income provides a considerable part of the cash flow necessary to finance cattle raising operations and reduces the operator's exposure to the income uncertainty inherent in the high variance of slaughter and feeder calf prices.

Poultry. Poultry production is carried out almost exclusively in a large scale vertically integrated industry. The operation of one large poultry operation on the Eastern Shore of Maryland is well-described in Perdue (1989). Before 1950, poultry production was organized by small, geographically dispersed farmers usually located near large urban areas, selling poultry and eggs on the open market and purchasing a large part of the feed they used. Today's large scale poultry operations grew from the feed suppliers who ultimately integrated their business with the production and marketing of the final product to take advantage of new technology in marketing, genetics and poultry nutrition. A typical company on the Eastern Shore contracts with a large number of independent farmers per pound of live weight less the costs of feed, which the company supplies. The company owns title to the baby chicks throughout the process and supplies these to the farmer from a tightly controlled hatching operation, which is also contracted out to a much smaller number of farmers, in order to limit the loss of important proprietary genetic information. The farmer owns outright one or more chicken houses, each of which cost about \$100,000 on average in 1993, and is typically up to his eyeballs in debt for this reason. Each chicken house holds about 25,000 birds; a flock matures in about 7 weeks and losses from deaths run about 6%. Chicks are replaced after a brief hiatus of a week or 10 days. Thus, total output of a chicken house runs about 150,000 birds

per year. The manure is the farmer's to keep and he usually uses this on his fields, on which he grows corn and soybeans which are in turn sold on the open market. Overall, local farmers supply about 60% of the needs of the poultry companies' feed operations on the Eastern Shore. (The use of the manure is alleged to be the cause of the severe environmental degradation of the Chesapeake Bay in recent years; a growing aquaculture industry on the Eastern Shore may alleviate some of these problems.) After the chickens are harvested, the company slaughters, disassembles and markets the birds. The residual-- heads, feet, feathers, offal-- is cooked, ground up and used to formulate the feed mixture which the company supplies to the farmers with whom it has contracted. The farmer's contribution to this process seems to be limited to controlling the ventilation and temperature of the chicken house, keeping the birds comfortable, and assiduously clearing out dead birds to control the spread of disease. Feed and water supply is highly automated. While the farmer spends only a small fraction of his time in these activities they are extremely important in determining the efficiency of the process by which feed is converted into chicken meat. On the spot decisions and a constant presence near by are required for success. Thus these farmers generally do not work off farm but do combine chicken raising with other farming activities. Their heavy debt load is said to sharpen their incentives to perform well. (Given a contract the farmer generally has little trouble in raising capital at favorable rates.) It seems to me that the structure of this industry makes perfectly good sense in the light of the theory proposed above stressing the importance of location-specific human capital and sequential decisions in agriculture. Only that part of the operation which involves on the spot decisions is actually contracted out, and that with a highly refined regard to incentives.

This industry is concentrated in the Atlantic Coast states from Delaware to Georgia and in Arkansas. These areas would otherwise be areas which would lose substantial agricultural population to nonagricultural activities, although the number of farmers involved is small, about 38,000 in 1987.

Leasing in U. S. Agriculture

Three recent publications of the USDA/ERS (Reining, 1990; Rogers, 1991; and Wunderlich, 1991) describe the structure of land ownership and tenure in U.S. agriculture in detail based on the 1987 *Census of Agriculture*, earlier censuses, and on the 1988 *Agricultural Economics and Land Ownership Survey* (AELOS). These publications and the data on which they are based give a dramatic picture of widespread leasing of land in the U.S., the type of leases found, and who leases to whom, which, at first glance, seems much at variance with the story emphasizing the importance of location-specific human capital in traditional and transitional agriculture.

Leasing of land in U.S. agriculture is highly significant, but its prevalence varies from commodity to commodity and from region to region. Overall in 1988, 45% of all land used in agriculture was leased and 41% of all farmers operated at least some leased land. Full owners, who operate only the land they themselves own, constitute the dominant tenure class, 59%; part owners, who operate some land that they themselves own and additional leased land, make up 29% of all operators and farmed 56% of all land in farms and leased more than 65% of the rented land; pure tenants, who own no land themselves, constitute 12% of all farmer operators and operated 15% of all land in farms. It is interesting to note that, while the percentage of land leased has remained roughly constant over the last century, the number of pure tenants has declined dramatically. In 1940, for example, that category made up 39% of all farm operators. Leasing is more prevalent in the West Coast (California Oregon, and Washington), the Midwest (Wisconsin, Illinois, Indiana, Michigan and Ohio) and in the Southwest-Central states (Texas, Oklahoma, Arkansas and Louisiana), 45%, 45% and 48% of all land in agriculture, respectively, and least important In New England, only 17%. While most of those who lease land own and farm some of their own, most of those who lease land to others are not actively engaged in farming, 90%. There is a not insignificant number of farmers, however,

who both farm and lease some land to others. I have been unable to determine whether there are some U.S. farmers who both lease land in and lease land out, but note that there were such farmers in the Zona da Mata, Brazil, in the late 1970's.

