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A Cross-Cultural Historical Analysis of Subsistence Change

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This paper reports on a comparative study of changes in subsistence patterns in small-scale communities resulting from contact with global economic forces. The local communities are represented by 87 Standard Cross-Cultural Sample Societies ("Standard Sample") (Murdock and White 1969) distributed across four major world geographic areas. This study describes the patterns and general characteristics of the societies on a new set of coded variables representing change processes. The variable set includes agricultural and nonagricultural intensification, the addition of new crops and animals, changes in settlement patterns and expansion, catastrophic loss, changes in trade and wage labor, and the date of ethnographic observation. The findings of the study are both methodological and substantive. The methodological results focus on sampling problems for comparative studies as well as the dates of observation set for sample societies. The substantive findings indicate that variables are regionally clustered, with two basic patterns emerging for the way subsistence systems are affected and changed in different world regions.

The research reported here is part of a larger project, the University of California-Irvine "World-Systems and Ethnological Theory" project. The larger study was designed to explore the political, economic, social, and ecological impact of the world economic system on small-scale societies, as well as to describe trade networks and political and economic relationships between small- and large-scale societies.

Subsistence Economy in Anthropological Research

Subsistence economy has formed the cornerstone of much anthropological research, particularly in studies using holocultural methods. Anthropological theories about the relationship between subsistence and other aspects of culture tend to have one of two emphases. They focus either on the adaptations of individual societies to their environments, or on the constraints that subsistence economies place on other elements of society or culture.

Subsistence economy has been shown to have good predictive power in studies of socialization (Barry, Child, and Bacon 1959), the sexual division of labor (Boserup 1970; Bradley 1987; Burton and White 1984; Ember 1983; Martin and Voorhies 1975; Nerlove 1974; Sanday 1973), and features of social structure (Goody 1976). Psychological anthropologists, such as Whiting and Whiting (1975) for example, formulate a model for psychological research that begins with the culture's "maintenance systems." Cultural materialists and traditional Marxists include subsistence within infrastructure. In the cultural-materialist perspective, infrastructure "probabilistically determines" other aspects of the economy as well as behavior and mentality (Harris 1979:55). Because of the importance of subsistence to materialist theory, types of food-getting activities constitute a major organizing principle within anthropology texts (e.g., Martin and Voorhies 1975).

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Some comparativists have used subsistence economy as a part of social evolutionary theory building, particularly for creating scales with which to predict cultural complexity or cultural evolution. Subsistence economy was a popular index of cultural evolution around the turn of the century (e.g., Steinmetz 1899; Nieboer 1910; and Hobhouse, Wheeler, and Ginsberg 1915). More recently, Lomax and Arensberg (1977) used type of subsistence economy as a measure of cultural evolution. However, comparativists generally do not consider subsistence type to be an especially precise measure of cultural evolution (Levinson and Malone 1980:33; Naroll 1978:421). Most recent cross-cultural investigations into cultural evolution do not rely on subsistence types (e.g., Carneiro 1970) or use them only peripherally (Freeman 1957; Tatje and Naroll 1970).

In economic anthropology, subsistence economy is often distinguished from market-oriented activity. In contrast, most cross-culturalists tend to include market-oriented food production under the subsistence rubric. Barry, Child, and Bacon (1959:53) defined subsistence as "what general types of food-getting are predominant." This broad definition includes both production for use and production for exchange. Murdock and Morrow's (1970) definition of subsistence economy includes not only the acquisition (or "derivation") of food, but also its transport, preservation, and storage. Subsistence economy is defined in this report as the acquisition, transport, and storage of all products of agriculture, herding, hunting, fishing, and gathering, for use or exchange, and also includes wage labor and trade.

Past analyses have tended to emphasize change in subsistence through local evolutionary adaptation. In contrast, the current study looks at changes in subsistence economy as a consequence of larger systems of trade and political economy.

Description of the Project

The Sample

The data were collected as part of the "World-Systems and Ethnological The-

ory" project, a study of societies from the Standard Sample. The Standard Sample consists of 186 societies and includes many of the best-documented and widely known cultures in the anthropological literature. Each Standard Sample society has a locational pinpoint focusing on a particular society or unit within a society. Each culture also has a focal date. These range from 2,000 years ago to 20 years ago.

The 87 societies included in the current study were selected from the larger group of 186 via stratified random sampling and have pinpoint dates of ethnographic observation ranging from 1750 to 1965.[1] The geographic distribution of the sample includes 38 societies from Africa and Eurasia, 17 from Oceania, 18 from Northeast Asia and North America, and 14 from Central and South America.

