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SOURCES OF RISK, INSTITUTIONS FOR SURVIVAL, AND A GAME AGAINST NATURE IN PREMODERN ICELAND

by

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I. Introduction

Random environmental factors, such as climatic disturbance or disease, often cause large variation in the outputs of poor agrarian communities which operate with low levels of technology. As lives may be at stake, traditional societies have a strong incentive to seek ways to reduce variability over time in their consumption, but high costs of transacting in these communities usually prevent or limit the use of insurance, credit and other intertemporal markets. Recent studies show, however, that traditional societies are able to stabilize their consumption and lower the cost of risk by relying on various non-market institutional arrangements and adjustments in production.[2] Newbery (1989) combines the economics of risk and the information-transaction costs perspective in a lucid survey of the theory of agricultural institutions for insurance and stabilization. Also using the transaction-cost framework, Binswanger and Rosenzweig (1986) lay out a general theory of economic institutions in traditional rural areas; Binswanger and Mclntire (1987) explore the structure of land-abundant tropical agriculture, and Binswanger, McIntire and Undry (1989) analyze institutions in semi-arid African agriculture. Bromley and Chavas (1989)

[1] I have received valuable help from a number of scholars, especially Doug Allen, Lee Alston, Kyle Kauffman, Lin Ostrom, Vincent Ostrom, and three anonymous referees for *Explorations in Economic History.* Presentations of various versions of the paper at the Economic History Workshop, and the Workshop in Political Theory and Policy Analysis both of Indiana University in Bloomington, at the Rational Choice Section of the 13th World Congress of Sociology, and at the Social Science History Workshop at Stanford University brought helpful suggestions. The paper owes a large debt to Icelandic historians, both the resourceful pioneers and a vigorous new generation of iconoclasts.

examine risk and transactions in semiarid tropics, and Fafchamps (1992) studies mutual insurance networks in preindustrial societies in terms of information and transaction problems. Townsend (1992; 1993) applies general equilibrium analysis and contract economics in an empirical and theoretical study of Asian village economies, and Cheung (1969, 1970) pioneered the study of agricultural contracts in terms of risk and transaction costs.

My purpose with this paper is contribute to the literature on risk management in agrarian societies by analyzing sub-arctic primitive farming in premodern Iceland. Premodern Iceland was at the margin of the habitable world; at times, especially in the 18th century, the community was close to extinction. The North Atlantic island was settled in the late 9th and early 10th century mainly by Norsemen, who raised livestock (eventually mostly sheep) and caught fish on the side (Johannesson, 1974). The technologies and methods of production, and the country's industrial organization did not change substantially for almost a millennium. Until sustained growth took off in the 19th century, the population is thought to have fluctuated around a size of 50.000 people.[3]

Premodern Iceland is of considerable interest for the economics of institutions and a potential testing ground for competing theories. Social organization in a small, homogeneous, and stationary community is relatively transparent, and one might expect that the harsh environment would weed out unrealistic ideologies and inappropriate policies. Actually, social science does not tell us unambiguously whether these features tend to select relatively efficient economic arrangements and lower the cost of distributional conflicts. Ostrom's (1990) study of local management of common pool resources, and Posner's (1980) study of institutions in primitive societies support the case for effective social solutions. Similarly, the literature on non-market risk management in traditional agrarian societies finds relatively efficient solutions in these institutional environments. Olson (1982), on the other hand, argues that special interest groups and negative-sum games thrive in stationary societies, and that social change undermines rent seeking. North

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[2] For an introduction to the literature on traditional systems of social security in developing countries, see the various contributions in Ahmad et al., eds. (1991). Also, see Janvry et al. (1991).

[3] Hastrup (1990) gives an account in English (from the viewpoint of an anthropologist) of Icelandic society during the period 1400-1800, and provides an extended bibliography. Gunnarsson's (1983) study of Danish monopoly trade in Iceland, 1602-1787 (in English) analyzes premodern Iceland in economic terms. For a history of the Commonwealth, see English translation of Jóhannesson (1974).

(1990, 1993) and Greif (1995, 1997) emphasize how, in various contexts, certain cultures are associated with mental models and shared systems of beliefs that support relatively imperfect institutions and make them endure. Relying in part on archeological evidence, McGovern (1981) provides a fascinating account of attempts by the Norse settlements on the west coast of Greenland (c. AD 985-1500) to maintain European lifestyles and stubbornly refuse to adjust fully to the arctic environment. The extinction of these communities still puzzles scholars.

Social organization in Iceland was shaped not only by the micropolitics of interest groups but also by the macropolitics of colonial authorities. For centuries premodern Iceland lingered under distant foreign rulers, who followed a policy of limited involvement and isolated the country from the rest of the world, which was a common colonial strategy.[4] Iceland lost its independence in 1262 and was ruled first from Norway and later from Denmark, until regaining independence in the 20th century. Limited Scandinavian engagement in the remote island, and the country's rich fishing grounds, which were known in Europe at least since the 15th century, invited incursions by fishers and traders of various nationalities. The Danish crown responded to these advances with rules that limited foreign contacts by Icelanders to merchants of a royal monopoly (1602-1787), and only during the summer months. The crown also joined with landed interests in restricting labor mobility and preventing urbanization, and, until the 19th century, these measures together preserved the traditional economy and blocked structural changes in the fisheries (Eggertsson, 1996)

Economic historians tend to agree that the Icelandic economy was stagnant and even on a declining path from the end of the Middle Ages till early in the 19th century (Gunnarsson, 1983; Magnússon, 1985; Jónsson, 1991). The main features of the country's decentralized social insurance system, which is the subject of this paper, apparently survived with few changes from the 13th century until the 19th century, although sources are limited for the early years (Gunnlaugsson, 1983).

Traditional farm societies reduce risks and provide social security both through general rules that directly assist actors who qualify under the rules, and more indirectly through the structure of private contracts, such as contracts for labor, land, and livestock. Institutions of social insurance

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[4] Gustafsson (1985) provides an account (in Swedish) of agency problems and limited engagement in Iceland by the Danish crown in the 1 8th century.

[6] For a survey of the economics of behavior under risk, see Hirshleifer and Riley (1992). Stiglitz (1989) discusses rational peasants, rural organization, and development economics.

also affect the distribution of wealth and the joint value of aggregate output, and they typically invite moral hazard and adverse selection, problems which can have serious economic consequences unless they are constrained. This essay, however, is concerned primarily with social security and welfare, and only considers distribution, production, and opportunism in the context of risk reduction.

The remainder of the study is divided into three major parts that examine for premodern Iceland:

(a) the sources of general and specific risks;

(b) the effects of various laws, regulations, contractual arrangements and informal social practices on specific and general risks, and possible side-effects of these arrangements;

(c) the proclivity of farmers to gamble with their supply of fodder (hay) and not keep sufficient reserves to feed the animals in the event of a hard year; a practice which reformers saw as serious institutional failure.

A final section concludes with thoughts about the storage puzzle and the overall effectiveness of the country's social insurance system.

II. General and Specific Risks in Traditional Societies

(a) Theory of general and specific risks

Random shocks, such as natural disasters, disease, climatic disturbance or even adverse market conditions, periodically strike all communities and affect output, which threatens to reduce consumption. In advanced industrial economies, intertemporal markets—including markets for insurance, credit, and futures—are the natural media for smoothing consumption, but in traditional farm societies two factors often hinder the emergence of these markets.[5] First, the risks faced by individual economic units frequently have high positive covariance, which removes much of the gain from pooling and sharing risks; and, second, in these settings high transaction costs of enforcing intertemporal market transactions often render the transactions impractical.

Weather-related risks, for instance, have a positive correlation when all economic units in a community belong to the same climatic zone, and risks of disease are correlated when proximity exposes human or animal populations simultaneously to infection from contagious diseases.

Correlation between risks faced by a set of actors often can be reduced by extending the geographic dispersion of the actors, but greater scope usually increases monitoring costs and acerbates transaction problems such as moral hazard (Binswanger and Rosenzweig, 1986). At the local level, repeated interactions and reputation effects, ties of kinship, and social norms of cooperation lower transaction costs, but in long-distance transactions these effects tend to be weaker, and also the tasks of measurement and enforcement becomes more complex (North, 1990; Ostrom et al., 1994). In traditional societies, therefore, unfavorable trade-off between covariance problems and transaction costs often rules out formal intertemporal markets. When insurance, credit, and futures markets are unworkable, rural communities rely on various non-market institutional arrangements and adjustments in production and consumption to reduce risks.