Most of the owners who lease land to others are individuals or families, 84%, the remainder being partnerships or corporations, many of which are family held. Most landlords lease land only to one tenant and their leases are small, averaging only 180 acres for those who do no farming themselves and 142 acres for operating owners. Although small farms (\$2,500-19,999 1969 \$'s) both rented in and rented out most of the land rented, the importance of land rented in by large farms (\$100,000 and over 1969 \$'s) has been growing dramatically. Reining (1991) describes the concentration of sales of agricultural products from farms in the largest size class and attributes much of this concentration to increase control over land resources, much of which is by lease rather than acquisition. "Rental contracts for land are generally easier and faster than land purchases. Renting, therefore, allows [large, price responsive] farmers to respond to commodity price increases more readily than if they purchased the land." (p.2) Leasing land also permits such farmers to contract rapidly and at minimal cost when market conditions are not favorable.

Owners who lease land to others are older than owners on the average, disproportionately 60 and older. More than half are retired, many from farming, and many are women, and these landlords tend to live on or near the land they rent to others, although nonoperating owners participate very little in farming decisions.

Pure cash and pure share leases make up 94% of all leases and cover 95% of all acres leased. Share leases typically allow more participation by the landlord in the management of the farm operation and for sharing some of the expenses, but cash leases predominate overall, 64% of all leases. The prevalence of cash leases among nonoperating owners, 65%, is somewhat greater than among owners who also farm, 57%, which presumably reflects a more active participation by the latter in the actual decisions. The percentage of farmland rented under cash leases has increased and under share leases declined in the last 20 years. These fractions also vary

considerably from one region to another in the U.S. Cash leases predominate in the Eastern part of the U.S., 80-85% of all leases, and are less important in the Midwest and Great Plains regions, 54-57%. Landlords surveyed were asked whether the following five management decisions were made by the landlord, by the tenant or by both, jointly: selection of fertilizer and chemicals, cultivation practices, selection of crop variety or of livestock breed, harvesting decisions, marketing decisions. The first four decisions were made 77-82% by the tenant alone, whereas marketing decisions were more equally shared under share lease contracts: tenants made marketing decisions alone in only 47% of the share-leasing agreements.

Variation in lease contracts and reported participation in decisions by commodity sector might be expected to shed considerable light on the motives of farmers and of landlords for choosing particular contractual forms for leasing land or for not leasing at all. Unfortunately, commodity detail is not available at the present time, although regional variation reveals some related differences.

It is clear enough from the description of leasing in the U.S. that modern agriculture does not at all follow the pattern we would expect from looking at traditional and transitional agriculture. In modern agriculture, as exemplified by the United States in 1987, landlords are principally older, retired farmers or other rural residents who have invested in farmland. In contrast to older people in developing countries, these individuals do not live in extended farming families and so lease their assets in order to realize a return from them, which presumably exceeds that which could be achieved by selling the land and investing the proceeds. Renters, on the other hand, are primarily active farmers who own land of their own and rent in order to augment their access to land resources without risking scarce capital assets through purchase. The lack of participation by most landlords in decision-making in the production process and greater involvement in marketing decisions under share-leasing agreements suggests that incentives for cooperation in the face of sequentially resolvable uncertainty is not an important factor in determining the form of lease.

5. Conclusions

Agricultural organization, historically and in developing countries, can be explained in large part by the nature of production and marketing in pre-modern agriculture. The characteristics of pre-modern agriculture make location-specific managerial human capital a key element in the efficient organization of traditional and transitional agriculture and in the sequential resolution of uncertainty under conditions of factor heterogeneity. Agricultural modernization, however, breaks down dependence on location-specific human capital necessary to cope with location-specific heterogeneity and uncertainty. Modern inputs permit a more generalized managerial human capital to operate larger-scale agricultural enterprises. Modern infrastructure and modern technology in marketing, storage and transport permit increased regional specialization and make alternative forms of organization, such as vertically integrated poultry production or vertically disintegrated beef production, economically efficient and thus permit a greater variety of organizational forms. The shift of population out of agriculture and out of rural areas which accompanies agricultural modernization results in a demographic configuration in the agricultural sector which leads to increased availability of agricultural land. Because of the greater efficiency of large agricultural enterprises in the production of some, but not all, commodities, larger units evolve for those commodities and in those regions which have a comparative advantage in their production. Land is acquired in those enterprises which are land-intensive largely through lease rather than outright purchase because of capital-market imperfections and the desire of individual farm managers for increased flexibility in the face of longer-term uncertainty with respect to markets and government interventions. These uncertainties are borne by land owners who presumably receive higher returns from leasing their land assets than they would receive by outright sale.