Coding

Coding of the subsistence variables began as part of the larger project, then developed into a separate study as it became apparent that changes in subsistence systems due to world-system contact were widespread. A separate codebook was developed by Moore and Bradley (1986), which focused specifically on changes in subsistence systems. Ethnographers' statements about the nature of change in indigenous forms of subsistence, as well as the causes and consequences of such changes, were recorded in narrative form. A codebook was then developed that encompassed a majority of the categories that had emerged through the reading.

Variable Definitions and Frequencies

Fourteen variables were coded as indicators of change processes. They are discussed here along with their frequencies. The sample, the codebook for the variables, and the codes for societies are presented in the Appendix.

Whether change had occurred within 100 years prior to the designated date of ethnographic observation. The most important piece of information coded is whether or not changes in subsistence patterns occurred in the society within 100 years before the date of observation. Changes earlier than

100 years were noted but not coded for the present study. If change occurred, it was noted whether it was due to world-system contact. Seventy-three societies, or 84%, had experienced changes in their subsistence systems. In all cases, the changes were due to world-system contact. In 14 societies, the subsistence economy was unaffected.[2]

Extent of change. This describes whether changes in the subsistence system were partial or total, that is, if the change in the system was so extensive that the entire subsistence system changed. Of the 73 societies where change had occurred, the extent of change was partial in 65 societies and total in 8.

Agricultural intensification. Agricultural intensification is defined as any increase in agricultural inputs per hectare. Boserup (1965) sees agricultural intensification as a consequence of population pressure, while other theorists see it as resulting from microscopic processes such as the policies of the state. The agricultural intensification variable is defined to include increased production of an existing crop, introduction of new agricultural technology, changing from shifting to permanent cultivation, or change in the diversity of crops (e.g., a move to monocultivation). Agricultural intensification occurred in 29 of 73 societies.

Nonagricultural intensification. This variable is defined to include intensification of any nonagricultural activity, including herding, hunting, fishing, or gathering. Hunting and fishing people are very sensitive to technological changes, such as the introduction of rifles, which increase profit-oriented production. These types of changes upset ecological balances and lead to rapid depletion of resources (Curtin 1984; Wolf 1982). Intensification in nonagricultural modes of subsistence occurred in 14 of 73 societies.

A number of new subsistence activities were introduced in various societies. Two are represented here, by two variables pertaining to agriculture and herding:

New crops includes the introduction of new crops and the first introduction of agriculture. New crops were introduced in 23 of 73 societies.

New animals includes the introduction of new domesticated animals or the introduction of herding. New animals were introduced in 15 of 73 societies.

Change in settlement patterns. This describes change in the indigenous pattern of settlement that occurred in relation to change in subsistence activities. It includes change toward increasing sedentarism as well as increasing nomadism, both of which have been shown to result from contact with state-level societies. It also includes the impacts of pacification, disruption of transhumant migration, and the establishment of national boundaries (Barth 1969). Change in settlement patterns occurred in 18 of 73 societies.

Expansion. This is defined as any increase in the amount of land utilized by the subsistence system. It includes expansion of grazing areas, expansion of the amount of land cultivated, and expansion of cultivation into a new ecozone. Expansion occurred in 17 of 73 societies.

Major subsistence loss. This describes disruption of the subsistence system due to the decline or loss of a subsistence activity or due to major catastrophic events. It includes decimation of animal populations, decline and loss of hunting, decline in agriculture (including decline of an important indigenous crop), loss of pastoral activities, reduction in the amount of land occupied by the society, economic domination and enslavement, and large-scale disruption by a world war. Major subsistence loss occurred in 26 of 73 societies.

Introduction of wage labor. This is defined as introduction of wage labor to a society for the first time. It is restricted to describe the exchange of money for work. Wage labor was introduced in 27 of 73 societies.

Increase in wage labor. This describes both the increasing participation of society members in wage labor activities and the increasing demand for wage laborers. An increase in wage labor occurred in 22 of 73 societies.

Introduction of trade. This is defined as the introduction of new goods into a society by trade for the first time with the world economic system. The medium of exchange for new goods includes goods,

labor, or money. Trade was introduced in 22 of 73 societies.

Increase in trade. This describes increases in trade relationships with the world economic system. It includes increasing demand by society members for import products and the development of products or resources for export. An increase in trade occurred in 33 of 73 societies.

Date of ethnographic observation. This is the Standard Sample pinpoint date for each society assigned by Murdock and White (1969). The date references the earliest and most reliable ethnographic reports for each society. The date is given in years and has also been dichotomized at 1918, a major turning point in world history which is close to the median date for this sample.