Not all local risks are covariate or *general risks.* Agrarian communities also face uncorrelated or *specific risks:* individual mishaps such as accidents, non-epidemic diseases, localized fires, or drowning of people and farm animals. The cost of specific risks can be reduced by pooling and sharing these risks within various local groups. One such group is the extended family, and the transaction-costs approach suggests that variations in risk environments may influence family size and structure (Rosenzweig, 1988; Rosenzweig and Wolpin; Pollak, 1985). Informal insurance schemes also may cover the labor force of a farm, the members of an agricultural village or a township, but these groups tend to be small because primitive measurement techniques and weak formal enforcement mechanisms usually confine social networks of reciprocal obligations to close-knit groups.

The nature and extent of general risk is related to general equilibrium properties of an economy.[6] Variations in real incomes involve both prices and quantities of outputs, and prices of inputs and consumption goods. By their choice of products, methods of production, and location, producers acting individually often can reduce their risks. Consider a community of farmers on an island, all operating in the same climatic zone and facing a high positive yield variance for their crop (Newbery, 1989). Although pooling their yield risks in the current activity would not help (even if transaction costs were low), the farmers possibly could reduce their risks by diversifying into new lines of production, for instance by reallocating some of their inputs to coastal fisheries. If the correlation between outcomes in the new and the old activity is less than 1, each farmer has reduced his overall risks, but probably at a cost. Diversification of effort can reduce expected

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[8] For instance, if the price elasticity of demand for cash crops is equal to -1, the gross nominal income of cultivators is unaffected by bad (or good) harvest (Newbery, 1989).

wealth because of losses from foregoing specialization, which implies that risk-neutral actors or actors in a risk-free world would avoid output-reducing diversification. If actors diversify in spite of expected reduction in wealth, their action can be interpreted as willingness to pay an implicit premium for more security. Risk averse economic units in traditional communities, therefore, sometimes self-insure by diversifying and shunning output-enhancing specialization.

(b) Sources of risks in premodern Iceland

Experts agree that "Iceland's climate is extraordinarily marginal with respect to agriculture. Its summers are barely warm enough or long enough for either natural herbage or cultivated grasses to provide fodder for livestock" (Bergthdrsson, 1987; 7). In this environment, which Vasey (1991; 344) characterizes as the limits of European farming, the Icelanders practiced sedentary pastoralism, raising sheep, cattle, and horses, but exploited the rich fisheries only as a part-time activity.[7] The homesteads, mostly operated by tenant farmers, spread out through coastal lowlands and valleys and as a rule did not form agricultural villages.[8] Higher grounds were used collectively for summer pastures, but further up, in the country's vast central region, the land was barren and of no value in farming.[9] In summer unsupervised sheep roamed the spacious mountain pastures and grazed home fields the remainder of the year.[10] In farming the main crop was hay, which was used primarily as feed for dairy animals.[11] Sheep (and horses) usually were fed hay only when snow and ice prevented grazing in the winter pastures. Hay reserves were

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[7] In Iceland the institutional environment and the choice set of economic actors changed remarkably little from the Commonwealth period (930-1262) until the structural changes of the 19th century, when entrepreneurs introduced decked sail vessels (and later trawlers), economic forces gradually eroded age-old constraints in the labor market, and a specialized fishing industry finally took off (Magnusson, 1985; Chapter 2).

[8] Thorvaldur Thoroddsen (1919, 1922), writing in Icelandic, is still the best source for the history of Icelandic agriculture.

[9] Eggertsson (1992) examines the history of property rights in the Icelandic mountain pastures.

[10] Historians believe that cattle raising was a relatively important aspect of Icelandic farming during the centuries immediately following the settlement in the late ninth century. Subsequently sheep became the farmers' chief concern.

limited which meant that sometimes in hard years a significant part of the livestock starved to death.

Loss of livestock was related closely to cold spells because drop in temperatures increased the livestock's feed requirements, reduced grass growth, and often kept ice and snow on the fields until late spring or early summer. Cold weather also affected the human population. Ogilvie (1981; 278), in a statistical study based on the Icelandic Annals and other written sources, concludes that famine and human death from hunger "almost always occurred during (or immediately after) cold spells."[12]

Because climatic fluctuations were the major source of widespread risks in Iceland's marginal farming (along with epidemics and volcanic eruptions), it is important to know whether climate divided the country, and its four regions, into more than one risk zones. The evidence is somewhat mixed. Ogilvie (1981; 291), drawing on qualitative historical data, concludes that in certain periods the climate was distinctly different in different regions," mild and severe years were regionally variable. Gunnarsson (1980a) argues that Iceland essentially consists of two ecological regions: the North and the East, and the South and the West. A leading authority on climate in Iceland states, however, that "climatic variations, especially longer-term changes in temperature, tend to affect the whole country at the same time, varying regionally only in terms of their magnitude" (Bergthórsson, 1987; 13). The North-East has lower temperature and greater variation in climate than does the South-West.[13] Twentieth century data reveal a strong positive

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[11] As of the 15th century, the Icelanders no longer grew any cereals.

[12] Ogilvie (1981) uses qualitative data from the Icelandic Annals and other sources for the period 1601-1780 to establish a statistical relationship between a short-term drop in temperature, on the one hand, and poor hay harvests and loss of people and farm animals, on the other hand. Bergthórsson (1985) provides indirect evidence by using 20th century data to estimate the impact of a drop in mean annual temperature on grass growth (in modern cultivated fields). Bergthórsson finds that a drop in temperature of 1 degree centigrade reduces grass growth by some 30%.

[13] Although short-term and long-term drop in temperatures often had disastrous consequences for premodern Iceland, warm ocean currents make the climate milder than the country's northerly location (between latitudes 63°23'N and 66°32'N) suggests.

correlation between fluctuations in temperatures in the country's four regions (Björnsson & Helgadottir, 1987; 50).

The study of institutional responses to risks is concerned not so much with (small) differences in average conditions between regions (which presumably adjust the organization of production and consumption to such differences), as with correlations over time between changes in outcomes between regions. For the purpose of analyzing risk management in farming, the present study assumes that in the Icelandic case uncorrelated regional variations in climate are not important.

The impact of climate also varied among farm districts in the same region, and among farms within the same district. Snow, for instance, collects more easily and stays longer in certain localities and on the fields of certain farms than elsewhere. Similarly, alternative thawing and freezing in spring (winter kill) can affect seriously the productivity of hay fields, and such very short-term fluctuations need not occur simultaneously throughout the country but vary even within districts. But the local impact of climate is not a random effect. Given the event, for instance, of a hard winter or spring for the whole country, a relatively severe impact is correlated with the geographic features of individual farms and districts, such as their altitude above sea level, and actors living in known high-risk locations have an incentive to adjust to their circumstances.

Although all studies find strong positive correlation between temperature and hay yield, there is only weak correlation between temperature and output in the part-time fisheries (Ogilvie, 1981). Farmers who diversified by entering the coastal fisheries lowered their risk. Fishing was pursued mostly in winter when the opportunity cost of releasing labor from farming was relatively low, but in winter the important cod fisheries were off the south and west coasts of the country. In summer the cod migrated north and east, but coastal fisheries did not develop on any scale in these regions. Although many farmers and farm laborers in the North-East left their homesteads in winter to fish in the South-West, the fisheries were far more important for the economy of the latter area.

In sum, because of the country's location, temperature fluctuations were the major source of general risks in premodern Iceland, along with volcanic eruptions and epidemics. Temperature fluctuations in the various regions have a positive correlation, but outcomes in farming and fishing were weakly correlated. Individuals, farmsteads, and small clusters of households also were exposed to specific risks—including illness, fires, floods, avalanches, and local weather conditions—that could be pooled.