APPENDIX: Types of Farming, U.S. Agriculture, 1987

1. Corn, soybeans, hogs. 64% of these farms' sales are accounted for by these three commodities; 75% of U.S. sales; most of these farms are in the Corn Belt.

2. Poultry. 66% of these farms' sales are accounted for by poultry; 68% of U.S. poultry and poultry products originate from these farms; these farms are located primarily along the East Coast and in Arkansas.

3. Dairy. Farms in this cluster produce dairy (55% of the farms' sales) and cattle and calves (14%); these farms also produce a substantial amount of feed for on farm use; more than 40% of U.S. dairy sales are from these farms, which are located primarily in the Northeast and Lake States.

4. Cattle, wheat and sorghum. Cattle sales account for 68% of these farms' sales and wheat for another 10%; these farms are relatively large (43% have more than 500 acres) and there is little off farm employment reported. They are located primarily in the Great Plains and Rocky Mountain states. However, the bulk of cattle supplied to feedlots and for slaughter in the U.S. come from farms in cluster 6.

5. Tobacco. These farms are small, frequently operated by part-time farmers, located principally in Kentucky, Tennessee, Southern Virginia, and North and South Carolina. Tobacco accounts for 38% of these farms' sales, followed by cattle (17%) and dairy (12%); they supply 70% of U.S. tobacco.

6. Part-time Cattle. 60% of the operators of these farms report a non-farm occupation as their principal one. Sales are small relative to the U.S. farm average and consist mostly of cattle and hay. These farms are found almost everywhere but are concentrated in eastern Texas and Oklahoma, along the Gulf Coast and in Appalachia.

7. Fruit. 47% of these farms' sales are accounted for by fruit; they are small in area (average less than 10 acres) but have net cash returns more than twice the U.S. average. These farms tend to be geographically concentrated (West Coast and Southeast) and employ considerable contract and hired labor.

8. Miscellaneous Crops: Peanuts, Sugar Beets, Sugarcane, Potatoes. These farms are geographically highly concentrated, e.g. peanuts in southern Georgia, sugarcane in southern Louisiana, etc. They are largely operated by full-time farmers and are relatively large in terms of both area and sales.

9. Horticultural Products. Many of these farms are part-time operations and are small (less than 10 acres) and are located near urban areas in the Northeast, in Florida and in the Pacific Coast states. On average these farms derive only 38% of sales from vegetables and nursery products and sell significant amounts of dairy, cattle and fruit.

10. Cash Grain. These farms specialize in the production of feed grains, food grains and oilseeds. Wheat, oats and barley are important in the Northern Plains, rice in the gulf coast areas of Texas, Louisiana, and Mississippi, and in California. Large farms predominate (average more than 900 acres) and are operated primarily full-time.

11. Cotton. These farms are geographically concentrated in the Texas High Plains and in the Mississippi Delta and are relatively large in area (averaging more than 700 acres with sales 60% higher than the U.S. average); 45% of sales are accounted for by cotton and government payments contribute significantly to net farm income.

12. Cattle, Sheep and Other Livestock. These farms are very large in area, averaging more than 1800 acres and mainly located in Texas and the Mountain states. They are relatively unimportant in terms of contribution to total U.S. agricultural sales.