Summary

Change in the subsistence system occurred in 73 of 87 societies, being partial in 65 and total in 8. The five most frequent indicators of change processes are: increase in trade (45%), agricultural intensification (40%), introduction of wage labor (37%), major subsistence loss (36%), and the introduction of new crops (32%).

Regional Patterns of Change: An Optimal Scaling Analysis

An optimal scaling analysis was performed in order to examine relationships among the change processes as well as the societies. Optimal scaling is a model that represents societies and variables in the same joint space. The model produces a set of dimensions and corresponding scores for societies and variables on the dimensions. The scores are proportional to the original frequency patterns across the variables. Thus, societies are placed close to the variables that characterize them, as well as to other societies with similar response patterns (Kendall and Stuart 1961:568–584; Moore 1988; Whiting et al. 1988). The method is also known as correspondence analysis (Greenacre 1984; Hoffman and Franke 1986), dual scaling (Nishisato 1980), and canonical analysis (Gittins 1984).[3]

The set of societies where change had occurred served as the basis for the scaling analysis. Only societies with complete data on all variables were used. A binary matrix of 63 societies by 13 indicators of change served as the input data matrix.[4] The input matrix as well as the optimal scores for societies are listed in the Appendix.

Figure 1 presents the two-dimensional optimal structure displaying the interrelationships of change processes.[5] The first dimension contrasts two distinct clusters of change processes. At the positive pole (in rank order of importance) are the presence of wage labor increase, agricultural intensification, expansion, date of observation after 1918, and increase in trade. At the negative pole are the presence of total change, change in settlement patterns, major loss, nonagricultural intensification, and the introduction of trade and new animals. Hence, the first dimension contrasts a pattern of partial change, associated with agricultural intensification, and 20th-century dates of observation, from a pattern of total change, associated with the intensification of activities such as hunting, fishing, and foraging, major subsistence loss, and 19th-century dates of observation. The second dimension of Figure 1 distinguishes a pattern of the introduction of trade and wage labor, at the positive pole, from a pattern of the introduction of new crops and animals and change in settlement, at the negative pole.

Figure 2 presents the same optimal structure displaying the interrelationships of societies, identified by geographic area. The figure provides striking evidence of the differential patterning of change processes by region. Dimension 1 strongly distinguishes Northeast Asian and North American societies at the negative pole. Correspondingly, the societies of Northeast Asia and North America are associated with the early, total change pattern of nonagricultural intensification, while the societies of Africa and Eurasia are characterized by the recent, partial change pattern of agricultural intensification and increase in wage labor. Societies in Oceania and South America also
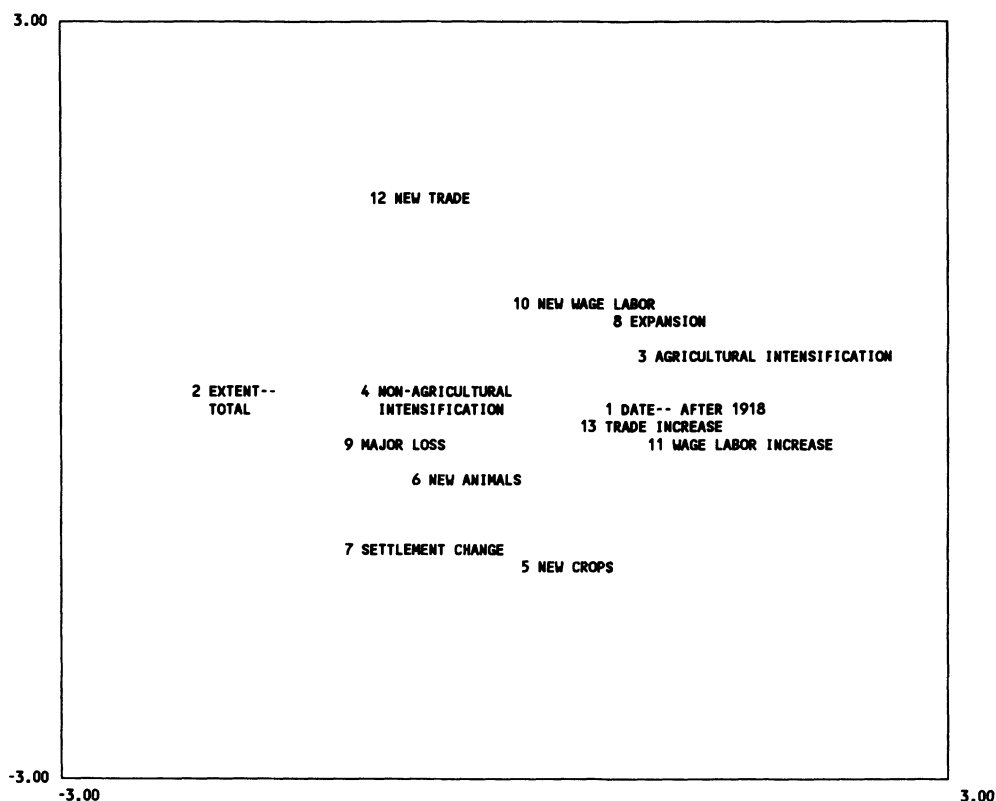
3.00