HI. Institutions for Survival

(a) Social security provisions of the old law books

The social safety net that served the Icelandic community in the premodern era originates with the laws of the Commonwealth, which are collected in *Gragas* and probably first put in writing in the 11th or 12th century, although the oldest surviving manuscripts date from 1250-1280 when civil conflict already had destroyed the Icelandic experiment with private enforcement of law (Friedman, 1979; Miller, 1990). In 1262 the crown of Norway became the country's highest authority, and soon thereafter Magnús Hakonarson, King of Norway and Iceland, laid down a new legal code, which the Icelandic *Althing* (parliament) ratified in 1281. The new law book, known as *Jonsbok,* was modeled extensively on *Gragas* and served the Icelanders throughout the premodern era, as frequent attempts to revise the law failed.[14]

As is customary in traditional societies, people in premodern Iceland were responsible for the welfare of their relatives, and kin was defined broadly.[15] In the law, responsibility for supporting indigent kinsfolk depended on the closeness of the family relationship. If the poor had no close relatives capable of supporting them, the duty was passed to collaterals three and four remove, provided their wealth exceeded a certain minimum *(Jónsbók,* 1970; 101-102).

When family support failed, local governance units, some 160 communes, *hreppar,* became the centerpiece of the social safety net. The communes apparently emerged during the Commonwealth period to collect the tithe (introduced in 1096), to provide relief for the poor, and to control utilization of the common mountain pastures (Bjornsson, 1972). *Gragas* required at least 20 adjacent farms of taxpaying farmers as the minimum size for a *hreppur,* and in practice the

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[14] As late as in 1839 and 1841 the Danish crown, which then ruled Iceland, appointed committees to revise *Jónsbók,* but with no results. Substantial part of *Jonsbok's* agricultural law survived into the 20th century (Thoroddsen, 1990; 382-383). As Jonsbok increasingly became obsolete, Danish-Norwegian laws were informally introduced in certain areas, along with regulations and edicts emanating from Copenhagen. "All this caused much confusion, and by the 18th century rather few people knew what the prevailing laws of the land were" (Lârusson, 1958; 215, my translation).

[15] *Gragas* extended kinship to an individual's collaterals of fifth remove *(Gragas,* 1992; 82).

population usually ranged from about 100 to 500 individuals.[16] To limit free riding, everybody had to be a member of a commune, and the law imposed a fine on people who failed to show up at communal meetings.[17] In the early law, the communes were fairly autonomous self-governing bodies administered by members of a board selected by the farmers.

The typical household, *bu,* usually included a primary family, farm servants, and often poor relatives and indigent people that the local commune had assigned to the farm. According to both *Gragas* and *Jonsbok,* paupers without family support were assigned for specific periods of time to households in their commune, the length of stay in each location being proportional to the farmer's wealth. A 1305 amendment of Jonsbok lightened the burden of the rich: The number of days that farmers were required to house paupers was no longer a constant proportion of their wealth. Instead the "tax" became regressive and the marginal rate fell to zero when the wealth of a farmer reached a certain level *(Jonsbok,* 1970; 291).[18] A commune responded with a subsidy when households appeared to run into temporary difficulties, but split the family and divided the members among households in the community when the problems seemed unmanageable even in the long run.

In designing the social legislation, the old law books seem to recognize the role of incentives and the need to cope with information problems such as moral hazard. If a foster child reached maturity and left some wealth at the time of death, the law gave his or her assigned foster parents priority claim on the estate, so they might recover the expenses of the upbringing (but without interest). These privileges were not extended to an individual who for "for the sake of God," has volunteered to foster a child because "God would reward him" *(Jónsbók,* 1970; 105).

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[16] In the Census of 1703, the *hreppar* numbered 163, and the country's population was 50,358. Therefore the average population of a *hreppur* was some 309 persons, and about 80% of the *hreppar* had a population of 100-500 individuals. During the Commonwealth period, the *hreppar* probably numbered about 150 (Bjórnsson, 1972; 93, 126).

[17] *Grâgâs* gave people until noon to show up or else they were fined 3 merkur, which corresponds to about 70 meters of homespun woolen cloth *(vathmal)* of nearly 1 meter in width.

In dealing with damages caused by accidental fire on a homestead, *Gragas* (1992; 188-189) stipulates that members of the relevant commune must compensate the owner, but subject to the following provisions: (1) the insurance is limited to three major units of the homestead (plus a chapel, if it exists); (2) the compensation covers only half the damage; and (3) the same person can claim compensation at most three times. By the time of *Jónsbók,* tenancy had become the predominant arrangement, and the risk of fire damage was shifted partly onto tenants of damaged properties: *Jónsbók* divides the cost of accidental fires between tenant and landlord, with the tenant's share being two-thirds *(Jónsbók* 1970; 158).[19]

And, as a final example, *Gragas* guarded against moral hazard while providing insurance against pestilence in livestock. The law said that one-fourth of his stock of cattle must perish before an owner can seek compensation from the commune, and the compensation cannot exceed one half of the damages. The farmers of a commune were required to contribute no more than one percent of their wealth to compensate for lost livestock, which implies that compensation could amount to less than half the damage when loss of cattle was extensive *(Gragas,* 1992; 188).

(b) Preoccupation with opportunism

(i) Population control

The high-risk environment of premodern Iceland generated not only a comprehensive, decentralized social insurance system but also gave rise to preoccupation with moral hazard and adverse selection. Worries about cheating are evident already in the old law books, and an amendment of *Jónsbok* from 1305 is a draconian expression of this concern. The amendment deals with the possibility that poor people may run away to other districts and leave their children behind to be cared for by the local community. In these circumstances, "it is appropriate to arrest such a man and bring him back, in ropes if needed, and then tie the child onto his back and make him walk it out of the commune" *(Jonsbok,* 1970; 291, my translation).

As time passed, not only formal rules but various informal social norms evolved to cope

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[18] The cutoff point was at 200 hundreds, but a hundred was a unit of measurement that corresponds to 120 ells (an ell being 49 x 98 centimeters) of *vathmál* (homespun woolen cloth), or one mature cow, or six ewes.

with the perceived threat of opportunistic exploitation of the welfare system. The two most significant such institutional arrangements constrained population growth and obstructed occupational and industrial specialization in the country.

Population control in premodern Iceland attests to the power of informal social constraints. The farmers were concerned that, if left to their own devices, poor individuals, especially landless servants, would pile up children, live off welfare, and place heavy burdens on people of means. Despite concerns about excessive reproduction by the poor, the law never explicitly limited the right to marry to specific social categories, but instead the community relied on economic barriers to limit entry into farming, and on informal constraints which made the purchase or rental of a farmstead virtually a necessary condition for family life. Married servants generally could not find employment with the same farmer, and the number farms, remained relatively stable in postmodern period and put an approximate ceiling on the number of married couples.[20]

Informal institutions can have dramatic results: In the census of 1703, some 90 percent of all male heads of *bú*, but only 2 percent of male farm laborers, were married men or widowers. Gunnarsson (1983; 1980B), comparing demographic data for Iceland and Sweden, finds that the Icelandic population had surprising low marriage and birth rates. In 1703, for instance, some 44 percent of all Icelandic women 50 years and older had never been married (Gunnarsson, 1983; 16).[21] Illegitimacy was fairly low, and couples who had children out of wedlock often later married (Vasey, 1996; 377).

(ii) Restricting specialization

The underdevelopment of its fishing industry during the premodern period is an interesting aspect of the economic history of Iceland, because expansion of the fisheries was the most obvious escape from the country's abject poverty (Gunnarsson, 1983; Eggertsson, 1996). After centuries of stagnation, it eventually was an efficient, specialized, export-oriented fishing industry that late

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[19] Thoroddsen (1919; 34) reports that, during the calamities of the 18th century, landlords tried to place all the risk of fires and natural disasters on their tenants. A new law of 1884 again explicitly divided the responsibility between the two parties.

[20] Population pressures could lead to further subdivision of farmsteads, and, during long spells of warm climate, farming would invade inhospitable areas of the country but later withdraw when the climate reverted to its long-term trend.

in the 19th century became the engine of sustained economic growth.

From the 15th century onward, the Iceland fisheries drew fishers from various European countries, but the demonstration effect of latest fisheries technology did not stir Icelandic entrepreneurs. Ocean fishing by Icelanders was restricted to farmers and their servants, who relied on small open rowboats and operated, mostly in the winter, from beaches on the south and west coasts (Gunnarsson, 1983). pistorians have advanced two related arguments to explain why Iceland's elite strived to preserve the *status quo,* enforced institutional arrangements that tied labor to the land, and struggled against industrial specialization and urbanization. One of these explanations relates to the social security system, the other emphasizes access to cheap labor.