References

- Allen, D.W., and D. Lueck, "Contract Choice in Modern Agriculture: Cash Rent versus Cropshare," *Journal of Law and Economics*, 35:397-426 (1992)
- Allen, D.W., and D. Lueck, "Transaction Costs and the Design of Cropshare Contracts," *RAND Journal of Economics*, 24:78-100 (1993)
- Allen, D. W., and D. Lueck, "Risk, Uncertainty and Contracts," unpublished (1994)
- Arrow, K. J. and G. Debreu, "Existence of an Equilibrium for a Competitive Economy," *Econometrica*, 22:265-290, (1954)
- Barzel, Y., *Economic Analysis of Property Rights* (New York: Cambridge University Press, 1989)
- Binswanger, H.P., Deininger, K., and Feder, G., "Power, Distortions, Revolt and Reform in Agricultural Land Relations," forthcoming in Vol. III of *The Handbook of Development Economics*, ed. J. Behrman and T. N. Srinivasan (New York: Elsevier, 1994)
- Binswanger, H. P., and J. McIntire, "Behavioral and Material Determinants of Production Relations in Land-Abundant Tropical Agriculture," *Economic Development and Cultural Change*, 36:75-99 (1987)
- Binswanger, H. P. and M. R. Rosenzweig, "Behavioral and Material Determinants of Production Relations in Agriculture," *Journal of Development Studies*, 22:503-539 (1985)
- Chambers, R. G., "Some Notes on Sharecropping and U.S. Agriculture," unpublished ms., University of Maryland, Department of Agricultural and Resource Economics (1993)
- Coase, R.H., "The Nature of the Firm," *Economica*, n.s.4, (1937), reprinted in Coase (1988)

- Coase R. H., *The Firm, the Market and the Law*, (Chicago: University of Chicago Press, 1988)
- Courtenay, P.P. *Plantation Agriculture* (London: G. Bell, 1965, 2nd. ed. Boulder: Westview Press, 1980)
- Griliches, Z., "Hybrid Corn: An Exploration in the Economics of Technical Change," *Econometrica*, 25:501-522 (1957)
- Knight, F.H. *Risk, Uncertainty and Profit* (Boston: Houghton Mifflin, 1921)
- Nerlove, M., "Household and Economy: Toward a New Theory of Population and Economic Growth," *Journal of Political Economy*, 82:S200-S218 (1974)
- Nerlove, M., "Modernizing Traditional Agriculture," International Center for Economic Growth Occasional Paper No. 16 (San Francisco: Institute for Contemporary Studies, 1988)
- Nerlove, M., S. Vosti, and W. Basel, "The Role of Product Mix and Farm-Level Diversification in Adoption of Modern Technology: The Case of the Zona da Mata of Minas Gerais, Brazil," forthcoming International Food Policy Research Center Research Report, (Washington, D.C.: 1994)
- Perdue, Mitzi, *Frank Perdue* (Salisbury, MD: Published by the author, 1989)
- Pryor, F. L., "Feudalism as an Economic System: A Review Article," *Journal of Comparative Economics*, 4:56-71 (1980)
- Pryor, F. L., "The Asian Mode of Production as an Economic System," *Journal of Comparative Economics*, 4:420-442 (1980)
- Pryor, F. L., "The Plantation Economy as an Economic System: A Review Article," *Journal of Comparative Economics*, 6:288-317 (1982)
- Pryor, F.L., *The Red and the Green: The Rise and Fall of Collectivized Agriculture in Marxist Regimes* (Princeton: Princeton University Press, 1992)

- Reid, J., "Sharecropping and Tenancy in American History, in *Risk, Uncertainty, and Agricultural Development*, J. Roumasset, J. M. Boussard, and I Singh, eds. New York: Agricultural Development Council, 1979)
- Reimund, D. A., and F. Gale, "Structural Change in the U.S. Farm Sector 1974 to 1987: 13th Annual Family Farm Report to Congress," unpublished. USDA/ERS, 1991
- Reining, R. C., "Structural Change in U.S. Farm Land," USDA/ERS, Agricultural Economic Report No. 617 (1990)
- Reyes, C. M., "A Study of the Adoption of Modern Technology: An Agricultural Household Model for the Philippines," unpublished Ph.D. dissertation, University of Pennsylvania, 1990
- Rogers, D. M., "Leasing Farm Land in the United States," USDA/ERS, AGES Report No. 9159 (1991)
- Rosenzweig, M., "Rural Wages, Labor Supply and Land Reform: A Theoretical and Empirical Analysis," *American Economic Review*, 68:861-874 (1978)
- Rosenzweig, M. and K. Wolpin, "Specific Experience, Household Structure, and Intergenerational Transfers: Farm Family Land and Labor Relations in Developing Countries," *Quarterly Journal of Economics*, 100:961-987 (1985)
- Sommer, J.E., and F. K. Hines, "Diversity in U.S. Agriculture: A New Delineation by Farming Characteristics," USDA/ERS, AgEcon. Report No. 646 (1991)
- Wunderlich, G., "Trends in Ownership Transfers of Rural Land," USDA/ERS Agriculture Information Bulletin No. 601 (1990)
- Wunderlich, G., "Owning Farm Land in the United States," USDA/ERS Agriculture Information Bulletin No. 637 (1991)