                              12 NEW TRADE

                                        10 NEW WAGE LABOR
                                             8 EXPANSION

                                               3 AGRICULTURAL INTENSIFICATION

        2 EXTENT--   4 NON-AGRICULTURAL
          TOTAL   INTENSIFICATION   1 DATE-- AFTER 1918
                                                  13 TRADE INCREASE
                          9 MAJOR LOSS   11 WAGE LABOR INCREASE

                            6 NEW ANIMALS

                      7 SETTLEMENT CHANGE
                               5 NEW CROPS

-3.00
     -3.00   3.00

Figure 1
Optimal scaling structure of change processes.

cluster positively, on dimension 1, sharing the pattern of agricultural intensification common to the Africa-Eurasia group. Dimension 2 further distinguishes societies with partial change. The societies of Oceania cluster at the positive pole of dimension 2 and are differentiated by the introduction of trade and wage labor. Contrastingly, both South American and African-Eurasian societies cluster at the negative pole, characterized by the introduction of new crops and animals as well as the disruption of settlement patterns.[6]

Discussion

The evidence in this study of regional differences in patterns of change is strongly linked to a number of well-known historical themes. The Northeast Asian-North American change system, which includes intensification of hunting, gathering, and fishing as well as loss and

destruction of the subsistence system, has been discussed by Curtin (1984) and Wolf (1982). In this study, the pattern includes a high proportion of societies in which trade was introduced and more than half that experienced changes in settlement patterns. The Pawnee, for example, experienced intensification of buffalo hunting in the 18th and 19th centuries as a result of trade with beaver trappers (White 1983). Similar events transformed a group of Pacific Northwest cultures including the Ainu, Aleut, Eyak, Gros Ventre, and Comanche. Contrastingly, the Continental Old World, Central America (including Mexico), and South America contain regions of agrarian civilizations with long histories of external penetration and contact, and show characteristic patterns of agricultural intensification (e.g., the Tiv, Lepcha, Vietnamese, Otoro Nuba, and Goajiro) and of
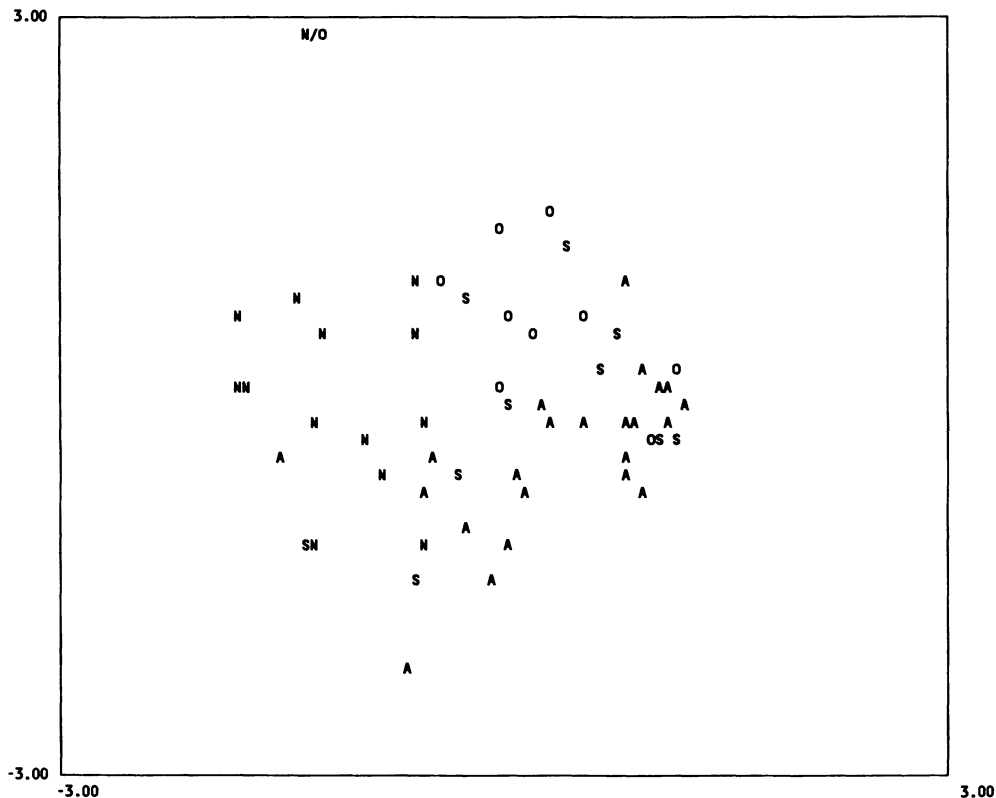
Figure 2
Optimal scaling structure of societies identified by geographic area.