The idea that specialized fishers would free-ride on the social security system was based on the notion that the variance in output was greater in fisheries than in farming. Fears that specialized fishers would overload the welfare system is evident already in *Grdgds* (1992; 104), which forbids people to set up households with no livestock, unless the relevant commune explicitly agrees to insure their welfare. The inferior technology and primitive capital stock in Icelandic fishing partly explains why many Icelanders saw fisheries as an unreliable source of livelihood. The small open boats were not suited for winter storms in the North Atlantic, and operations were confined mostly to one-day excursions (Gunnarsson, 1983).[22] The development of a fleet of decked ships—which could fish all-year round, go further than a few miles from the coast, and follow migratory species—would have raised productivity and lowered risks in fishing.

There was another reason why the farm community supported institutions that tied labor to the land and restricted mobility: it was believed that these arrangements would hold down labor costs (Gunnarsson, 1983). In a free labor market, the relatively high productivity in the fisheries, even with primitive technology, would pull up wages in the low-productivity farming sector. Although these considerations ignore the effects of a burgeoning new sector on demand for farm products, the evidence clearly shows that landed interests were preoccupied with labor shortage and upward pressures on pay that were seen as originating in the fisheries (Thoroddsen, 1919; 1922).

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[21] Also see Gunnarsson (1980b).

[22] In spite of primitive technology, the fisheries made an important contribution to the Icelandic economy. Along with dairy products, fish was a key ingredient in the national diet and a vital export as far back as the 14th century. And many farmers diversified their activities and lowered their risks by combining farming and fishing.

These thoughts raise the question, why defection from the coalition of landowners and entry into a specialized fishing industry was not the dominant strategy of wealthy landowners, especially those with experience in the part-time fisheries.[23] Eggertsson (1996) argues that a viable fishing industry required cooperation with foreign actors, both for acquiring inputs and accessing export markets. The Danish crown prohibited all such cooperation and channeled trade with Iceland through a restrictive royal monopoly. Denmark cooperated with landed interests in Iceland to suppress specialized fisheries because the Danes feared losing their control over the country to other European powers, unless they prevented economic contacts between Icelanders and foreign interests outside the kingdom.[24] In the 19th century, when Denmark gradually introduced free international trade in Iceland, many actors defected, and the system of labor bondage collapsed while the relevant rules and regulations formally were still in effect. With free trade, Denmark gradually lost control over the country.

(c) Private contracts and risks

(i) Theory

In farming, as well as in other activities, the structure of contracts affects the distribution of risks between contracting parties (Cheung, 1969). Extensive literature has emerged which

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[23] In premodern Iceland, a number of wealthy people were potential defectors from the collusion of the landed class. Land was the major source of wealth and the distribution of land ownership was unequal. In the last years of the 17th century, private owners of land numbered about 1,200 and of these some 7 percent (84 owners) possessed 45 percent of all private land in terms of its value. At this time, about 52 percent of the land was privately owned, the church owned about 32 percent, and the Crown the remaining 16 percent (Lárusson, 1982; 38).

[24] Denmark followed a policy of limited engagement in Iceland and did not maintain a garrison there. Cooperation with the landed elite, who supplied most of the functionaries for the royal administration in the country, was an important aspect of Danish strategy during this period (Gustafsson, 1985).

explores risk attributes of alternative contractual arrangements.[25] The effects of basic contractual forms on the distribution of risks is well established.[26] In farm production, when risks involve both price and quantity of output, a fixed-wage contract leaves the risks with the entrepreneur, a fixed-rent contract places the risks with tenants, a share contract shares (usually, the output) risks, and a piece-rate contract divides the production risk but assigns the price risk to the entrepreneur.[27]

These results must be qualified in various ways. People employed on fixed-wage contracts, for instance, carry the risk that unforeseen events may render their employers insolvent and unable to pay wages. And contracts are not limited to the basic types: to meet particular needs, actors can use hybrid arrangements. Stiglitz (1974) shows how contracting parties are able to share their risks in any proportions they desire by combining fixed-rent contracts and wage contracts. In practice, the structure of contracts often is more complex than formal theory of basic types and hybrids implies, and they frequently include terms for protecting assets against wasteful use and destructive treatment of the assets involved (Cheung, 1970; Barzel, 1989).

(ii) Tenancy contracts

Already by the time of *Jónsbók* (1281), tenancy was prevalent in Icelandic agriculture, and its importance grew with time. Toward the end of the 17th century, 85 percent of all farmers

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[25] For surveys see Newbery (1975), Hart & Holstrom (1987), and Platteau & Nugent (1992). Some economists do not recognize contracts as instruments for affecting risks and explain the structure of contracts solely in terms of transaction costs. These economists argue that the concept of transaction costs, by itself, has a greater explanatory power than risk and transaction costs together. They further contend that classification of actors by their degree of risk aversion is *ad hoc* and without theoretical foundation (Barzel, 1989; Allen & Lueck, 1992).

[26] Platteau and Nugent (1992), in their Figure 1, rate four types of pure contracts (fixed-wage, piece-rate, fixed-rent, and share contracts) by their vulnerability to five types of shirking and by the division of production and price risks between the contracting parties.

[27] Fixed-wage contracts generally are not used in contracting between absentee landlords and cultivators, presumably because of high monitoring and enforcement costs when the cultivators are not residual claimants (Allen & Lueck 1992; 399). For similar reasons, the factory system usually has not worked well in farming.

owned no land at all, and some 96 percent of the farmers were tenants (Lárusson, 1967; 1982). The contracts predominantly were of the fixed -rent variety. If risk aversion is inversely related to wealth, which is the usual assumption, then risk considerations and the relative wealth of landlords and tenants suggest that the parties would avoid fixed-rent contracts. Three related considerations, however, may justify the choice of fixed-rent contracts: (1) transaction-costs dominated the choice of contracts; (2) the social structure provided alternative, low-cost institutions for coping with risk; and (3) the fixed-rent contracts were not rigidly fixed but could be adjusted informally to share the costs of large exogenous shocks. I already have outlined the country's commune-based social safety net that partly substituted for private insurance arrangements. I next present evidence of flexibility in fixed-rent contracts in Iceland, and then examine the issue of transaction costs.

Although pure fixed-rent contracts assign risks primarily to tenants, the literature cites cases from various parts of the world where landlords (informally) reduce the rent in times of severe exogenous shocks, thus sharing the risks with their tenants (Platteau, 1991; 129). Furthermore, if some calamity strikes a community, the demand for land will fall temporarily and market forces press for reduction in rent. In the Icelandic case, Teitsson (1973; 136) reports conclusive evidence of reduction in rents in response to the *Famine of the Mist* (1784-1785), which followed an immense volcanic eruption in the Laka Craters (1783) that seriously damaged vegetation in Iceland and, indeed, was felt in various ways around the globe. Generally, Teitsson (1973) finds that shocks which killed livestock caused greater reduction in rents than epidemics, such as smallpox, which spared the animals but devastated the elderly and the weak. The livestock was the tenants' critical asset, and usually the rent was paid in kind with yield from the animals. Similarly, Lárusson (1982; 25-36) in a careful study of the old land registers of the 17th and 18th centuries shows that reduction in rent (including livestock rent) often followed large shocks. Thoroddsen (1919; 1922), in his massive history of Icelandic agriculture, argues that the rent of land was responsive to economic forces, in spite of attempts by landlords to introduce floors for rent when the relative value of land declined.

Fixed-rent contracts invite excessive use of unpriced inputs by the cultivator, particularly of valuable qualities of the soil: the tenant has an incentive to overuse the land. Share contracts weaken the incentive to use unpriced inputs excessively, but now measurement of shared output becomes a problem for the landlord because the tenant has an incentive to underreport output (Allen & Lueck, 1992; 401-404).

In premodern Iceland it generally was costly for landowners to monitor their tenants.[28] The country was sparsely populated with a difficult terrain (although forests did not limit travel) and poor communications.[29] The farmsteads were scattered, and landowners often held property in several districts. Excessive use and abuse of inputs, however, is a lesser issue in farming which primarily emphasizes grazing and hay making than in more complex form of agriculture and cultivation, although overgrazing can become a serious concern. The exclusive use of fixed-rent contracts is consistent with theoretical and empirical findings by Allen & Lueck (1992; 402) which show that (in the U.S. Midwest) land leased for pasture is cash rented. In the Icelandic case, the law also helped lower the cost of monitoring. The communes not only supervised use of the shared mountain pastures and controlled free riding (Eggertsson 1992), but also provided assessors to evaluate the status of the property each time a farmstead was passed from one tenant to another. The assessors determined whether outgoing tenants should compensate for excessive depreciation of the farm assets (Thoroddsen, 1919; 34).[30]

(ii) Livestock contracts

In Iceland most farmers rented not only the land but also some of their livestock. The problem of input-distortion costs (excessive use of input) appears to be particularly great in livestock tenancy, unless special circumstances lower the cost of protecting the animals (Newbery,

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In their empirical study of land contracts in the American Midwest of our times, Allen & Lueck (1992; 399) report that, "Landowners seldom monitor farmers and even then in the most casual fashion — directly measuring farmer efforts is unheard of."

[29] Iceland is 103 thousand km in area.

[30] Public assessment of farmsteads, when the tenants left, apparently was an old practice that later was given up, until a law of 1884 reintroduced it. Toward the end of the premodern period, owners and tenants did not maintain the capital stock. For instance, the failure of the farm community to keep up fences, which gradually deteriorated and nearly disappeared, is one of the puzzles in the economic history of the country. At the time, expert commentators, both domestic and foreign claimed that lack of fencing severely reduced output. The solution of this and other comparable riddles is left for future work.

1975; 115-120; Binswanger & McIntire 1987; 80-81; Binswanger & Rosenzweig, 1986).[31]

Livestock tenancy has a long history in Iceland. In the beginning, tenants apparently were not required to rent livestock from their landlords, but gradually many landowners tied the provision of land and livestock. Thoroddsen (1919; 49) reports that contracts tying land and livestock may have become common toward the 15th century. A land register compiled at the beginning of the 18th century lists about one-third of the livestock in the country as leased.[32]

In livestock tenancy, just as in land rentals, fixed-rent contracts predominated, but various formal and informal provisions made landlord and tenant share certain risks that with relative ease could be distinguished from moral hazard. Traditionally the owners of livestock carried the risks of animals dying from pests, from giving birth, or from attracting lightning, and usually the tenants bore all other risks, particularly the important climate-related risks *(Jonsbok,* 1970; 225). Good care can cushion the impact of adverse climate on livestock, and often it is difficult for owners to distinguish pure climatic effects from moral hazard, which suggests that it may be efficient to let those who care for the animals, rather than absentee owners, carry climate-related risks.

Although landlords were responsible for certain risks in livestock contracts, events often overwhelmed them. In 1762 Iceland's sheep population was struck by an infectious disease that was brought under control only in 1779. The authorities attempted to limit the spread of the disease by slaughtering all sheep in whole districts, and in all some 280,000 animals perished (Thoroddsen, 1919; 401). The owners refused to carry the cost of the disease, as the law required them to do, and the tenants appealed to the Danish authorities, and they settled the dispute by

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[31] Transaction-costs economics suggest that joint renting of land and livestock may economize on monitoring and enforcement costs, if there are economies of scale in supervision (Alston and Higgs, 1982).

[32] Lárusson (1961; 62), cited in Teitsson (1973). Butter was a popular means of paying the livestock rent and generally an important medium of exchange in domestic transactions. For instance, at the beginning of the 19th century, Danish military officers that surveyed the Icelandic coastline paid their way in butter. Wealthy landowners, such as the two bishoprics, owned vast quantities of butter, which were piled up like bars of gold in special storerooms, a

dividing the burden between the two sides.[33] In the 19th century, another sheep epidemic gave rise to similar disputes between owners and tenants, and, in general, enforcement of livestock contracts was a continuous source of dispute between the two sides (Larusson, 1982; 28).

Fixed-rent contracts in livestock possibly provoked the tenants to take unreasonable risks with their borrowed capital. The gamble involves seeking quick wealth and independence by maximizing the size of the flock in years of mild climate, but not store enough fodder to carry the animals through future cold spells. A sequence of good years, then, would yield a large flock, but an event of one or more hard years would starve and kill the animals. In this game, the owners do not share the benefits, but carry much of the risk because poor tenants often are unable to fully compensate large losses.[34] Section IV takes up the issue of limited storage of fodder and frequent starvation of farm animals in Iceland.

(Hi) Linked labor contracts

In traditional farming, the productivity of farm workers varies over the agricultural cycle, and with specific and general events, such as personal illness and changes in climate. Traditional households often are able to smooth their consumption by storing food (and other essential commodities, including inputs). Unskilled workers, who possess few assets other than labor power, may find that contracting with their employers often is the least-cost method of providing storage. In many rural areas, therefore, long-term labor contracts are *linked* or *tied contracts* whereby labor power is exchanged in return for a payment that links basic remuneration with credit and social security (Bardhan, 1983; 1989A). In an arrangement resembling futures contracts, the laborers commit labor services at a predetermined price over the agricultural cycle

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sight that startled foreign observers. Butter was an important supplement to dried fish, which was an important stable in the Icelandic diet (Thoroddsen, 1919; 56-58).

[33] Gustafsson (1985; Chapter 6) analyzes the dispute and its resolution.

[34] The economics of contracting in Icelandic farming has not been analyzed in any detail, but scholars have noted that the rental rate for livestock was higher than the rate for land, often twice as high or more (Teitsson, 1973; 134; Magnússon, 1985 ; 32). No carefully reasoned economic explanation of this differential exists, although historians often accuse the landlords of profiteering. The high rate in livestock rentals may reflect a relatively large risk premium or, alternatively, different methods for evaluating the capital base for land and livestock.

(or longer), including the peak season(s) when the farmers fear labor shortages (Newbery, 1989), In return, the laborers receive a flow of income/consumption which is relatively unaffected by the agricultural cycle and exogenous shocks (to the extent that employers can cope with these shocks). The workers often receive the bulk of their pay in kind and are rewarded with food, housing, and clothing, even when they temporarily are disabled by illness or accidents.

The literature rationalizes linked labor contracts in terms of transaction costs: In traditional farm communities, it is often less costly for actors to link contracts and combine transactions than to specialize and negotiate several contacts for credit, peak-season labor, support during illness, and so on. Farmers often can monitor and control the behavior of their servants at less cost than specialized providers of credit and social security are able to do. Besides, agricultural labor contracts sometimes are reinforced by paternalism, which creates strong bonds between the two sides and further lowers monitoring and turnover costs (Alston & Ferrie, 1993; Platteau, 1991).

In premodern Iceland, tied or linked labor contracts literally were mandatory for the landless. The general thrust of labor legislation in this period sought to tie every laborer to a specific household in a one-year renewable contract (Gunnarsson 1983; Magnúsown, 1985; Chapter 2). Although casual and seasonal labor always existed, it played a small role in the economy, and for a time (1783-1863) the law explicitly forbid wage labor but did not fully uproot it. When wage labor was not forbidden, the law discouraged it by allowing only people with considerable wealth to be casual workers.[35] In the census of 1703, casual laborers numbered 371, while servants on long-term contracts were 8,953 (Gĭsli Gunnarsson, 1987; 33; Thoroddsen, 1922).

In long-term labor contracts, large share (some 80-90 percent) of the payment received by male laborers was food, clothing and housing, while female farm workers typically only received food, housing, and clothing (Gunnarsson, 1983; 23). The farm households knew how to store food, and there is ample evidence that food was stored systematically (Thoroddsen, 1919, 1922). The flow of essential consumption remained relatively stable through the year, although the

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[35] The law made entry into casual labor more difficult than entry into farming Gunnarsson, 1983; 21). The minimum-wealth requirement for farmers was equal to three cows but wage laborers had to be worth at least ten cows. Casual workers typically divided their time between fishing for farmers in the South and West during the winter season and working on farms where labor was needed during the hay-making season.

workers' marginal product varied.[36] The farmers could not dismiss their servants within the contract period even when their labor no longer was needed and sick workers could not be dismissed. Finally, workers who stayed for a long time with the same employer became permanent members of the household. A law of 1722 assigned lifetime tenure to servants who had been 15 years with the same employer.[37] Linked labor contracts, therefore, provided men and women of limited wealth with some insurance against both specific and general risks.

Premodern Iceland was unusual for its relatively large servant population (Gunnarsson, 1983; 22). Even poor tenants employed men and women laborers at considerable risk to themselves. To create more flexible households, which could expand and contract with their fluctuating fortunes, the farmers sent their children early away from home to work on other farms. The children often were replaced by hired servants on a one-year contract.[38]

IV. A Game Against Nature: Provision of Fodder

[36] In the slack season (winter), some farmers, however, sent their employees away to the fishing stations of the South and West. The servants often received no extra payment for these dangerous missions, but the farmers collected the servants' share in the catch. In the fisheries, share contracts were the rule (Thoroddsen, 1922; 325).

[37] The law required employers to care for workers of long standing as long as they lived, but allowed farmers get rid of servants that suffered from leprosy (Thoroddsen, 1922; 325).

[38] See Pinson (1992), who has studied the evolution of rural households in an Icelandic commune *[Hólahreppur],* 1703-1974.

[39] High cost made it impractical to import grain and establish central granaries for storing emergency fodder. Even at the beginning of the twentieth century, Bjarnason (1909; 182) reports that transportation costs would add a margin of about one-third to one-half to the foreign price of grain. Similarly, because of transportation and transaction costs, the farmers received only about one-half of the world market price of their products. In spite of high costs, four small granaries were set up in Iceland late in the 19th century and early in the 20th century, but expenses were covered partly by relief donations and by the Treasury (Thoroddsen,

In the premodern period, Icelandic farmers played a dangerous game against nature with their livestock, or so it has been claimed. In this section, I first provide evidence of wide fluctuations in livestock size that were correlated with variations in climate. I then briefly report how in previous centuries many expert observers saw periodic starvation of animals as major institutional failure, but all attempts to stabilize the fluctuations through institutional reforms failed. Finally, I discuss whether side-effects of the social insurance system were responsible for the farmers' high-risk strategy. My purpose here is to draw attention the storage issue and offer tentative explanations, which hopefully will inspire future research. Although scholars still benefit from Thoroddsen's massive study (1919; 1922), relatively little is known about the economic history of Icelandic farming. The tools of modern social science barely have touched the field, important questions remain unanswered, and published material is limited and often unreliable.

(i) Background

In her study of the impact of climate on Icelandic society in the period 1601-1780, Ogilvie (1981) uses qualitative variables to establish a statistical relationship between short-term decrease in temperature (often associated with arrival of drift ice from Greenland), poor hay harvest, loss of animals, and high human death rates. In summer, low temperature held back the output of vegetation, and in winter and spring it restricted grazing with a cover of ice and snow.

Icelandic farming was based on grazing, in the mountain pastures in summer and on home fields in winter. The hay crop was limited and reserved mostly for dairy animals and for emergencies when climatic conditions excluded grazing. In addition, many farmers on coastal properties grazed their flocks on seaweed, but other fodder such as corn was not available in the country, and there was no central storage of fodder.[39]

1919; 364-365; Bjarnason, 1912; 270-271).

In Icelandic farming, critical decisions were made in the fall when the animals were rounded up and brought back from the distant mountain pastures, and when foreign merchants purchased meat, skins and woolens (along with the important fish products). This also was the season when farmers knew how successful their hay making had been. In winter, the export market was closed and poor communications limited exchange in the domestic inter-farm market where fish and farm products were exchanged. The fall, therefore, was the appropriate time to plan for the contingencies of a sub-arctic winter.

One decision, which the farmers had to make, was whether to insure against relatively hard winters by storing hay and trimming their flocks, or avoid the cost but risk losing the animals. The evidence suggests that the farm community leaned toward the high-risk alternative. Available sources show that decline in temperatures and hard winters brought massive losses of animals, even early in the 20th century. The Annals for the years 1601-1780 and Ogilvie's (1981) statistical analysis show this clearly, and more recent quantitative data tell the same story. Bjarnason (1913; 182-193) estimates damage to livestock due to lack of fodder in the 19th century and early 20th century, using various rules of thumb to piece together information from several sources.[40] The raw figures show that a cold spell in 1800-1802 was associated with a reduction in the sheep population of about three-fifths (some 171,000 animals), and in the cold spell of 1881-1883 the loss was 187,000 sheep. For the period 1881-1908, Bjarnason (1913; 187) estimates total losses due lack of fodder as equivalent to 884,000 sheep or about 13 sheep on average for each person in the farm community. The estimate is comprehensive and incorporates not only loss of grown sheep, but also loss of lambs (not included in the official time series), loss of quality in survivors, and loss of horses.

The evidence, that the farm community was not prepared for hard winters is overwhelming, although lack of data prevents precise calculations of costs and benefits. Annual figures for livestock go back to 1703, but in the early years the series is discontinuous, and the data are unreliable, partly because the farmers had an incentive to underreport their livestock to avoid taxes *(Statistical Abstract of Iceland* (1984); 68-69). Thoroddsen (1919; 295) provides evidence that the farm community underreported their livestock. In the winter of 1903-1904, all sheep in Iceland were bathed for veterinary purposes. Although the official registry shows a total number

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[40] Bjarnason (1913) adjusts his time series of livestock size for epidemics, large-scale slaughter to contain epidemics, and for factors such as the sale of live animals to England, which was common in the years 1865-1880.

of 502,000 sheep for the country in the fall of 1903, veterinary registers reveal that about 658,000 sheep were bathed. In the fall of 1904, the official figure was back to 534,000 heads.

(ii) The debate and reform attempts

For centuries reformers and administrators saw limited storage of fodder and periodic starvation of farm animals as a clear sign of serious institutional failure and often recommended stringent regulations.[41] Thoroddsen (1919; 357) identifies Páll Vfdalfn (1667-1727) as the first person in Iceland to express in writing recommendations for public regulation of the size of livestock in relation to hay supplies.[42] In the last part of the 18th century, the virtual collapse of the economy intensified the debate over the storage issue. The Royal Commission (*Landsnefndin fyrri) 1110-1711,* which was appointed to find solutions to the country's economic ills, recommended public control of livestock size; punishment for farmers if their flocks exceeded prescribed numbers; and central stores of hay managed by commune leaders (Thoroddsen, 1919; 358).

When in 1874 Denmark granted the Icelandic assembly, *Althing,* the right to pass laws, bills proposing measures to control the farmers' dangerous game against nature soon were entered and debated in the legislature, which passed several laws dealing with provision of fodder and prudent management of livestock. The first such legislation, called the *Starvation Act,* was enacted in 1884 and instructed communal authorities to ensure that, in their districts, farmers would not enter the winter season with larger livestock than they reasonably could feed in a hard year. The law subjected farmers to fines if they ignored recommendations by the communal authorities and starved their animals (Stjdrnartithindi 1884 (A); 20). The *Starvation Act* was unpopular with the

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[41] In fact, the storage problem spans the entire economy history of Iceland, and even helped give the country its name. According to the Sagas, Raven-Flóki, one of the first Norsemen to settle in Iceland (probably in the 9th century), neglected to make hay for his animals. Raven-Flóki returned to Norway because his livestock perished during the first winter in the new country, which he named Iceland.

[42] The Danish king had in 1702 given Vidalin and Árni Magnusson the task of describing and registering all property (including rental terms) in Iceland and making recommendations for economic reforms. Vidalin not only recommended regulations for livestock but also called for strict punishment of farmers who ignore orders to downsize their flocks.

farm community, and historians agree that the legislation was ignored by farmers and local enforcement officials alike, although in 1889 a revision of the 1984 law provided for the imprisonment of offenders in extreme cases (Stjórnartíthindi 1989(A); 18-21); Thoroddsen, 1919; 362; Jóhannesson 1948; 107-108). Resistance to regulation of livestock size was not new to this period, earlier edicts of the crown apparently also were ignored thoroughly. For instance, little attention was paid to a royal decree of 1746, in which the king instructed local authorities to monitor hay supplies in the fall to determine whether each farmer had enough fodder to carry the livestock through the winter (Thoroddsen 1919; 357).

(iii) The logic of **the** game

Assuming that they aimed for greater output and more security, I can think of three explanations for the general refusal of Icelandic farmers to trim their livestock and store enough hay to meet the demands of hard years:

(1) The high-risk strategy was optimal for the community;

(2) The strategy of long-term storage and stable livestock size (the storage or low-risk strategy) was a superior alternative, but only if supported by appropriate institutions. These institutions were lacking because of political (collective action) failure to enact and enforce appropriate regulations. Generally, political failure is attributable to transaction costs and also to concern with power and distribution;

(3) The high risk strategy was an inferior alternative, but bounded rationality locked the farmers in their traditional approaches and made them unable to see how storage and management of livestock size could improve their welfare.

Finally, it is possible to elaborate explanation (1) and contrast partial and global analysis of the two strategies. The low-risk strategy may be optimal in a partial analysis of farm production, but sub-optimal in a general analysis of the social system, because the institutions of storage interfere with other parts of the system. Undesirable side-effects of the storage strategy might, for instance, undermine a decentralized provision of social security, and, at least in theory, make the high-risk strategy globally optimal. Therefore, the three proposition above can be restated in the following manner: If the storage strategy was optimal in a partial analysis of farm production, failure to adopt it was due to one or more of three factors: undesirable global side-effects, failure of collective action, or bounded rationality.

Not all recommendation by storage advocates were sound economic propositions. The Royal Commission 1770-1771 recommended central storage facilities which is an inferior solution to decentralized storage, if we make the reasonable assumption that there were no important

economies of scale in central storage (Thoroddsen 1919; 358). Although possibly there were some economies of scale in building barns, high transportation and transaction costs of a centralized system would outweigh such advantages. These costs would be high whether each farmer contributed to a central storehouse or a central authority contracted with individual farmers to specialize in making and storing hay for the community (Bjarnason 1912; 265-270). Decentralized storage appears to involve lower costs than centralized arrangements.

Long-term storage would not be a serious alternative, if hay rapidly lost its nutritional qualities. I discount this possibility, partly because empirical evidence shows that a small number of Icelandic farmers successfully practiced long-term storage, and because storage was advocated by educated people thoroughly familiar with Icelandic farming. Torfi Bjarnason (1912; 269), an agronomist educated in Scotland, a farmer, and the founder of the country's first agricultural school (in 1880), states that the rate of depreciation of nutritional value in hay is relative slow in the first two or three years, if the hay is properly prepared and stored. Once five or more years have passed, the nutritional value drops substantially. Hay supplies, therefore, must be cycled regularly, which further increases the cost of centralized storage relative to decentralized storage. Bjarnason (1909; 1912; 1913) wrote a series of essays advocating long-term, decentralized storage.

Even though long-term storage of hay is technically feasible, the flow of costs and benefits may rule out storage as a sound economic proposition. Consider the option of decentralized storage for an individual. In the absence of reliable figures on prices, opportunity cost, expectations about climate changes, and individual circumstances consider the following hypothetical example. Let's assume that a our farmer assigns the probability of .1 to the event that next winter and spring will be relatively hard, and, to simplify, also assume that the farmer's decision horizon is only one period and that the climate either is hard or mild. In a mild year, make the payoff from cautionary strategy A equal to 5, and the payoff from risky strategy B equal to 6, and then reverse the relative outcomes in a hard year, with A yielding 4 and B yielding 1. If our representative farmer is risk neutral, the expected value of strategy A is (5 x .9) + (4 x .1) = 4.9, and the value of strategy B is (6 x .9) + (1 x .1) = 5.5. In this example, the high risk strategy gives more value (or utility). The calculations, of course, can be extended to cover several periods, and various assumptions can made concerning the effects of hard years on the net earnings stream, attitudes toward risk, and expectations about variations in climate, including the probability of two or more bad years in a row.

Although different assumptions obviously would reverse the ranking of strategies A and B, the fact remains that the farmers ranked B>A. I will present evidence which shows that the institutional environment in Iceland biased decisions in the farm community toward B. I also

speculate why this was so, but I am not able to calculate counterfactual outcomes for strategies A and B. My argument centers on weak ownerships rights in hay reserves.

In the traditional Icelandic institutional environment, farmers who selected low-risk strategy A, were likely to find themselves burdened with the cost of storage but deprived of the benefits of reserves in a hard year. Already *Jonsbok* from 1281 (1970; 139-140) attenuates property rights in hay reserves by requiring farmers to sell surplus hay to their neighbors on demand.[43] According to the law, farmers who were short of hay could request public search for surplus hay in their general area, both in their own and neighboring communes. Appointed agents then would estimate whether individual farmers in the area had stored more fodder than they required for the winter. Surplus hay was to be sold and first offered to farmers in the same commune as the source. The law prescribed severe punishment for those who followed strategy A and refused to comply with the redistribution scheme: their reserves should be confiscated and the offenders also receive a fine. The law permitted use of force to remove surplus hay, and farmers who received injuries while defending their surplus could not claim compensation, but the crown would decide in each case whether compensation was justified, if those resisting were killed. The law created an incentive for people to expose stubborn neighbors who hid their reserves. If the neighbors refused to trade, those who first requested the hay could buy it at half price and also receive one half of the fine.

The law from 1281, by undermining property rights in surplus hay, technically outlaws strategy A, and in doing so the law emphasizes the ethics of mutual help, which was the central tenet of the country's decentralized system of social security. It is not clear whether the authorities rigorously enforced the law for all the 525 years of its existence, or until royal decree abolished it in 1806. However, if the law was credible initially, a rational farmer would not store surplus hay on any scale, and few if any enforced sales of hay would arise. With time, it is also likely that the idea of limited private property rights in hay reserves became a social norm. Strategy A did not emerge in 1806 when the law from 1281 was abolished, which may reflect the strength of informal institutions (or the general economic advantage of strategy B). The evidence suggests that in the 19th century informal institutions continued to undermine exclusive property rights in surplus hay. In those years, it was not uncommon for farmers who suffered some mishap to buy hay from their neighbors. In this particular type of exchange, late or no payment was considered a relatively mild

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[43] The law that introduced the tithe in 1096 had already created disincentives for long-term storage by taxing hay reserves if they were more than one year old.

offense and did not cause serious loss of reputation—as would, for instance, breach of contract in the purchase of sheep or horses (Thoroddsen 1919; 356-357. Bjarnason 1913; 201-204).

V. Conclusion

i. **The** storage **puzzle**

The main counterfactual puzzle of our story concerns the likely behavior of Icelandic farmers in an institutional environment of secure property rights in hay reserves. The answer depends in part on how the farmers formed expectations about future fluctuations in climate.[44] If the farmers, for instance, formed their expectations adaptively using the experience of previous 20 or 40 years, their outlook and calculations could vary greatly with location in time, because of the irregular occurrence of exceptionally hard winters. In hindsight, farmers who set up *bú* shortly before the cold spells at the beginning or the end of the 19th century, obviously would have benefited more from the low-risk strategy than those who farmed during long stretches of relatively mild climate.

Even if individual exclusive rights in hay reserves would not have persuaded the farmers at any time to adopt the storage strategy, the country's highest authorities might have found it in their interest to promote reforms that significantly lowered the probability of hunger-induced death of farm animals and ensuing social problems. Of course, the authorities would not favor such measures unless they were practical at reasonable cost, and, therefore, it is important look for empirical evidence of small scale experiments which show that the low-risk strategy was capable of stabilizing livestock fluctuations.

Bjarnason (1913; 201-4) reports attempts at coordinated livestock planning in a couple of communes in the 19th century. The experiment did not involve coercion, but two or three times a year appointed local inspectors visited all farms in the commune and advised the farmers how to plan their fodder requirements. In one instance, the performance of all the farmers was rated and made public, and those who took exceptionally good care of their animals received special recognition. Bjarnason reports that one of these communes survived the notorious winters of

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[44] The farmers' response to secure property rights in hay also would depend on what happened in other parts of the system— whether, for instance, the structure of livestock tenure

1881-83 with all the livestock unharmed, whereas in the country as a whole a substantial share of the animals starved to death. Bjarnason (1913) also notes that the experiments seemed to depend on mostly volunteer work by skillful inspectors, and the arrangement was abandoned when good inspectors no longer were available. Further, the storage strategy did not catch on in nearby districts. Bjarnason also reports (1913; 198) that regulations required unanimous agreement of all farmers in a commune before public funds could be used for livestock planning, which obviously increase the cost of introducing strategy A.

If strategy A was practical, the prevalence of high-risk strategy B cannot be attributed lack of interest or collective action problems in the higher reaches of the country's government. I have reported how central authorities for centuries tried to impose the low-risk strategy on the farmers, and how all such attempts failed at the local level. In the 20th century, when the Icelanders finally managed to set up institutional arrangements to stabilize livestock fluctuations, the initiative did not come from local organizations but from the national legislature, the central government, and a new national association of farmers. Furthermore, the program relied on substantial financial support from the central government (Bjornsson, 1979; 277-278; Johannesson; 107-114).[45]

In sum, my data do not permit a conclusive answer to the storage puzzle, but certain facts are reasonably well established:

(1) Higher authorities in Iceland and Denmark, which periodically faced severe crises caused by lack of fodder, typically favored some version of the storage strategy.

(2) The country's institutional environment emphasized sharing within extended families and local governance units, including sharing of surplus hay, as a means of coping with risks. Uncertain individual ownership rights in surplus hay obviously undermined the storage strategy, at least to some extent.

(3) In a technical sense, the farm community was capable of successfully carrying out the low-risk strategy and more or less stabilize livestock fluctuations.

(4) It is obvious that most farmers and local communes favored the high-risk strategy and ignored attempts to impose storage from the top down.

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and social insurance would be modified to increase the attractiveness of strategy A.

[45] In the 20th century, various developments had made the solution easier than in previous centuries, particularly improved communications, large increase in the hay-making and storage capacity of farmers, the availability of fishmeal as fodder from the country's new fishing industry, and imported supplies, which now were available on short notice.

What is not clear, is the motivation of tenants and landowners in rejecting the low-risk strategy. Did their behavior reflect ingrained social norms of sharing and uncertain exclusive rights? Did the actors calculate that, even with secure exclusive rights in reserves, the high risk strategy gave highest expected value? Or did the appeal of the high-risk strategy reflect bounded rationality and peculiarities of behavior under uncertainty? Although I intuitively favor the first of these explanations, I am not able to resolve the matter here.[46]

ii. **The** system as a whole

The economy of premodern Iceland was notoriously inflexible: Industrial organization was rigid with strict controls on labor mobility, economic opportunities offered by the fisheries were only partly recognized, technologies were stationary, investments in improvements rare, and, consequently, until the 19th century, the economy was unable to support a growing population. It is in this context that I have tried to evaluate the country's system of social security: How well did the institutional arrangements succeed in protecting the needy in this environment of stagnation? The point of view is similar to Platteau's (1991) examination of social security and hunger insurance in Third World village societies. The essay also has considered whether the social security system contributed to the country's serious economic sclerosis.

My answer to the latter question has been a qualified yes. Restrictions on labor mobility, which at least in part were reactions to a perceived problem of welfare opportunism, helped freeze the country's industrial organization. Laws and norms of sharing seem to have contributed to a high risk strategy in storing of fodder, which prevented the community from protecting livestock against periodic spells of cold weather that often killed a large share of the animals.

Within narrow confines, the social security system was successful: the institutions did cope relatively well with specific risks and smallish general risks, but major shocks, such as large volcanic eruptions or sequences of hard years, overwhelmed the informal insurance system, much as Platteau (1991) reports for his Third World villages. The policy of tying all individuals to a specific household was only partly successful. Large shocks could uproot whole communities, and

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[46] Gunnarsson (1987; 118-119) argues that it was economically rational for the farmers to follow the high-risk strategy, but does not discuss uncertain property rights in hay reserves in this context. Thoroddsen seems to favor the bounded rationality explanation and refers "to the nation being overtaken by spiritual lethargy already in the fourteenth century and languishing in stupor for three or four centuries" (1 992; 373, my translation).

because of the system's decentralized nature, many individuals, who could not rely on family support, had little choice but become drifters that roamed the countryside and caused distress in the farming community.[47]

Gragas treated vagrant beggars harshly, forbidding people to feed them, and allowed drifters to be castrated "even though it may cause disability or death *(Gragas,* 1992; 108, my translation). *Jónsbók* was more lenient toward the homeless and required farmers to feed and house drifters for one night and help them travel to their next destination. Farmers who indirectly caused the death of vagrants, by either refusing to house them or by depositing them in desolate places, had to pay full compensation to the families of the deceased *(Jonsbok,* 1970, 107-108).

People who were assigned to a specific household fared relatively well, especially servants. The evidence shows that farmers generally honored their contracts to share their food with unrelated household members, both their laborers and the poor assigned to them. Although the insurance system functioned rather well in this regard, in times of serious crises farmers were known to treat (often elderly) paupers unequally.[48] A recent study by Vasey (1991) supports this contention. Vasey examines in detail the demographics of the *Famine of the Mist,* 1784-85, using data from parish registers, civilian and church censuses and other sources.[49] Some 24 percent of the country's population perished in the famine, which nevertheless was only the second worst mortality crisis of the 18th century, as more people died in the smallpox epidemic of 1707-1709 (Vasey, 1991; 344, 346).[50] Using records of 12 parishes from all four regions of the country,

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[47] Thoroddsen (1922; 322) reports that in 1751 a clergyman from an eastern district, along with his parishioners, roamed begging through the countryside. For more on vagrancy in premodern Iceland, see Thoroddsen (1922; 265-372).

[48] Thoroddsen (1922; 332, my translation) supports this contention by referring to an old Icelandic adage: "the paupers still look fit, the times cannot be so bad."

[49] The famine is associated with volcanic eruption in the Laka Craters, which began in June 1783 and lasted into February 1784.

[50] "This [the excess-death rate in 1784-1785] is nearly double most estimates of mortality from the Irish potato famine and comparable to some famines in seventeenth century Beauvais, France, that are thought to be among the worst local manifestations of famine in early modern Europe" (Vasey, 1991; 344). The 18th century was Iceland's worst. In addition to the catastrophes of 1707-1709 and 1784-1785, one in nine Icelanders perished in the famine of 1756-1757 (Thorsteinsson & Jonsson, 1991; 239).

Vasey was able to compare mortality rates of four social groups in each household: kin, adopted children, persons on public or private assistance, and servants. Vasey concludes that

> one is impressed by the degree to which hardship and the risk of mortality were shared within households [during the 1784-1785 crisis]. [In parishes] where mortality was high [on average], persons on assistance and possibly servants were at high risk. Surprisingly, except for elderly persons on assistance, records show that no status category was at significantly greater risk than any other in parishes where excess mortality was comparatively low or moderate (Vasey, 1991; 349).

As one would expect, Vasey's (1991; 340-343) shows that the social insurance system was under stress in parishes where mortality was high. Still, only survival rates for servants in the 30-39 age interval were statistically different from the rates for kin. Adoptees did no worse than kin, but people on assistance were relatively vulnerable in high mortality districts.

Although the decentralized system of hunger insurance cushioned the impact of major shocks, it could not prevent disastrous outcomes. Possibly higher administrative units, including the royal administration in Copenhagen, could have operated an effective relief system on a national scale, but poor communications with Iceland would have required supplies to be stored mostly in Iceland rather than Denmark.[51]

[51] The first recorded instance of aid from Denmark was in the famine of 1756-1757, when the king gave the Icelanders 2,000 barrels of grain. Only 1,400 barrels made it all the way to Iceland, and poor communications hampered distribution of the supplies within the country (Thorsteinsson & Jdnsson, 1991; 231). In the fall of 1783, when the authorities in Copenhagen learned of the eruption in Laka Craters, they sent a ship with supplies from Copenhagen, which attempted a winter voyage to Iceland. The ship approached Iceland three times, coming close enough to see pillars of fire rising from the country, but each time the vessel was driven out to sea. The expedition eventually wintered in Norway and finally arrived in Iceland in April 1 784 (Thorsteinsson & Jonsson, 1991; 251).

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