modifications of pastoral subsistence (Abipon, Rwala, Kzak, Lapp, and Andamans). In Africa, for example, after the British pacification of the Nuba Hills, the Otoro Nuba were able to expand farming from the hills and gardens into the plains. This entailed increased demand for labor as well as the introduction of new crops and agricultural intensification (Nadel 1947). In Oceania, a region with a history of first contacts in the 19th century, the pattern of agricultural intensification is marked by the introduction of trade, wage labor, and expansion, and gains support from historical accounts of labor recruiting and trade in copra and sandalwood (Fox 1977; Hezel 1983). Palau and Truk, for example, experienced intensification of coconut production and fishing, introduction and increases in wage labor, as well as the introduction of trade. In both societies the changes were due to German and Japanese colonial policies.

One interesting trend in the data is that intensification of activities such as hunting, fishing, and foraging, along with destruction of subsistence systems, were reported during the 19th century, while agricultural intensification and expansion were reported during the 20th century. This finding lends support to theorists such as Curtin (1984) and Wolf (1982) about the temporal nature of the world economy, with the 19th century being marked by expansion of the world system into nonagricultural regions and the concomitant destruction of indigenous human and animal life, while the 20th century is characterized more by agricultural intensification.

Conclusions

The findings of this study are both substantive and methodological. Three conclusions are interesting and worth noting.

1. In cross-cultural analyses, the static variable "subsistence economy" must continue to be used cautiously. Whether subsistence economy is used as an independent or a dependent variable, it is an aspect of Standard Sample societies that is subject to rapid change. As we have shown, 84% of Standard Sample societies' subsistence systems changed as a result of contact prior to the designated date of observation. This is despite the fact that the Standard Sample was created with the goal of setting the dates of observation prior to the time of major acculturative contact (Murdock and White 1969). It might be argued quite correctly that all cross-cultural variables are subject to change. However, subsistence systems seem to be especially sensitive to the effects of contact, and what is coded at the time of observation is more apt to be a phenomenon in flux rather than a static aspect of a unified social system. The current study contributes two new independent variables, which directly capture change processes.

2. The temporal clusterings of the indicators of change raise questions about cross-cultural sampling. Cross-cultural samples are generally uncontrolled for time. This problem might be corrected by using samples that are stratified across time as well as space. Another solution, and one that this study is moving toward, would be to study the societies in samples such as the Standard Sample at different time pinpoints. The strong temporal trends in the data may indicate temporal differences in the nature of the world economy; however, it is just as likely that samples are temporally biased. This might happen one of two ways. First, the focus of anthropological interests has shifted from an emphasis on strictly non-agricultural societies to include peasant societies as the discipline has matured. Second, foraging societies have been more subject to destruction and extinction and thus have been less available for study and description during the 20th century.

3. The strong regional clustering of change processes is a reminder of Galton's observation that societies in close proximity to one another share common features, on the basis of shared historical processes. Societies are not isolated from one another in time and space, nor are they discrete independent units. We have attempted to show how the historical dimension may be incorporated in cross-cultural research.

Notes

[1] See Bradley (1987) for details of the sampling procedures.

[2] The 14 societies for which no changes are reported are: !Kung, Fon, Tuareg, Albanians, Lakher, Bali, Alor, Aranda, Tikopia, Maori, Inuit, Huichol, Yanomamo, and Aymara. They do not differ from the remainder of the sample in mean date of ethnographic observation or in regional distribution.

[3] In more formal terms, optimal scaling is a principal-components technique, which extracts maximally correlated principal components for both the rows and columns of a matrix. Optimal scores are computed which maximally differentiate cases. The optimal scores for each dimension are also independent.

[4] The 13 variables used include dichotomized date of observation (1a), "extent of change" (3), and "trade increased" (14). See the Appendix. The variable "was there change" (2) is not included in the scaling, since all societies used for scaling had experienced change.

[5] The optimal scaling revealed that the two-dimensional solution was appropriate. The two dimensions account for approximately 40% of the variance of the original data. No attempt was made to test the significance of the dimensions. Instead, the dimensions are used as a heuristic to explore the patterns among change processes and societies.

[6] The significance of the regional clustering was formally tested by a one-way analysis of the variance of the mean scores by regional groups on dimensions 1 and 2. The results were highly significant for both dimensions (dimension 1, df 3,59, $F = 19.752$; dimension 2, df 3,59, $F = 6.64$). The correlation ratio (eta squared) for dimension 1 is .50 and for dimension 2, .25.

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Appendix
Subsistence Change:
Sample, Codebook, and Codes for 87 Standard Sample Societies

Variables

1	Date of observation (year)		
1a	Date dichotomized	0 = before 1918	1 = after 1918
2	Was there change	0 = no change	1 = change
3	Extent of change 0 = no change	1 = partial	2 = total
4	Agricultural intensification	0 = absent	1 = present
5	Nonagricultural intensification	0 = absent	1 = present
6	New crops introduced	0 = no	1 = yes
7	New animals introduced	0 = no	1 = yes
8	Change in settlement patterns	0 = absent	1 = present
9	Expansion	0 = absent	1 = present
10	Major subsistence loss	0 = absent	1 = present
11	Wage labor introduced	0 = no	1 = yes
12	Wage labor increased	0 = absent	1 = present
13	Introduction to trade	0 = no	1 = yes
14	Trade increased	0 = absent	1 = present

15 Geographic area codes: Africa and Eurasia, "A"; Oceania, "O"; Northeast Asia and North America, "N"; Central and South America, "S".

16 Coordinates (scores) on optimal dimensions 1 and 2 for societies included in the scaling analysis.

Sample and Codes*

001	Nama	1860	0 1 2 0 0 1 1 – 0 1 1 1 0 1 A	—	—
002	!Kung	1950	1 0 0 0 0 0 0 0 0 0 0 0 0 0 A	—	—
006	Suku	1920	1 1 1 1 0 0 0 0 0 1 0 0 0 0 A	0.28	−0.01
011	Kikuyu	1920	1 1 1 1 0 0 0 0 1 0 0 1 0 1 A	1.12	0.06
013	Mbuti	1955	1 1 1 0 0 0 0 0 0 0 1 0 0 1 A	0.64	0.27
016	Tiv	1920	1 1 1 1 0 1 0 0 1 0 0 1 0 1 A	0.97	−0.33
017	Igbo	1935	1 1 1 1 0 0 0 0 – 0 0 1 0 1 A	—	—
018	Fon	1890	0 0 0 0 0 0 0 0 0 0 0 0 0 0 A	—	—
019	Ashanti	1895	0 1 1 1 – – – 0 – 0 0 0 0 1 A	—	—
021	Wolof	1950	1 1 1 1 0 0 0 0 – 0 – – – 1 A	—	—
022	Bambara	1902	0 1 1 1 0 1 0 0 0 0 0 1 0 1 A	0.95	−0.74

ID	Society	Year	Data	Group	V1	V2
023	Tallensi	1934	1 1 1 0 0 0 0 0 1 0 0 0 0 0 1	A	0.95	0.17
025	Fulani	1950	1 1 1 0 0 0 0 1 0 0 0 0 0 0 0	A	−0.27	−1.02
026	Hausa	1900	0 1 1 − − − − − 0 − 0 0 1 0 1	A	—	—
030	Nuba	1930	1 1 1 1 0 1 1 0 1 0 1 0 0 1	A	0.52	−0.15
031	Shilluk	1910	0 1 1 1 0 0 0 0 1 0 1 0 0 0	A	0.84	0.95
034	Maasai	1900	0 1 1 0 0 0 0 0 0 1 0 0 0 0	A	−1.49	−0.53
037	Amhara	1953	1 1 1 1 0 1 0 0 0 0 1 1 0 1	A	0.82	−0.28
039	Nubians	1900	0 1 1 0 0 1 0 0 0 1 0 1 0 0	A	0.05	−1.18
040	Teda	1950	1 1 1 0 1 1 1 0 1 − 1 0 0 0 0	A	—	—
041	Tuareg	1900	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	A	—	—
043	Egyptians	1950	1 1 1 1 0 1 0 0 − 0 0 1 0 0	A	—	—
046	Bedouin	1913	0 1 1 0 0 1 0 1 0 0 0 0 0 0	A	−0.65	−2.14
048	Albanians	1910	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	A	—	—
052	Lapps	1950	1 1 1 0 1 1 1 1 1 0 0 1 0 1	A	0.08	−0.69
056	Armenians	1843	0 1 1 0 0 0 0 0 0 0 0 0 0 1	A	0.80	−0.48
057	Kurd	1950	1 1 1 1 0 0 0 0 1 0 1 1 0 1	A	0.95	0.27
058	Basseri	1950	1 1 1 0 0 1 0 1 0 0 0 0 0 0	A	−0.10	−1.44
064	Burusho	1934	1 1 1 1 0 1 0 0 0 0 0 0 0 0	A	0.86	−0.59
065	Kazak	1885	0 1 1 0 1 0 1 1 0 1 0 1 0 1	A	−0.52	−0.79
068	Lepcha	1937	1 1 1 1 0 1 0 0 0 1 1 0 0 1	A	0.33	−0.24
069	Garo	1955	1 1 1 1 0 1 0 0 1 0 0 0 0 0	A	0.91	−0.19
070	Lakher	1930	1 0 0 0 0 0 0 0 0 0 0 0 0 0	A	—	—
073	Vietnam	1930	1 1 1 0 0 0 0 0 0 0 1 0 0	A	1.24	−0.08
076	Thai	1955	1 1 1 1 0 0 0 0 0 0 1 0 1	A	1.13	−0.18
077	Semang	1925	1 1 1 0 0 1 0 0 0 1 0 0 0 1	A	0.14	−0.83
079	Andamans	1860	0 1 1 0 1 0 1 0 0 0 0 0 0 1	A	−0.49	−0.49
116	Korea	1950	1 1 1 1 0 0 0 0 0 0 0 0 0 1	A	1.05	0.01
083	Java	1955	1 1 1 1 0 1 0 0 1 0 0 1 0 1	O	0.97	−0.33
084	Bali	1958	1 0 0 0 0 0 0 0 0 0 0 0 0 0	O	—	—
085	Iban	1950	1 1 1 1 0 0 0 0 1 0 0 1 0 0	O	1.20	0.20
089	Alor	1938	1 0 0 0 0 0 0 0 0 0 0 0 0 0	O	—	—
090	Tiwi	1928	1 1 1 0 0 0 0 0 0 0 1 0 0 0	O	0.56	0.65
091	Aranda	1896	0 0 0 0 0 0 0 0 0 0 0 0 0 0	O	—	—
093	Kimam	1960	1 1 1 0 0 0 0 0 0 1 1 0 1 0	O	−0.41	0.91
095	Kwoma	1937	1 1 1 0 0 0 0 0 0 0 1 0 1 0	O	−0.05	1.39
098	Trobriands	1914	0 1 1 1 0 0 1 0 0 0 1 0 1 1	O	0.02	0.62
099	Siuai	1939	1 1 1 1 0 1 1 0 0 1 1 0 1 1	O	−0.02	0.03
100	Tikopia	1930	1 0 0 0 0 0 0 0 0 0 0 0 0 0	O	—	—
102	Fiji	1840	0 1 1 0 0 0 0 0 0 0 0 0 1 0	O	−1.26	2.87
104	Maori	1800	0 0 0 0 0 0 0 0 0 0 0 0 0 0	O	—	—
108	Marshallese	1900	0 1 1 1 0 0 0 0 1 0 1 0 1 0	O	0.32	1.43
109	Truk	1947	1 1 1 1 1 0 0 0 1 1 1 1 1 1	O	0.18	0.46
110	Yap	1910	0 1 1 1 0 0 0 0 1 0 1 0 1 0	O	0.32	1.43
111	Palau	1947	1 1 1 1 1 0 0 0 1 1 1 1 1 1	O	0.18	0.46
118	Ainu	1880	0 1 2 0 0 1 0 1 0 1 1 0 0 1	N	−0.80	−0.64
121	Chukchee	1900	0 1 1 0 1 0 0 0 1 1 1 0 1 0	N	−0.59	0.96
123	Aleut	1824	0 1 2 0 1 0 0 0 0 1 0 0 1 0	N	−1.77	0.66
124	Inuit	1915	0 0 0 0 0 0 0 0 0 0 0 0 0 0	N	—	—
127	Salteaux	1930	1 1 1 0 0 0 0 − 0 1 0 0 0 1	N	—	—
129	Kaska	1929	1 1 1 0 1 0 0 1 0 0 1 0 1 0	N	−0.61	0.46
130	Eyak	1890	0 1 2 0 1 0 0 0 0 1 1 0 1 0	N	−1.39	0.79
136	Yokuts	1850	0 1 1 0 0 0 1 1 0 1 0 0 0 0	N	−1.31	−1.23
137	Paiute	1870	0 1 1 0 0 0 0 1 0 1 1 0 0 0	N	−0.97	−0.41
138	Klamath	1860	0 1 1 0 0 0 0 0 0 0 0 0 1 0	N	−1.26	2.87
140	Gros Ventre	1880	0 1 2 0 1 0 0 0 0 1 0 0 1 1	N	−1.26	0.43
141	Hidatsa	1836	0 1 1 0 0 0 0 0 0 0 0 0 1 0	N	−1.26	2.87
142	Pawnee	1867	0 1 2 0 1 0 0 1 0 1 0 0 1 0	N	−1.73	0.12
145	Creek	1800	0 1 1 0 1 1 1 1 0 0 0 0 0 1	N	−0.55	−1.15
147	Comanche	1870	0 1 2 0 0 0 0 1 0 1 0 0 1 0	N	−1.81	0.12

149	Zuni	1880	0 1 1 0 0 0 1 1 0 1 0 0 1 0 N	−1.30	−0.20
151	Papago	1910	0 1 1 0 0 0 1 1 1 1 1 1 0 0 0 N	−0.55	−0.27
152	Huichol	1890	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 N	—	—
158	Cuna	1927	1 1 1 1 0 0 0 0 1 0 1 0 1 0 S	0.45	1.14
159	Goajiro	1947	1 1 1 0 0 0 0 0 0 0 0 1 0 1 S	1.06	−0.41
160	Haiti	1935	1 1 1 0 0 0 0 0 0 0 − 1 0 0 S	—	—
162	Warrau	1935	1 1 1 0 0 1 1 0 0 1 0 0 − − S	—	—
163	Yanomamo	1965	1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 S	—	—
165	Saramacca	1928	1 1 1 0 0 0 1 0 0 0 1 0 1 0 S	−0.26	0.75
166	Mundurucu	1850	0 1 1 1 0 0 0 0 0 0 1 0 0 1 S	0.76	0.46
168	Cayapa	1903	0 1 1 0 0 1 0 0 0 1 0 0 0 0 S	−0.63	−1.40
169	Jivaro	1920	1 1 1 0 0 0 0 0 0 0 1 0 0 1 S	0.64	0.27
170	Amahuaca	1960	1 1 1 0 0 0 0 0 0 0 0 1 0 0 S	1.19	−0.38
172	Aymara	1940	1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 S	—	—
179	Shavante	1958	1 1 1 0 1 1 0 1 0 0 1 0 0 0 S	−0.31	−0.57
183	Abipon	1750	0 1 2 0 0 1 1 1 0 1 0 0 0 0 S	−1.33	−1.16
184	Mapuche	1950	1 1 1 1 0 0 1 1 0 0 0 1 1 0 S	0.01	−0.08

Coordinates for Change Processes on Optimal Dimensions 1 and 2

1. Date dichotomized	0.69	−0.02
2. Extent of change	−2.06	0.08
3. Agricultural intensification	0.94	0.30
4. Nonagricultural intensification	−0.97	0.09
5. New crops introduced	0.17	−1.29
6. New animals introduced	−0.63	−0.65
7. Change in settlement patterns	−1.07	−1.14
8. Expansion	0.74	0.57
9. Major subsistence loss	−1.04	−0.30
10. Wage labor introduced	0.09	0.75
11. Wage labor increased	0.98	−0.41
12. Trade introduced	−0.88	1.63
13. Trade increased	0.56	−0.28

*— = missing data.

Occupational Status, Landownership, and Reproductive Behavior in 19th-Century Sweden: Tuna Parish

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Resource competition is common in all species (Krebs and Davies 1984; Daly and Wilson 1983; Trivers 1986; Wittenberger 1981). In non-humans, selection favors traits increasing individual reproductive success, and resources are important. This paradigm has fueled enormous recent progress in human behavioral ecology (e.g., Hawkes and Charnov 1988). In some cases, the aggregate patterns of the demographic transition appear to be the result of individual shifts in family planning, related to available resources (e.g., Eriksson and Rogers 1978; Mosk 1983; Handwerker 1986). Yet few studies link familial resources to family patterns. This report analyzes reproductive patterns of individuals in the parish of Tuna, Sweden, from 1824–96, following genetic lineages and examining the interplay of resource control and reproductive behavior.

When resources are effective in establishing and continuing family lines, lineages with greater or lesser resources are likely to follow different strategies, or to be differentially successful with similar strategies. The impacts of resources may be strikingly different on men's and women's reproduction (cf. Low 1989). The following hypotheses arise: