

Accounting Institutions Emerge Very Early in an Economy's Development

Sudipta Basu¹, Marcus Kirk², Greg Waymire^{2*}

1. Fox School of Business, Temple University, Philadelphia, PA 19122 USA

2. Goizueta Business School, Emory University, Atlanta, GA 30322, USA

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Abstract

The “paper trail” of receipts and vouchers that is subsequently recorded in the journal entry provides the foundation for modern accounting. In this paper, we trace the impact of the recordkeeping function of accounting on small societies. Our tests, which use the ethnographic data in the Standard Cross-Cultural Sample (SCCS), indicate that recordkeeping is a foundational institution that originates very early in an economy's development. Recordkeeping promotes the emergence of economic institutions such as markets, hierarchies and specialized division of labor. These economic institutions in turn foster favorable societal outcomes such as agricultural success, political stability, and investment in tangible and human capital.

Keywords: Recordkeeping, accounting history, economic development and institutions.

*Contact information: Tel.: +1-404-727-6589; fax: +1-404-727-6313

Email address: Gregory_Waymire@bus.emory.edu

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1. Introduction

The foundation of modern accounting is a simple recordkeeping function represented in artifacts known as “receipts,” “vouchers,” and the “journal entry.” When does recordkeeping surface in the course of a society’s development? It is difficult to imagine families and small hunter-gatherer groups bound by kinship using even basic accounting for their internal dealings. Indeed, formal recording of transactions will likely be repugnant to family members or close friends (Silk 2004). At the other extreme are modern civilizations characterized by frequent long-term cooperative interactions between strangers. It is equally hard to imagine that these economies could function without well-developed recordkeeping and accounting systems. The receipt, for example, is ubiquitous to even mundane economic exchange in developed economies. We argue that accounting records play a critical role in facilitating societal expansion from small kin-based groups such as clans and tribes to modern civilizations.

Two complementary perspectives suggest that accounting institutions emerge early in economic development. Basu and Waymire (2006) hypothesize that recordkeeping appears early in an economy’s development as a device to sustain agents’ reputation for trustworthy behavior. Recordkeeping enables scale expansion and division of labor in an exchange economy, which implies that recordkeeping will emerge *before* markets, organizations, and supporting institutions. Another perspective is that accounting emerges early in response to fundamental stewardship and valuation demands for accounting information from complex hierarchical organizations and capital suppliers (Watts and Zimmerman 1986, pp. 196-8). This view differs somewhat in that causality runs from extant economic arrangements to accounting, which suggests that although accounting may emerge early, it will do so *after* the appearance of economic exchange and organizations as well as supporting institutions such as money. Both of these

complementary perspectives raise an empirical question of first-order importance: When do basic accounting institutions like recordkeeping appear as an economy grows in scale and complexity?

We provide evidence on this question by examining the emergence of recordkeeping and its association with the development of economic institutions and resultant societal outcomes using the Standard Cross-Cultural Sample developed by Murdock and White (1969). This data set provides extensive coded data for a variety of cultural variables - over 2,000 as of 2007 - constructed from published field research by ethnographers. Data are available for 186 societies chosen by Murdock and White (1969) to maximize the cross-society independence of observations.

We first demonstrate that recordkeeping emerges very early in an economy's development. Using social group size as a measure of developmental stage, we document that recordkeeping appears after primitive agriculture and simple division of labor, at the same stage as the use of money, storage of food surplus, and inheritance rights in land, and before credit arrangements, functioning judiciaries, and administrative hierarchies. Recordkeeping becomes more prevalent after group size has reached the limit (200 persons) beyond which the unaided human brain can no longer reliably store information on past social interactions (Dunbar 2001).

Economic institutions reflecting development of market exchange, division of labor, use of hierarchies and government, and demographic features capturing complexity of social interaction are significantly and positively associated with a society's use of recordkeeping. This is consistent with the Basu and Waymire (2006) prediction that recordkeeping is a necessary but not sufficient condition for the development of complex economies characterized by market exchange and division of labor.

Most important, institutional variables capturing the development of market exchange, division of labor, use of hierarchies and government, and demographic features are significantly associated with favorable societal outcomes such as agricultural success, political stability, and investments in tangible and human capital. Recordkeeping is also strongly associated with these outcome measures on a stand-alone basis, but this association is mostly eliminated when the variables reflecting institutional development are included in our empirical models. This is consistent with the prediction that recordkeeping promotes favorable societal outcomes, but it does so primarily by enabling beneficial institutions rather than leading to those outcomes directly.

More generally, our evidence is consistent with prior assertions that accounting is a necessary component of the engine that drives capitalist economic development. Werner Sombart hypothesized that double-entry bookkeeping was responsible for the emergence of capitalist economies (Most 1972). Max Weber and Joseph Schumpeter advanced variants of this hypothesis (Carruthers and Espeland 1991). Von Mises (1998, 210-232) hypothesized a central role for accounting in facilitating economic calculation that is the basis for entrepreneurial decision-making. Our findings are also important since they support De Soto (2000)'s contention that good property records are a prerequisite for the success of a capitalistic society. Thus, our evidence raises the real possibility that basic transactional data collected and summarized by accounting provides the basis for spontaneous market orders that arise from decentralized economic decisions within a competitive process (Smith 1776; Hayek 1968; Smith 2003; North 2005).

We first describe the Standard Cross-Cultural Sample because those data have not been used previously in the accounting literature. We next state our and then provide evidence on those predictions using the data in the Standard Cross-Cultural Sample. Concluding remarks are then offered.

2. Sample and Data

The Standard Cross-Cultural Sample (SCCS) provides a cross-section of ethnographic “snapshots” that we use to investigate cross-cultural variation in recordkeeping practices throughout the world. These pictures capture multiple elements of a culture or society in a location at a specific point in time. Because these data have not been previously used in the accounting literature, we describe the construction of this sample in some depth.

Murdock and White (1969) constructed the SCCS to standardize the data used in cross-cultural research and facilitate statistical analysis. Paying careful attention to ethnographic distributions, Murdock and White (1969) included 186 societies in dispersed locations and time periods. The SCCS societies include contemporary hunter-gatherers, early historic states, and contemporary industrial societies. The data in Panels A and B of Figure 1 confirm that the SCCS cultures are sampled from a wide range of time periods (including two from before the Common Era) and geographical locations. This reflects the effect of Murdock and White’s (1967) conscious decision to mitigate biases that favored societies with English language ethnographic sources.

< Insert Figure 1 Here >

The SCCS also was designed to standardize researchers’ choice of societies. Previous researchers had tended to analyze their own selection of specific societies, which often was based on small samples that were not comparable across studies. The SCCS helped standardize researchers’ choice of societies and has improved cross-study comparability.

A major purpose in constructing the SCCS was to increase the extent to which statistically valid inferences could be drawn from ethnographic data. Specifically, prior

studies had often used data that lacked independence. Cross-cultural correlation in cultural practices arises from the diffusion of those practices among cultures with a common heritage. Anthropologists have recognized this problem (referred to as *Galton's Problem*) for over a century. Murdock and White (1967) dealt with this problem by “pinpointing” their societies to specific locales and dates. The pinpointing of societies permitted selection of cultures with weaker cultural and historical diffusion relationships – i.e., the SCCS was constructed to maximize independence in terms of cultural and historical origin while preserving a large enough sample to permit sufficiently powerful statistical tests.¹

Murdock (1968) initiated the pinpointing process when he analyzed nearly 1,300 societies chosen for the completeness of their ethnographic coverage. He classified these societies into clusters based on the similarity of the cultures and categorized groups of clusters into 200 “sampling provinces” (Murdock 1968; Murdock and White 1969). From the initial 200 sampling provinces, two had no culture that could be accurately pinpointed to a particular locale and date, two were split in half, and 14 others were dropped because they were too similar to others in the sample.

Murdock and White (1969) then identified that culture from each of the 186 sampling provinces with the earliest period of satisfactory ethnographic coverage unless significantly richer data were available for a later period. The 186 cultures selected in this step comprise the SCCS. The cultures in SCCS are assigned a number from 1 to 186, which facilitates statistical identification of those cultural practices that originate from a common cultural heritage. This is done because societies with close geographical

¹ A sample of n=186 societies may appear small until one notes that the typical cross-country study in accounting frequently uses only four categories of countries based on accounting heritage (Anglo-American, French, German, and Scandinavian). The SCCS was begun in an era before statistical adjustments of standard errors for cross-sectional dependence became commonplace.

proximity are likely ones where cultural diffusion may still be a prominent force. Thus, the correlation between adjacent societies within the SCCS measures the extent to which the pinpointing process did not completely eliminate *Galton's Problem* (more on this below).

The initial study using the SCCS coded 22 variables related to subsistence economy and related practices (Murdock and Morrow 1970). Researchers who use the database code new variables, and these additional variables are added to the database as a result. Not all 186 societies are coded for all variables as some researchers elected to code data for only a subset of the SCCS cultures. For example, many variables are coded for only 93 cultures suggesting, for example, a sampling scheme such as using every other culture in the database.

Thus, each new study increases the depth of the database. There are presently more than 2,000 categorical variables (as of 2007) coded nominally or ordinally by over 60 different studies.² Unlike the usual market studies, the data we use are limited to only one observation per culture; thus, SCCS does not provide a pooled cross-sectional data set. The SCCS was designed to ensure that standard errors are not inflated by multiple observations from the same unit.

Our primary variable of interest is *Recordkeeping* (#149 in SCCS, entitled “Writing and Records”), which is coded on an ordinal scale from 1 (no records) to 5 (true writing and written records of modest significance).³ Panel A of table 1 describes how this variable is categorized.

< Insert Table 1 Here >

² An online journal, *World Cultures*, founded by Douglas R. White in 1985, maintains, refines and expands the SCCS. The journal is available in paper and CD-ROM as well as over the Internet. The journal can be accessed at <http://eclectic.ss.uci.edu/~drwhite/worldcul/world.htm>.

³ Murdock and Provost (1973) originally coded it 0 to 4 but the SCCS presently reports it from 1 to 5.

A value of 1 for *Recordkeeping* signifies “writing, records, and mnemonic devices in any form are lacking or unreported.” Seventy-three (39.3%) of the SCCS societies are coded as completely lacking in records. The next level, coded as 2, refers to “mnemonic devices.” Forty-nine SCCS societies (26.3%) are coded as having mnemonic devices. Examples of mnemonic devices are the tokens used in ancient Mesopotamian exchange or the shells used as wampum by American Indians (Schmandt-Besserat 1992; Szabo 2005). A specific example within the SCCS societies is that of the Kapauku Papuans of New Guinea, who make extensive use of shell artifacts in exchange (Pospisil 1963, 291-293 & 300-311). Economists have noted that shells and similar artifacts can serve as money to promote exchange and that these monetary artifacts provide memory of past exchanges (Townsend 1989; Kocherlakota 1998).

A value of 3 for *Recordkeeping* indicates a society with non-written records. Twenty-one SCCS societies (11.3%) are coded as having non-written records. One of these societies is the Incas, who were pinpointed in 1530 AD shortly after the Spanish invasion of the Americas. The Incan quipu has long been seen as a basic accounting device to record transactions (Keister 1964; Urton 2002).

A value of 4 for *Recordkeeping* denotes “true writing; no records.” Twelve of the SCCS societies (6.5%) fall into this category. This is the most ambiguous of the five categories for *Recordkeeping*. An examination of the ethnographic sources underlying this SCCS classification suggests that this category includes societies where written language is present. The authors sometimes note that written administrative records exist, but no examples are supplied in the texts on which coding is based. For example, Longrigg (1953, 21-25) describes book production and newspapers in Kurdistan around 1900, Barth (1960, 32) notes that marriage contracts among the Basseri were written up by specialists in marriage rites, and Gamble (1967, 22-6) remarks that Wolof was the

commercial language in the Wolof society and that school books on this language existed as early as 1823.

The final category for *Recordkeeping* (coded as 5) applies to those 31 SCCS societies (16.7%) classified under “true writing; records.” This group includes the society (Babylonia) with the earliest pinpointing date (1,750 BCE) in the SCCS sample. This date is at the end of Hammurabi’s reign as Babylonian monarch in a period when economic transactions and contracts data were stored on written clay tablets (Van De Mierop 2002; 2004).

Figure 2 shows the frequency of alternative recordkeeping scores with the sample partitioned by the year that the culture is pinpointed. The data in panel A of Figure 2 indicate that the incidence of written recordkeeping (as indicated by score of 5) is higher in the period 1935-65. However, the frequency of no recordkeeping (as reflected in a score of 1) is no lower in later periods than earlier periods. In addition, panel B of Figure 2 indicates that the majority of non-recordkeeping cultures are located in Africa and South America. The frequency of cultures possessing written records is highest in the Mediterranean and Eurasia.⁴

< Insert Figure 2 Here >

An initial analysis of the SCCS data indicated that *Recordkeeping* is subject to stronger patterns of cultural and historical diffusion relative to other SCCS variables. For example, *Recordkeeping* displays strong correlation ($\rho = 0.30$) when comparing adjacent neighbors within the SCCS database. This suggests historical influences in *Recordkeeping* may have a large impact when evaluating the functional relationship between recordkeeping and the other economic variables. Consequently, we estimate our

⁴ These findings are consistent with Diamond’s (1997) theory that technologies were more likely to spread along the same latitudes in Eurasia than along the same longitudes in Africa and South America.

empirical models using heteroskedasticity-consistent standard errors adjusted for residual correlation among observations belonging to the same major language family. Clustering the standard errors by major language family is consistent with the economic intuition that diffusion effects will have difficulty traversing major cultural/linguistic barriers between groups.

We use several other variables from the SCCS database in our analysis. These variables reflect various aspects of a society's development in terms of economic and social complexity. We will introduce these variables and discuss their definition as we use them in our empirical analysis.

3. Predictions

Social scientists have long been fascinated by why some nations or peoples have achieved greater prosperity than others that appear similarly situated. At the most basic level, the explanations boil down to differences in natural resource endowments (e.g. climate, minerals, etc.) and/or differences in institutions (e.g. markets, religion, laws) that facilitate transformation of basic resources into valuable goods and services. In this paper, we examine the contribution of one basic institution, early accounting, to differences in economic development across societies, after controlling for natural resource endowments.

The simplest accounting systems create a record of historical economic transactions in which a one-way transfer or bilateral exchange has occurred. Transactions generate a “paper trail” of receipts, vouchers and contracts that can be used to verify transaction details in case of forgetfulness or subsequent disputes.⁵ The double-entry

⁵ The “paper trail” documenting an exchange transaction, which is represented by receipts and ultimately the journal entry, is the foundation upon which modern accounting was built. Classical accounting scholars

system, whose origins trace to early 13th century Italy, facilitated systematic aggregation and combination of these records (DeRoover 1955). Double entry has likely survived and spread because it conferred a competitive advantage on users through improved cooperation and coordination, both within and between organizations.

The archaeological record is broadly consistent with the view that recordkeeping promotes economic development (Basu & Waymire, 2006). Transactional records are common to large-scale societies, even those that are pre-literate. The first accounting records using “tokens” appear at the same time and place (c. 8000 BCE Mesopotamia) as the emergence of agriculture and permanent human settlements (Schmandt-Besserat 1992). Other non-written transaction records include the Incan “quipu” (knotted string) and the “tally stick” used all over the world (Robert 1956; Ifrah 2001, ch. 5 and 6). The Sumerians invented writing to keep records and accounts (3200 BCE), and this occurred at the same time as substantial increases in group size and population density in the earliest cities (Nissen et al. 1993). Thus, accounting innovations in ancient Mesopotamia coincided with societal and economic development, suggesting a potential causal connection.

The current paper uses anthropological field data to examine whether the tight coupling between accounting advances and economic development in the ancient Near East was unique, or a pattern that describes human societies worldwide. In addition, we examine whether recordkeeping emerges earlier than other economic institutions such as money and credit across different cultures, similar to the Sumerian experience. We find that more advanced recordkeeping (as measured by increasing levels of *Recordkeeping*) is positively associated with greater economic and societal development across a broad

have long recognized the importance of basic recordkeeping and its role in providing memory of past exchange transactions (e.g., Hatfield 1924; Littleton 1933, 1953; Potter 1952; Ijiri 1975; Demski 1993).

cross-section of human societies that have been studied by anthropologists. This paper thus provides more systematic evidence that generalizes the anecdotal archaeological evidence collected by Basu & Waymire (2006).

In a parallel paper, Basu et al. (2007) conduct an experiment to evaluate whether recordkeeping emerges endogenously in complex cooperative exchange and how much it increases realized gains from trade. They implement a multi-person networked repeated version of the Berg et al. (1995) trust game, and contrast the history of transfers in games where players can(not) keep personal records. Their results suggest that recordkeeping helps players to better remember the past behavior of anonymous partners over several rounds of play, and helps them to selectively transact with those players who have previously been cooperative. In the laboratory recordkeeping economies, higher average and less variable returns are earned, trust and reciprocity increase among those playing in later rounds, and players' economic risk is reduced because they can use more prior information in their decisions. The stylized laboratory experiment in Basu et al. (2007) facilitates tracing of causal linkages between the societal ability to keep records and improved economic outcomes, but (like all experiments) lacks external validity. The current paper thus provides external validity to complement the experimental evidence provided by Basu et al. (2007), both in support of the Basu & Waymire (2006) hypotheses.

Figure 3 graphically summarizes the predictions that we investigate in this paper. Arrow (1) in the left-hand part of the figure depicts the emergence of accounting as a move from mental records to external records. That is, recordkeeping outside the brain is necessary for economic development and is expected to emerge early relative to other economic institutions.

< Insert Figure 3 Here >

Relying solely on mental memory, humans are able to sustain social exchange at a scale greater than other primates. This is largely because our evolved brains remember past interactions and analyze exchange opportunities more effectively than other species (Wilson 2000; Cosmides and Tooby 2005). That is, human brains are adapted for social exchange and cooperation that improves our prospects for resource acquisition and survival. Within a small kin-based group, mental memory of past interactions and gossip helps actors identify trustworthy partners for a contemplated cooperative venture (Barkow 1992; Demsetz 2002). Hence, small groups will have little need for permanent external records because members can accurately track others' reputations even if they cannot perfectly recall the particulars of specific past interactions (Silk 2004).

Keeping records outside the brain allows people to reliably store greater amounts of information on past interactions (Basu and Waymire 2006). Recordkeeping thus expands human capacity to “recognize other individuals and keep score” (Ridley 1996, 83), which is a prerequisite for sustaining repeated cooperative social exchange and reciprocity (Axelrod and Hamilton 1981; Nowak and Sigmund 2005).⁶ We therefore predict that external recordkeeping as measured by *Recordkeeping* will emerge relatively early compared to other economic institutions as societies become bigger and more complex.

These arguments suggest that sole reliance on mental records will constrain societal expansion beyond a certain group size. Anthropological research suggests that

⁶ An organism's ability to recall past interactions with its environment and adjust behavior in response is of first-order importance to its survival. This ability is important even for single cell organisms like the *e coli* bacterium (Allmen 2000, 3-8).

the unaided human brain can sustain stable cooperative groups to an upper limit of between 125 and 200 members.⁷ Dunbar (2001, 181) writes:

“(t)here is indeed a characteristic group size of around 125-200 that reappears with surprising frequency in a wide range of contemporary and Neolithic horticultural societies. These groups ... all share one crucial characteristic: they consist of a set of individuals who know one another intimately and interact on a regular basis... Thus there seems to be quite strong evidence that at least one component of human grouping patterns is as much determined by relative neocortex size as are groups of other primates. We have bigger, more complexly organized groups than other species simply because we have a larger onboard computer (the neocortex) to allow us to do the calculations necessary to keep track of and manipulate the ever-changing world of social relationships within which we live.”

Dunbar’s Number is the estimated limit to human group size in the absence of institutions that store data on past exchange outside the human brain. This suggests that external recordkeeping should become increasingly prevalent after groups reach a size exceeding 200 persons. We predict therefore that the relation between *Recordkeeping* and group size will be nonlinear, with little association across groups of 200 or fewer persons and a positive association across groups exceeding 200 persons.

In addition to increasing the number of potential partners, records also help parties coordinate more complex economic interaction. This is shown by arrow (2) in Figure 3 leading to the box to the right of external recordkeeping. Within animal and human families, many resource transfers are unidirectional grants, with little expectation of immediate reciprocity. In small family- and kin-based units, unidirectional transfers can be motivated by love (parents for children), fear (low status members of alpha males) and ignorance (not recognizing that an object is valuable) (Boulding et al., 1972).⁸ Most

⁷ “Dunbar’s Number” of 125-200 persons was calculated by correlating troop size and (neocortical) brain size across different primates such as monkey, baboons and chimpanzees, and extrapolating to expected human group size using actual human brain size. The predicted number was validated by studying the historical maximum sizes of hunter-gatherer tribes, Neolithic villages, Hutterite settlements, Roman army units, and other human groups. The computation of Dunbar’s Number is described in Dunbar (1992, 1998).

⁸ Over lifetimes, such one-way resource transfers likely balance out, but given high mortality rates in these groups, there is less expectation of stable partnerships. In more egalitarian societies, transfers between

primitive human societies are kin groups with a norm of generalized reciprocity, where help is expected from and is available to all group members (Sahlins 1972). Many primitive societies engage in gift exchanges with neighboring societies (Malinowski 1922; Mauss 1925), which promotes coordination of economic activity within these societies. Power- and status-based hierarchies are also used to increase economic coordination and increase group sizes. Such complex coordination inevitably entails norms of behavior and monitoring to reduce shirking and cheating, and we predict that recordkeeping will be more prevalent (i.e., *Recordkeeping* will take on larger values) in societies organized through large hierarchies.

As the number of group members grows however, repeated interaction with familiar partners occurs less often. In addition, individual cooperation with members of other groups cannot rely on familiarity or repeated interaction. At some point in the recent human past, a new form of economic interaction arose in the form of bilateral exchange or barter (Seabright 2005) with an associated norm of balanced reciprocity (Sahlins 1972). The experimental results in Basu et al. (2007) suggest that recordkeeping may be crucial to this transformation, in that experimental economies where recordkeeping was permitted exhibited stronger patterns of reciprocity than non-recordkeeping economies. Thus, we predict that recordkeeping is associated with more exchange transactions within human societies. In addition, increased group size and more complex economic coordination should also lead to greater specialization and division of labor within these societies (Smith 1776).

Cooperative exchange is likely crucial to economic development, so recordkeeping potentially plays a foundational role in human history. If this hypothesis is

spouses may have more of an implicit exchange character than in less egalitarian cultures. Thus, we do not mean to characterize these transfers as necessarily excluding an exchange component, but rather want to emphasize that they are not purely exchange transactions between equals.

descriptive, we expect that the quality of various economic institutions enabled by recordkeeping should correlate strongly with measures of economic development. We predict that exchange transaction and hierarchical transaction measures should explain societal outcomes such as agricultural success, political stability, and permanent investment in tangible and human capital. Arrow (3) in Figure 3 indicates that larger groups develop a nexus of economic institutions to promote cooperative economic interaction. Further, although we expect *Recordkeeping* to correlate with these outcome measures incremental to natural resource endowments, its explanatory power will be reduced in the presence of these later institutions. Arrow (4) in Figure 3 represents the weakened direct association between *Recordkeeping* and outcome variables after controlling for hierarchies, market exchange, division of labor, and scale.

To summarize, we investigate four predictions:

- (1) Recordkeeping is a necessary institution that will emerge early as an economy develops.
- (2) Recordkeeping exerts a direct positive effect on the use of hierarchical organization, market exchange, division of labor, and demographic measures such as group size and population density.
- (3) The extent to which a society develops institutions such as hierarchical organizations, markets, division of labor, and large groups will be positively associated with favorable societal outcomes like military success and investment in tangible capital and education.
- (4) Recordkeeping's direct effect on the societal outcomes in (3) will be limited after controlling for the developmental state of a society's institutions.

4. Empirical Evidence

4.1 The Emergence of Recordkeeping

Group size is extensively used to measure the scale of sustained cooperation within a given species; likewise it is used as a parsimonious measure of the scale and development of human social complexity (Chick 1997; Johnson and Earle 2000; Wilson

2000, 131-138; Dunbar 2001). Accordingly, we begin our empirical analysis by exploring the relation between *Recordkeeping* and group size using SCCS variable #63, *Community Size*, to partition the data. *Community Size* takes on eight possible categorical values. At the lowest are societies where ethnographers estimate the typical community size to be less than 50 persons and at the highest are communities that each comprises more than 50,000 people. Panel B of Table 1 shows the various categories of *Community Size*.

Panel A of Figure 4 plots the frequencies of each *Recordkeeping* score for a given level of *Community Size*, where bubble size is proportional to frequency. A line connects the mean *Recordkeeping* score for each of the eight sets of societies partitioned by *Community Size* categories. The societies that lack records cluster in the lower *Community Size* communities. Further, no SCCS society coded as having communities exceeding 5,000 persons (n=8) lacks recordkeeping. The Spearman correlation between *Recordkeeping* and *Community Size* is .32 ($p < .01$), which indicates a positive association between recordkeeping and the scale of social complexity.

< Insert Figure 4 Here >

This graph also shows that the mean *Recordkeeping* score increases monotonically once *Community Size* has reached categories indicating 200 or more persons. This is a statistically significant effect; a model with *Recordkeeping* as the dependent variable and *Community Size* as an independent variable indicates that the relation between *Community Size* and *Recordkeeping* is nearly twice as positive for societies with communities exceeding 200 persons. This evidence is consistent with the hypothesis that recordkeeping is more likely to be present when social and economic

interaction has reached a scale that cannot be sustained solely by unaided individual memory.⁹

These data do not speak to when recordkeeping emerges relative to other institutions. To evaluate this, we compared *Recordkeeping* with several other SCCS variables. We used SCCS variables reflecting primitive division of labor, the use of money and credit in an economy, and the presence of administrative hierarchies. The variables we compare with *Recordkeeping* are: (1) *Administrative Hierarchy* (SCCS variable #91), (2) *Agriculture* (SCCS variable #151), (3) *Credit* (SCCS variable #18), (4) *Food Surplus via Storage* (SCCS variable #21), (5) *Inheritance of Land* (SCCS variable #278), (6) *Judiciary* (SCCS variable #89), (7) *Money* (SCCS variable #155), and (8) *Technological Specialization* (SCCS variable #153). These eight variables, all of which are ordinal, are defined in the Appendix.

Panel B of Figure 4 shows comparative data for *Recordkeeping* relative to the developmental state of these other economic institutions as proxied by alternative levels of *Community Size*. The figure plots for all nine variables the cumulative percentage of coded societies where the practice is absent by the point at which a society has reached a given level of *Community Size*.

The nine SCCS variables' cumulative frequency functions cluster generally into four groups referenced by the capital letters on the right-hand side of panel B. *Agriculture* and *Technological Specialization* are in cluster A, which represent practices that are absent (present) in about 20% (80%) of the SCCS societies. This suggests that basic

⁹ With training, some individuals are capable of prodigious feats of mental memory such as memorizing religious texts or numerous digits of non-repeating numbers such as pi. Thus, it is possible that some larger societies entrusted a few such individuals with a specialized duty of mental recordkeeping, or that memory was retained communally via folklore transmitted across generations through verse and song.

agriculture and primitive division of labor take root within human groups at low group size levels.

The next cluster (labeled B) includes *Recordkeeping* along with *Food Surplus Storage*, *Money*, and *Inheritance of Land*. These basic institutions are present in approximately 60% of the SCCS societies. This suggests that recordkeeping is a fundamental institution that, like monetary exchange and simple property rights systems, appears very early in an economy's development. That recordkeeping and money emerge similarly is perhaps not surprising. As already noted, mnemonic devices can fulfill both a recordkeeping function and a monetary function (Townsend 1989; Kocherlakota 1998).

The final two clusters include *Administrative Hierarchies* and *Judiciary* (cluster C) and *Use of Credit* (cluster D). Practices in clusters C and D are present in nearly 50% and 35% of the SCCS societies, respectively. These data indicate that more advanced institutions like hierarchies, courts, and extension of credit appear later in an economy's development after more basic institutions like recordkeeping, money and basic property rights. Overall, the evidence in Panel B of Figure 4 supports the inference that recordkeeping is a foundational institution that appears relatively early in an economy's development.

4.2. The Effect of Recordkeeping on Exchange, Division of Labor, Hierarchical Organization, and Demographics

We now investigate whether recordkeeping is associated with expansion in the scale and complexity of economic interaction within a society. We predict that *Recordkeeping* will enable increased use of market exchange and hierarchical organizations, greater division of labor, and more generally, more complex social organization reflected in demographics like urbanization and population density. We first combine multiple SCCS variables to obtain comprehensive measures for each of the four

institutional constructs using factor analysis techniques. We then use our factor estimates of these constructs as dependent variables and examine their relation to *Recordkeeping* after including additional variables to control for other natural endowments.

We estimated each of the four factors *Market Exchange & Property Rights*, *Specialized Production & Division of Labor*, *Use of Hierarchies & Government*, and *Demographics* using the variables listed in Panel C of Table 1.¹⁰ To illustrate, no single variable in the SCCS directly measures a broad economic construct such as *Market Exchange & Property Rights*. To measure this construct, we used six variables, each of which likely captures an aspect of the underlying construct. We then perform a principal factor analysis using the communalities among these six variables to extract underlying dimensions. We used a minimum eigenvalue of one as the criterion to determine how many factors to retain.

Panel A of Table 2 shows that one factor with an eigenvalue of 1.79 accounts for 71% of the total variance of the six SCCS variables used in the *Market Exchange and Property Rights* analysis. Thus, we retain only one factor to specify *Market Exchange & Property Rights*.¹¹

< Insert Table 2 Here >

Panels B to D of Table 2 show that one factor in each of *Specialized Production & Division of Labor*, *Hierarchies & Government*, and *Demographics* can explain 99%,

¹⁰ The variable *Specialized Production & Division of Labor* is a more complex measure of division of labor that is based on variables beyond the simple measure (i.e., *Technological Specialization*) we used earlier in constructing panel B of figure 4.

¹¹ Instead of four separate factor analyses, we also perform an iterated principal factor analysis on 12 variables (three from each theorized institutional construct): *Intercommunity Trade as a Food Source*, *Money*, *Credit Source*, *Technological Specialization*, *Agriculture*, *Intensity of Cultivation*, *Administrative Hierarchy*, *Jurisdictional Hierarchy beyond Local Community*, *Class Stratification*, *Population Density*, *Fixity of Settlement*, and *Settlement Patterns*. We retain four factors from this analysis and rotate them using a promax oblique rotation. These four resultant factors correspond with the four institutional constructs in terms of strength of factor loadings. Defining our four institutional constructs in this manner gives qualitatively similar results to those reported in the ensuing analyses.

88%, and 88% of the variance in each of those measures. We therefore again retain only one factor from each of these analyses.

Panel E shows the factor loadings between the four factors and the original variables. The factor loading is the standardized coefficient in a regression of the variable on the factor and reflects the strength of the relationship. For example, note that Factor 1 (*Market Exchange & Property Rights*) depends more heavily on *Intercommunity Trade as a Food Source* and *Money* than on *Food Surplus via Storage* and *Recent Large-scale Slaveholding*. The *Division of Labor* factor is most heavily influenced by the two measures of agricultural activity (*Agriculture* and *Intensity of Cultivation*). The *Hierarchies & Government* factor is most strongly related to variables reflecting *Administrative Hierarchy* and *Political Integration*, variables that represent the extent to which communities in the society are tied together by government and other political links. *Demographics* is most strongly associated with *Fixity of Settlement*, a variable that captures the degree to which people in the society live in permanent communities.

Panel F of Table 2 presents the Pearson and Spearman correlations between the institutional factors as well as with the variables *Recordkeeping* and *Community Size*, all of which are statistically significant with two-tailed p-values < 0.005 . Consistent with our predictions, *Recordkeeping* is positively correlated with all four factors. The correlation between *Recordkeeping* and *Market Exchange & Property Rights* is the most positive among the four factors. In addition, the four factors are positively correlated with each other.

Table 3 presents the results from estimating two models of the relation between institutions and the presence of recordkeeping. In the first model, a dummy variable, *RK_B*, which equals one if recordkeeping is present, is included along with controls for resource endowments (*AgPotential*, *Climate*, and *Region*). In this model, the coefficient

on *RK_B* is positive for all institutional factors and significantly different from zero at the .05 level for all but *Demographics*. Consistent with the univariate correlations shown in panel F of Table 2, the model for *Market Exchange & Property Rights* has the greatest explanatory power in all cases.

< Insert Table 3 Here >

The second model in Table 3 allows the effect of *RK_B* to vary more for societies where Community Size exceeds 200 persons (i.e., *Large_Comm* = 1). The results suggest that the interactive effect of *RK_B* and *Large_Comm* is positive and statistically significant for *Market Exchange & Property Rights* as well as *Specialized Production & Division of Labor* and *Demographics*. This evidence suggests that *Recordkeeping* plays an important institutional role in extending the market and the division of labor, both of which economists view as crucial to economic growth (Smith 1776, Book I, Chapter III).

To summarize, the evidence in Table 3 suggests that societies that use records are characterized by more extensive use of economic exchange, division of labor, and organizational hierarchies and government. These findings are generally consistent with the hypothesis that recordkeeping is necessary to promote the development of economic institutions.

4.3. The Association Between Recordkeeping and Favorable Societal Outcomes

Our final two predictions are that more developed economic institutions will be associated with more favorable societal outcomes (e.g., greater food production through agriculture) and that the effect of *Recordkeeping* on societal outcomes is indirect. That is, any direct effect of *Recordkeeping* on societal outcomes will be modest when the effects of institutional development are controlled for. Thus, *Recordkeeping* improves societal

outcomes because it facilitates the development of economic institutions, which are the proximate cause of more favorable societal outcomes.

The measures of societal outcomes we examine are listed in Panel C of Table 1 with specific definitions of these measures provided in the Appendix. These eight specific variables are measures of success in agriculture (*Resource Base*, *Cropping Index*, and *Occurrence of Famine*), warfare and political stability (*Military Success*, *Frequency of Internal Warfare*, and *Political Autonomy*), or long-term investments in tangible assets and human capital (*Large or Impressive Structures* and *Education Investment*).

We estimated Ordered Logistic regression models with these measures as dependent variables and the four factors from Table 2 as independent variables along with *Recordkeeping*. Control variables are included for resource endowments and community characteristics.

Results for the estimated models are shown in Table 4. Three models are shown for each outcome measure. The first includes the four institutional factors as explanatory variables and the second is identical except that *Recordkeeping* is added as an additional explanatory variable. The third model includes only *Recordkeeping* as an independent variable with the institutional factor variables omitted. This model provides a benchmark for assessing how *Recordkeeping* influences societal outcomes.

< Insert Table 4 here >

Three important features of the evidence in table 4 are worthy of mention. First, as we predicted, the institutional factors are significant in explaining the societal outcome measures. However, these effects are not uniform across the outcome measures. For instance, *Market Exchange & Property Rights* and *Hierarchies & Government* are positively associated with *Resource Base* and *Division of Labor* is positively related to *Cropping Index* as measures of agricultural success. None of the variables bear a

significant relation to the *Occurrence of Famine*. Likewise, the factors *Specialized Production & Division of Labor* and *Hierarchies and Government* are positively associated with *Political Autonomy* but bear no relation to the warfare variables. As to investments in tangible and human capital, *Hierarchies & Government* and *Demographics* are associated with *Large and Impressive Structures* and *Market Exchange & Property Rights* and *Specialized Production & Division of Labor* are associated with *Education Investment*.

Second, also consistent with our predictions, *Recordkeeping* bears no significant direct association with the outcome variables when the institutional factors are also included as explanatory variables. In contrast, the coefficient on *Recordkeeping* is positive and statistically significant at the .05 level or lower in all but two cases (*Occurrence of Famine* and *Frequency of Internal Warfare*) when the institutional factors are excluded. In short, the evidence in Table 4 supports our prediction that *Recordkeeping* has no direct effect on favorable societal outcomes independent of the economic institutions whose development it helps promote.

One limitation of the outcome measures examined in Table 4 is that they capture individual aspects of a society's success. To obtain a more comprehensive measure of societal outcomes, we applied principal factor analysis to the eight outcome measures in Table 4 to obtain a single measure, which we refer to as *Economic Development*. Panel A of Table 5 indicates that a single factor with an eigenvalue of 1.89 accounts for 56% of the total variance of the eight outcome measures. Panel B of Table 5 shows the factor loadings of the eight original variables for *Economic Development*. The factor loadings show that *Resource Base*, *Cropping Index*, *Large or Impressive Structures*, and *Education Investment* are the outcome measures most strongly associated with *Economic Development*. *Military Success* and *Political Autonomy* have coefficients exceeding .25

whereas *Frequency of Internal Warfare* and *Occurrence of Famine* exert a limited effect on *Economic Development*.

< Insert Table 5 Here >

Panel C of Table 5 shows the results from OLS estimation of models identical to those in Table 4 except that now *Economic Development* is used as the outcome measure. These results are similar to the findings in Table 4 in that two institutional factors (*Specialized Production & Division of Labor* and *Hierarchies & Government*) are positive and significantly related to *Economic Development* at the .05 level or better. These effects remain highly significant even when *Recordkeeping* is added to the model. Consistent with the results in Table 4, the coefficient on *Recordkeeping* declines by over 70% (dropping to .09 from .32) when the institutional factors are included in the model. However, the coefficient on *Recordkeeping* in model (2) is statistically significant at better than the .01 level. This is likely attributable to lower coefficient standard errors associated with the model's high explanatory power (adjusted $R^2 = .83$).

To summarize, the evidence in Tables 4 and 5 is consistent with our prediction that recordkeeping is associated with favorable societal outcomes, but this effect occurs primarily through the effects recordkeeping exerts on the development of institutions that foster favorable societal outcomes.

5. Conclusions

Our evidence suggests that recordkeeping, like money, storage of food surplus, and inheritance of land, emerges at relatively early stages of an economy's development after the appearance of agriculture and primitive division of labor. The emergence of recordkeeping precedes the appearance of a judiciary, administrative hierarchies and the extension of credit. Our evidence also suggests that economies where recordkeeping is

possible are characterized by greater reliance on market exchange, more specialized division of labor, greater use of hierarchies and the provision of government services, and demographics indicative of greater social complexity. The institutions enabled by recordkeeping are associated with more favorable societal outcomes associated with agricultural success, political stability, and investment in tangible and human capital.

These findings suggest that the basic accounting function of recordkeeping is a precursor to economic development through market exchange, division of labor, and organizations. Thus, the evidence suggests that the relation between accounting and economic development is one where causality runs from accounting to market and organizational development rather than accounting being the result of demand derived from extant organizations and markets.

Our evidence suggests that basic accounting functions are necessary in extending the scale of human cooperation from small primitive human groups to large-scale modern human societies characterized by extensive market exchange and complex organizational hierarchies. These findings indicate that accounting emerges very early in economic development (Basu and Waymire 2006; Watts and Zimmerman 1986). Our results are also broadly consistent with conjectures offered by an earlier generation of scholars (i.e., Sombart, Weber, Schumpeter, and von Mises) that capitalist economies would be impossible without modern accounting (Most 1972; Carruthers and Espeland 1991). Thus, we call for future research on how recording and analysis of basic transactional data can extend a market order and may even fulfill the role of Adam Smith's "Invisible Hand" in promoting beneficial economic interaction (Smith 1776).

References

- Allmen, J., 2000, *Evolving Brains*, New York, NY: Scientific American Library.
- Axelrod, R., and W. Hamilton, 1981, The evolution of cooperation, *Science* 211 (4489): 1390–1396.
- Barkow, J., 1992, Beneath new culture is old psychology: Gossip and social stratification, in J. Barkow, L. Cosmides, and J. Tooby (eds.), *The Adapted Mind*, New York, NY: Oxford University Press, 163–228.
- Barth, F., 1960, *Nomads of South Persia: The Basseri Tribe of the Khamseh Confederacy*, New York, NY: Humanities Press.
- Basu, S., Waymire, G., 2006, Recordkeeping and human evolution, *Accounting Horizons*. 20 (3): 1-29.
- Basu, S., J. Dickhaut, G. Hecht, K. Towry, and G. Waymire, 2007, Recordkeeping changes the course of economic history,” Emory University and University of Minnesota, Working paper, June.
- Berg, J., J. Dickhaut, and K. McCabe, 1995, Trust, reciprocity, and social history, *Games and Economic Behavior*, 10 (1): 122–142.
- Boulding, K.E., Pfaff, M., and J. Horvath, (1972), Grant economics: a simple introduction, *American Economist*, 16 (1): 19-28.
- Carruthers, B. and W. Espeland, 1991, Accounting for rationality: Double-entry bookkeeping and the rhetoric of economic rationality, *The American Journal of Sociology* 16 (1): 31-69.
- Chick, G., 1997, Cultural complexity: The concept and its measurement, *Cross-Cultural Research* 31 (4): 275-307.
- Cosmides, L., and J. Tooby, 2005, Neurocognitive adaptations designed for social exchange, in D. M. Buss (Ed.) *Evolutionary Psychology Handbook*, New York, NY: Wiley, Chapter 20.
- Demsetz, H., 2002, Toward a theory of property rights II: The competition between private and collective ownership, *Journal of Legal Studies* 31 (2): S653-S672.
- Demski, J., 1993, *Managerial Uses of Accounting Information*, New York, NY: Kluwer Publishing.
- DeRoover, R., 1955, New perspectives on the history of accounting, *The Accounting Review* 30 (3): 405-420.

- De Soto, H., 2000, *The Mystery of Capital: Why Capitalism Succeeds in the West and Fails Everywhere Else*, New York: Basic Books.
- Diamond, J. 1997, *Guns, Germs, and Steel: The Fates of Human Societies*, New York, NY: W.W. Norton & Co.
- Dunbar, R.I.M., 1992, Neocortex size as a constraint on group size in primates, *Journal of Human Evolution*, 22: 469-493.
- Dunbar, R.I.M., 1998, The social brain hypothesis, *Evolutionary Anthropology* 6: 178-190.
- Dunbar, R.I.M., 2001, Brains on two legs: Group size and the evolution of intelligence, in de Waal, F.B.M. (ed), *Tree of Origin*, Cambridge, MA: Harvard University Press.
- Gamble, D. P., 1967, *The Wolof of Senegambia*, London: International African Institute.
- Hatfield, H., 1924, An historical defense of bookkeeping, *Journal of Accountancy* 37 (4): 241-253.
- Hayek, F., 1968, Competition as a discovery procedure, in *New Studies in Philosophy, Politics, Economics, and the History of Ideas*, Chicago, IL: University of Chicago Press, 179-190.
- Ifrah, G., 2001, *The Universal History of Numbers*, New York, NY: Wiley.
- Ijiri, Y., 1975, *Theory of Accounting Measurement: Studies in Accounting Research # 10*, Sarasota, FL: American Accounting Association.
- Johnson, A., and T. Earle, 2000, *The Evolution of Human Societies*, Palo Alto, CA: Stanford University Press.
- Keister, O., 1964, The Incan quipu, *The Accounting Review* 39 (2): 414-416.
- Kocherlakota, N., 1998, The technological role of fiat money, *Federal Reserve Bank of Minneapolis Quarterly Review* 22 (3): 2-10.
- Littleton, A. C., 1933, *Accounting Evolution to 1900*, New York, NY: American Institute Publishing Co.
- Littleton, A. C., 1953, *The Structure of Accounting Theory*, Sarasota, FL: American Accounting Association.
- Longrigg, S., 1953, *Iraq, 1900 to 1950: A Political, Social, and Economic History*, London: Oxford University Press.
- Malinowski, B., 1922, *Argonauts of the Western Pacific*, London: Routledge and Kegan Paul.

- Mauss, M., 1950, *The Gift*, London: Norton & Co. Translated by W. D. Halls, 1990.
- Most, K., 1972, Sombart's propositions revisited, *The Accounting Review* 47 (4): 722-34.
- Murdock, G., 1968, World sampling provinces, *Ethnology* 7: 305-326.
- Murdock, G., and D. Morrow, 1970, Subsistence economy and supportive practices: cross-cultural codes, *Ethnology* 9: 302-330.
- Murdock, G., and C. Provost, 1973, Measurement of cultural complexity, *Ethnology* 12: 379-392.
- Murdock, G., and D. White, 1969, Standard cross-cultural sample, *Ethnology* 8: 329-69.
- Nissen, H. J., P. Damerow, and R.K. Englund, 1993, *Archaic Bookkeeping: Writing and Techniques of Economic Administration in the Ancient Near East*. Translated by Paul Larsen, Chicago, IL: University of Chicago Press.
- North, D., 2005, *Understanding the Process of Economic Change*, Princeton, NJ: Princeton University Press.
- Nowak, M. and K. Sigmund, 2005, Evolution of indirect reciprocity, *Nature* 437 (7063): 1291-1298, October 27.
- Pospisil, L., 1963, *Kapauku Papuan Economy*, New Haven, CT: Yale University Publications in Anthropology #67 (Reprinted 1972 by Human Relations Area Files Press, New Haven, CT, 1972).
- Potter, C., 1952, Initial development of accountancy, *Canadian Chartered Accountant* (January), reprinted in *Readings in Accounting Development*, 1978, New York, NY: Arno Press.
- Ridley, M., 1996, *The Origins of Virtue*, New York, NY and London: Penguin Books.
- Robert, R., 1956, A short history of tallies, in Littleton, A.C. and B. Yamey (eds.), *Studies in the History of Accounting*, London, UK: Sweet & Maxwell.
- Sahlins, M., 1972, *Stone Age Economics*, New York, NY: Aldine De Gruyter.
- Schmandt-Besserat, D., 1992, *Before Writing, Vol. 1*, Austin, TX: Univ. of Texas Press.
- Seabright, P., 2004, *The Company of Strangers: A Natural History of Economic Life*, Princeton, NJ: Princeton University Press.
- Silk, J. 2004, Cooperation without counting: The puzzle of friendship," chapter 3 in Hammerstein, P. (ed.) *Genetic and Cultural Evolution of Cooperation*, Cambridge, MA: MIT Press, 37-54.

- Smith, A., 1776, *The Wealth of Nations*, Chicago, IL: University of Chicago Press (Reprinted 1976).
- Smith, V., 2003, Constructivist and ecological rationality in economics, *American Economic Review* 93 (3): 465-508.
- Szabo, N., 2005, Shelling out – The origins of money, Copyright by N. Szabo, available online at <http://szabo.best.vwh.net/shell.html>.
- Townsend, R., 1989, Currency and credit in a private information economy, *Journal of Political Economy* 97 (6): 1323-1344.
- Urton, G., 2002, An overview of Spanish Colonial commentary on Andean knotted string records, in Quilter J. and G. Urton, (eds.), *Narrative Threads: Accounting and Recounting in Andean Khipu*, Austin, TX: University of Texas Press.
- Van De Mieroop, M., 2002, Credit as a facilitator of exchange in Old Babylonian Mesopotamia, in Hudson M. and C. Wunsch, (eds.), *Debt and Economic Renewal in the Ancient Near East, Volume 3 of the International Scholars Conference on Ancient Near Eastern Economies*, Bethesda, MD: CDL Press.
- Van De Mieroop, M., 2004, *A History of the Ancient Near East*, Oxford, UK: Blackwell Publishing.
- von Mises, L., 1998, *Human Action: The Scholar's Edition*, Auburn, AL: The Ludwig von Mises Institute.
- Watts, R. and J. Zimmerman, 1986, *Positive Accounting Theory*, Englewood Cliffs, NJ: Prentice-Hall.
- Wilson, E., 2000, *Sociobiology: The New Synthesis (25th Anniversary Edition)*, Cambridge, MA: Harvard University Press.

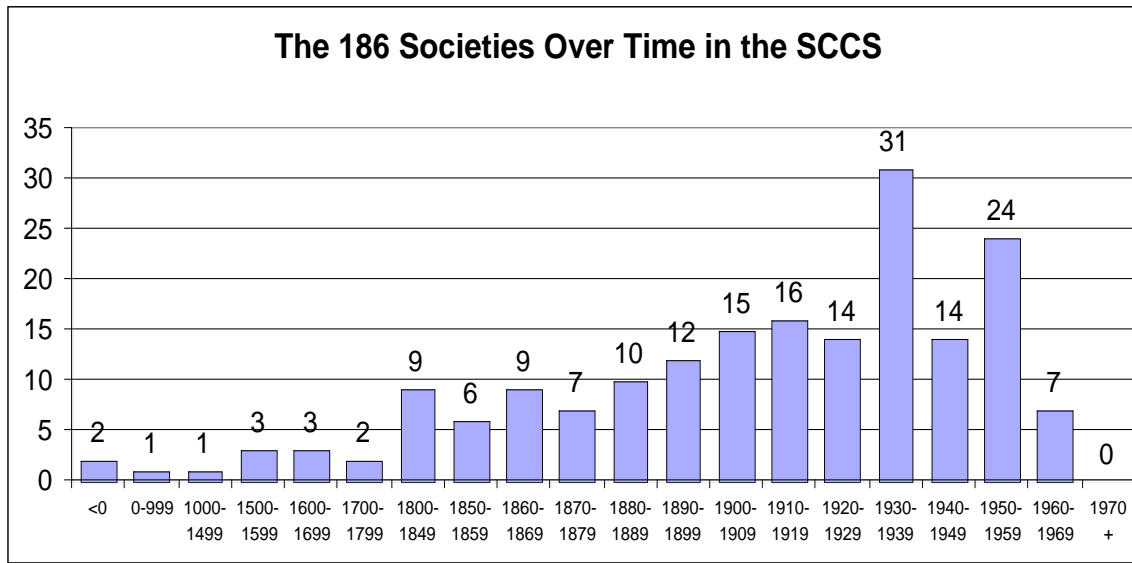
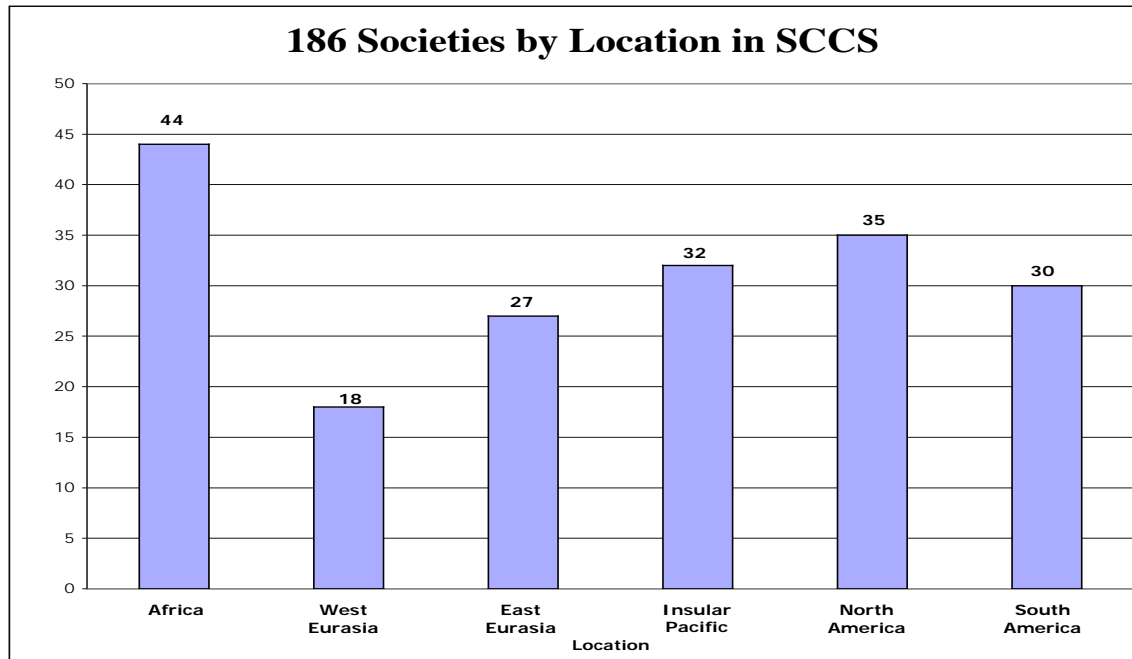
Figure 1**Panel A: The 186 SCCS societies over time****Panel B: The 186 SCCS societies by geographical location**

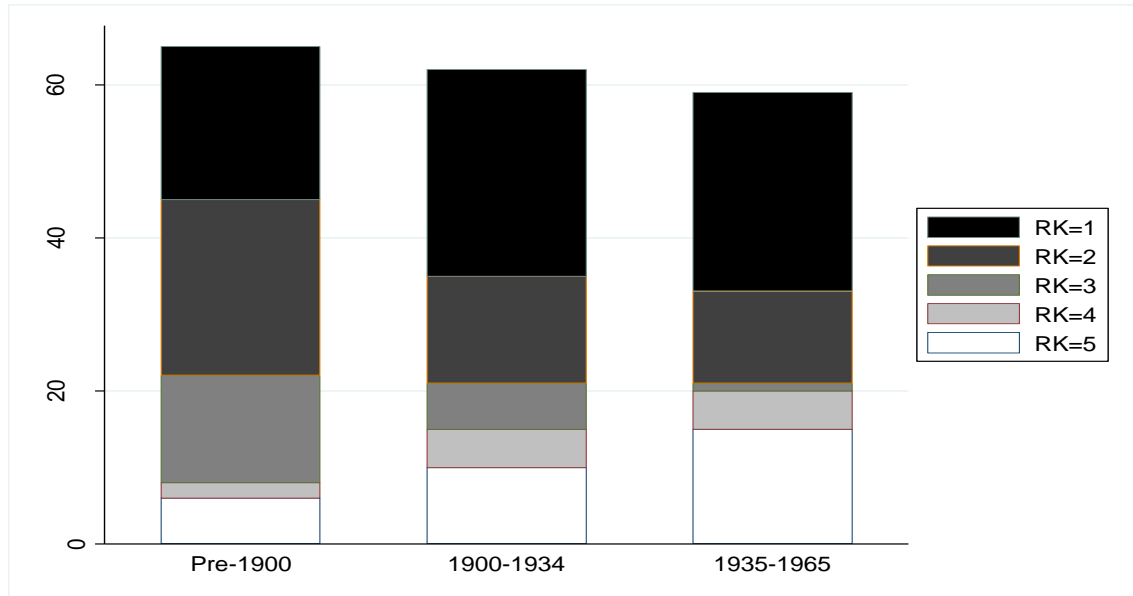
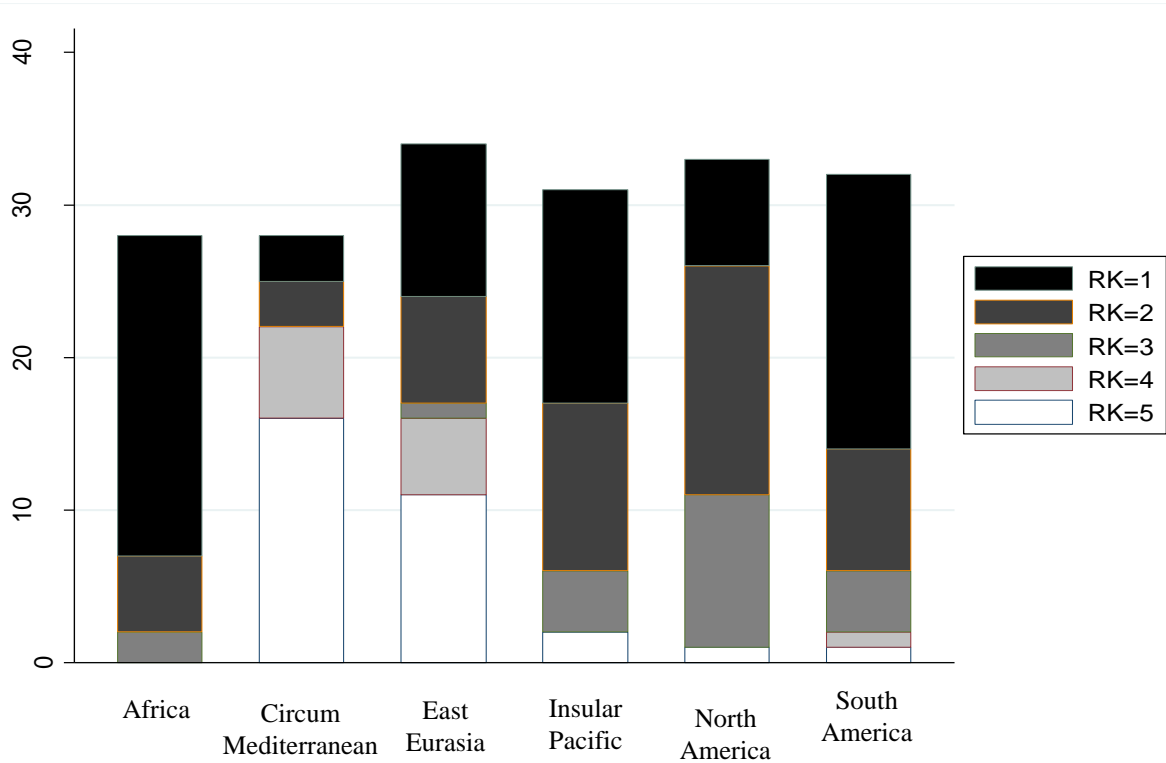
Figure 2*Panel A: The 186 SCCS societies over time by recordkeeping score**Panel B: The 186 SCCS societies by region and recordkeeping score*

Figure 3

The emergence of external recordkeeping and its relation to economic interaction and outcomes

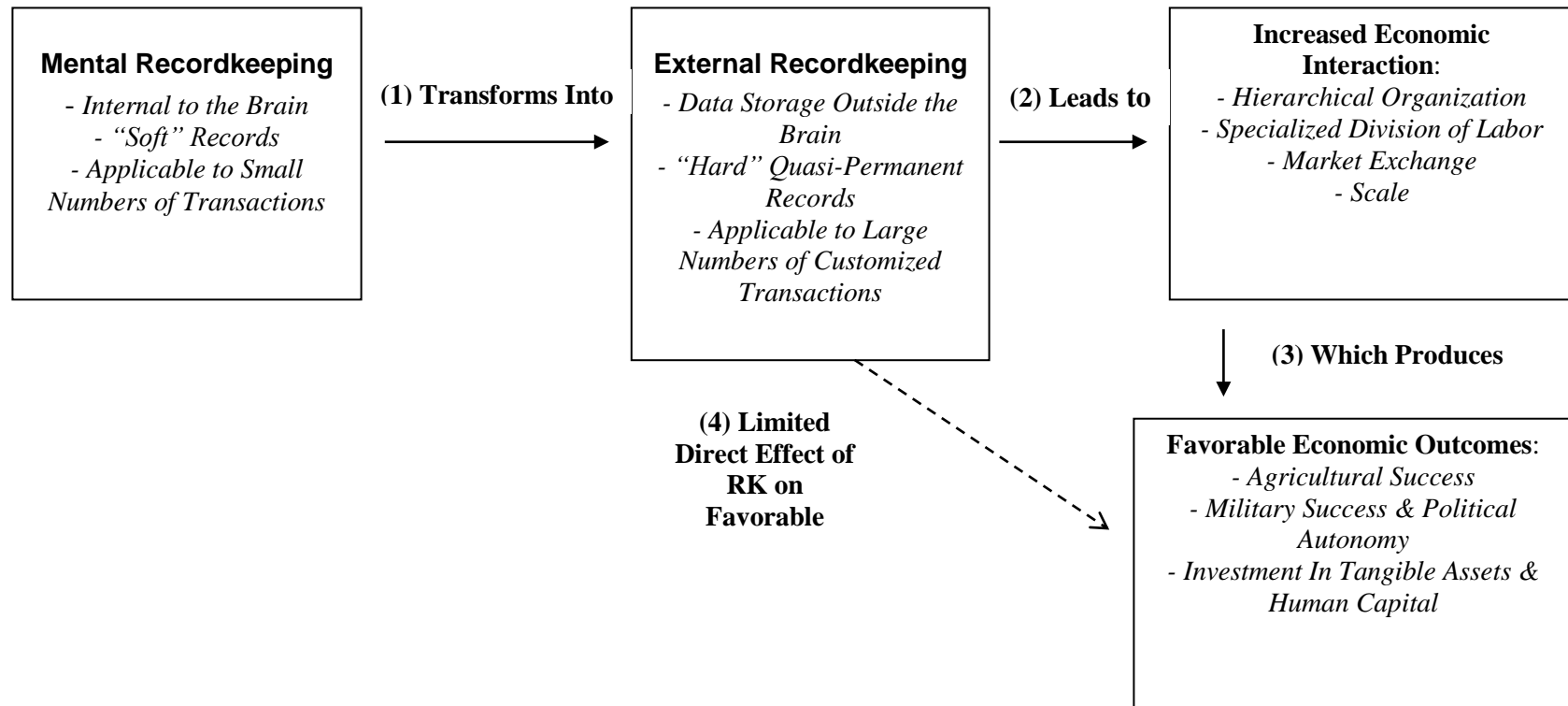
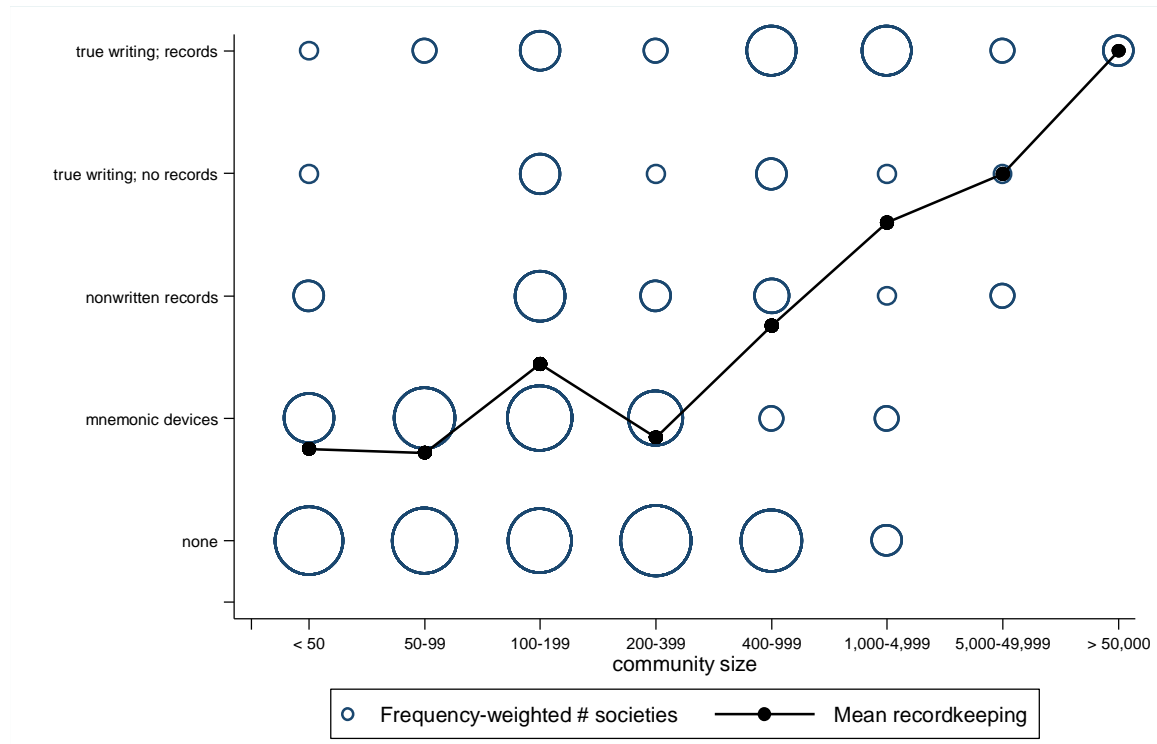


Figure 4**Panel A: Mean and Frequencies of *Recordkeeping* Score Plotted Against *Community Size***

Spearman $\rho = .32$ ($n=185$, $p < .01$)

$$\text{RECORDKEEPING}_i = \alpha + \beta_1 \text{COMM_SIZE}_i + \beta_2 \text{COMM_SIZE}_i * \text{LARGE_COMM}_i + \beta_3 \text{LARGE_COMM}_i + \varepsilon_i$$

Variable	Pred. sign	Coef.	p-value
Community Size	+	0.54	0.01
Community Size * Large Community	+	0.52	0.02
Large Community	+/-	- 3.35	0.00

RECORDKEEPING is SCCS variable #149 (Writing and Records) with categories defined on the y-axis in Panel A. COMM_SIZE is SCCS variable #63 (Community Size) with categories defined on the x-axis in Panel A. LARGE_COMM is an indicator variable equal to 1 if COMM_SIZE is greater than 200 persons and equal to 0 if COMM_SIZE is less than 200 persons. The model is estimated using Ordered Logit. P-values are one-tailed where the sign is predicted and are based on heteroskedasticity-consistent standard errors adjusted for residual correlation among observations belonging to the same major language family.

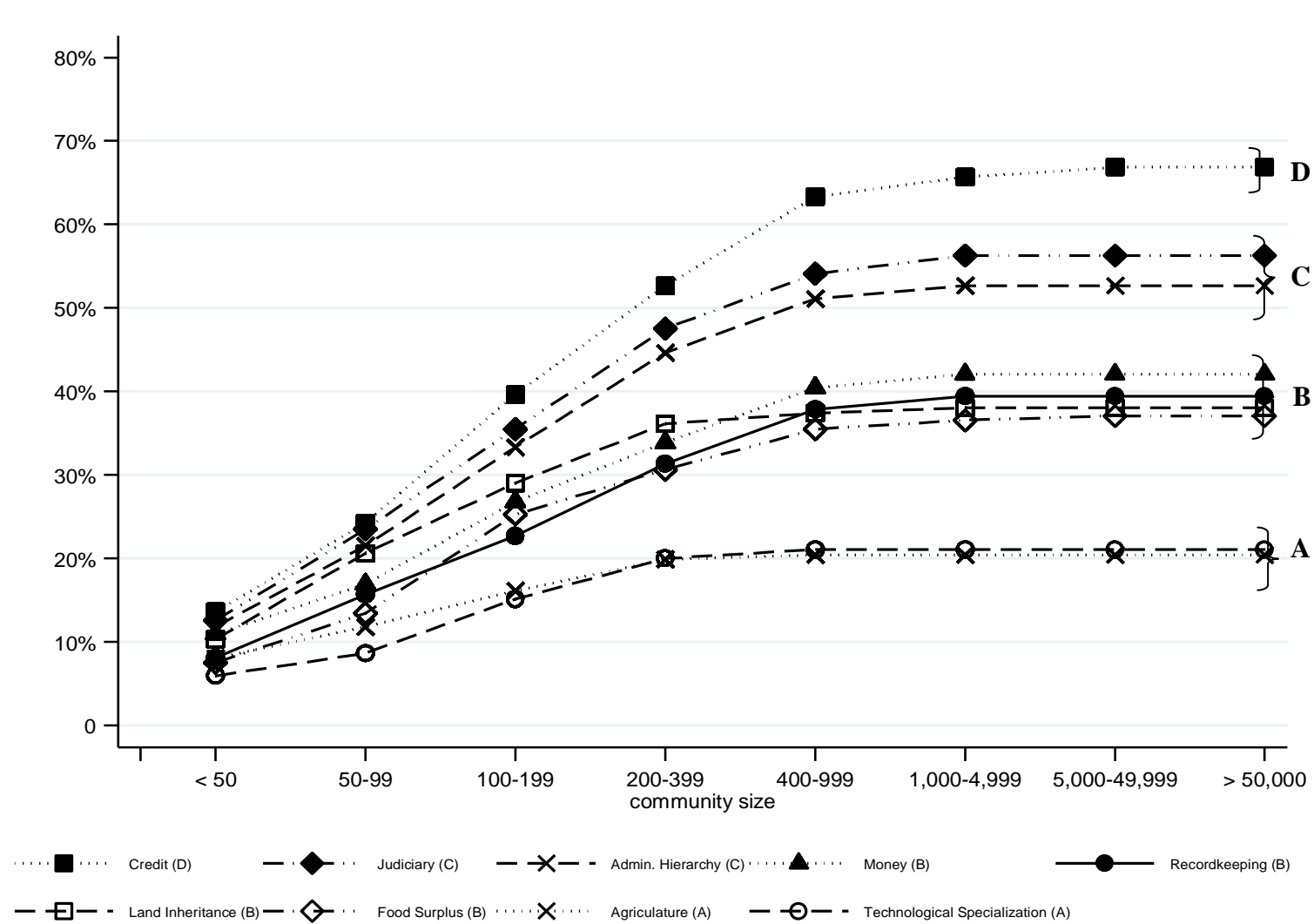
Figure 4 (cont.)**Panel B: Cumulative percentage of SCCS Societies where a particular economic institution is absent plotted against community size**

Table 1

Ethnographic Variables from Standard Cross-Cultural Sample (SCCS) for Recordkeeping, Group Size, and Other Measures Used in Empirical Tests

Panel A: Recordkeeping Variable

Writing and Records (SCCS Variable #149; n=186)

- 1 = None
- 2 = Mnemonic devices
- 3 = Non-written records
- 4 = True writing; no records
- 5 = True writing; records

Panel B: Group Size Variable

Community Size (SCCS Variable #63; n=185)

- 1 = < 50 persons
- 2 = 50–99 persons
- 3 = 100–199 persons
- 4 = 200–399 persons
- 5 = 400–999 persons
- 6 = 1,000–4,999 persons
- 7 = 5,000–49,999 persons
- 8 = > 50,000 persons

Panel C: Other SCCS Variables Used in Empirical Analysis (See Appendix for definitions)

Variable	Sample Size	SCCS Variable #
<u>Used in Factor Analyses</u>		
<i>Market Exchange & Property Rights</i>		
Intercommunity trade as a food source	183	1
Food surplus via storage	186	21
Land transport	186	154
Money	186	155
Predominant use of animal husbandry	186	244
Recent large-scale slaveholding	186	919
<i>Specialized Production & Division of Labor</i>		
Agriculture	186	151
Technological specialization	186	153
Intensity of cultivation	186	232
<i>Use of hierarchies & government</i>		
Executive	183	85
Judiciary	183	89
Administrative hierarchy	183	91
Political integration	186	157
Jurisdictional hierarchy beyond local community	184	237
Class stratification	186	270

Table 1 (cont.)**Panel C: Other SCCS Variables Used in Empirical Analysis (cont.) (See Appendix for definitions)**

Variable	Sample Size	SCCS Variable #
<u>Used in Factor Analyses (cont.)</u>		
<i>Demographic</i>		
Fixity of settlement	186	61
Urbanization	186	152
Settlement patterns	186	231
Population density	186	1130
<u>Societal Outcome Measures</u>		
Large or impressive structures	186	66
Political autonomy	184	81
Guidance of formal schooling	177	Sum of 425 - 428
Resource base	186	859
Frequency of internal warfare	160	891
Military success	172	908
Cropping index	162	1128
Occurrence of Famine	170	1265
<u>Controls</u>		
<i>Endowments</i>		
Region	186	200
Climate type	186	857
Agricultural potential	186	921
<i>Community</i>		
Compactness of settlement	186	62
Community integration	186	73
Prominent community ceremonials	186	74
Family size	186	80
Domestic organization	185	210
Jurisdictional hierarchy of local community	186	236
<u>Other Variables Used in Figure 4, Panel B</u>		
Credit Source	169	18
Inheritance of Land	155	278

SCCS variable numbers are the corresponding variable code in the Standard Cross-Cultural Sample database. Sample size is the number of societies (out of a possible 186) with non-missing coded data for that variable.

Table 2

Results of Factor Analysis to Specify Variables for Market Exchange, Specialized Production and Division of Labor, Use of Hierarchies & Government, and Demographics

Panel A: Market Exchange & Property Rights (Iterated principal factors)

Factor	Eigenvalue	Proportion explained	Cumulative explained
1	1.79	0.71	0.71
2	0.37	0.14	0.85
3	0.28	0.11	0.96
4	0.09	0.04	1.00
5	0.01	0.00	1.00
6	-0.00	-0.00	1.00

Panel B: Specialized Production & Division of Labor (Iterated principal factors)

Factor	Eigenvalue	Proportion explained	Cumulative explained
1	2.11	0.99	0.99
2	0.01	0.01	1.00
3	-0.00	-0.00	1.00

Panel C: Use of Hierarchies & Government (Iterated principal factors)

Factor	Eigenvalue	Proportion explained	Cumulative explained
1	4.39	0.88	0.88
2	0.51	0.10	0.98
3	0.09	0.02	1.00
4	0.01	0.00	1.00
5	0.01	0.00	1.00
6	-0.00	-0.00	1.00

Panel D: Demographics (Iterated principal factors)

Factor	Eigenvalue	Proportion explained	Cumulative explained
1	2.59	0.88	0.88
2	0.32	0.11	0.99
3	0.04	0.01	1.00
4	-0.00	-0.00	1.00

Table 2 (cont.)**Panel E: Factor loadings (One factor retained from each)**

	Factor 1 Mkt Exchange	Factor 2 Div Labor	Factor 3 Hierarchies	Factor 4 Demographics
Intercommunity trade as food source	0.54			
Money	0.66			
Land transport	0.62			
Animal husbandry	0.66			
Food surplus via storage	0.21			
Recent large-scale slaveholding	0.24			
Technological specialization		0.61		
Agriculture		0.92		
Intensity of cultivation		0.95		
Administrative hierarchy			0.92	
Juris. hierarchy beyond local community			0.84	
Executive			0.82	
Judiciary			0.83	
Political integration			0.92	
Class stratification			0.71	
Population density				0.75
Fixity of settlement				0.94
Settlement patterns				0.88
Urbanization				0.52

Panel F: Pearson/Spearman Correlation Matrix

Pearson (Spearman) correlations are shown above (below) the diagonal. The number of observations is reported below each correlation coefficient. Two-tailed p-values were less than .005 for all coefficients.

Variable	RK	Community Size	Market Exchange	Division of Labor	Hierarchies, Government	Demographics
Recordkeeping		0.41 185	0.66 183	0.46 186	0.58 180	0.31 186
Comm. Size	0.32 185		0.48 182	0.55 185	0.46 180	0.55 185
Mkt Exchange	0.54 183	0.43 182		0.52 183	0.66 177	0.42 183
Div of Labor	0.43 186	0.55 185	0.53 183		0.54 180	0.75 186
Hier & Govt	0.49 180	0.44 180	0.65 177	0.52 180		0.50 180
Demographics	0.35 186	0.61 185	0.50 183	0.74 186	0.57 180	

Table 3*Association Between Recordkeeping and Market Exchange, Division of Labor, Hierarchies & Government and Demographics*

This table presents the association between *Recordkeeping* and broad economic institutions. Community size (related to Dunbar's number) is also investigated as a variable that moderates the relationship between *Recordkeeping* and the institutional factors. Two models are estimated for each institutional factor:

$$(1) \text{Institution}_i = \alpha_0 + \beta_1 \text{RK_B}_i + \beta_2 \text{AgPotential}_i + \beta_3 \text{Climate}_i + \text{Region Dummies}_i + \varepsilon_i$$

$$(2) \text{Institution}_i = \alpha_0 + \beta_1 \text{RK_B}_i + \beta_2 \text{Large_Comm}_i + \beta_3 \text{RK_B} * \text{Large_Comm}_i + \beta_4 \text{AgPotential}_i + \beta_5 \text{Climate}_i + \text{Region Dummies}_i + \varepsilon_i$$

where *Institution* varies by model and is one of the four factors: *Market Exchange*, *Division of labor*, *Hierarchies*, or *Demographics*.

Variable	Pred. Sign	<i>Market Exchange</i>		<i>Division of labor</i>		<i>Hierarchies</i>		<i>Demographics</i>	
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
RK_B	+	0.45 (0.00)	0.28 (0.03)	0.39 (0.01)	0.26 (0.08)	0.53 (0.00)	0.53 (0.00)	0.21 (0.09)	0.08 (0.37)
Large_Comm			0.16 (0.17)		0.41 (0.01)		0.29 (0.11)		0.49 (0.02)
RK_B*Large_Comm	+		0.43 (0.03)		0.36 (0.04)		0.03 (0.45)		0.35 (0.05)
<i>Controls</i>									
AgPotential		0.02 (0.22)	0.01 (0.61)	0.07 (0.00)	0.06 (0.00)	0.05 (0.01)	0.04 (0.06)	0.08 (0.00)	0.06 (0.00)
Climate		0.04 (0.34)	0.04 (0.33)	0.13 (0.01)	0.11 (0.01)	0.15 (0.00)	0.14 (0.00)	0.19 (0.00)	0.18 (0.00)
Region dummies		y	y	y	y	y	y	y	y
Adj. R ²		0.44	0.50	0.36	0.46	0.38	0.40	0.32	0.45
N		177	177	177	177	177	177	177	177

This sample is derived from the 186 societies of the Standard Cross Cultural Sample (SCCS), with N reporting the number of observations in each regression. The models are estimated using OLS. *Market Exchange*, *Hierarchies*, *Division of Labor*, and *Demographics* are our names given to the factors derived from the factor analysis in Table 3. The factor is the dependent variable in the appropriate model. *RK_B* is a transformed binary version of SCCS #149 (Records and Writing) where 0 indicates recordkeeping of any kind is absent and 1 indicates recordkeeping of any kind is present. *Large_Comm* is an indicator variable that equals 0 when Community Size is less than 200 persons and equals 1 when *Community Size* is greater than 200 persons. *Community Size* is SCCS #63 and denotes the typical size of communities from the society. *AgPotential* represents the Agricultural Potential (SCCS #921) of the society's region and is defined as the sum of land slope, soils, and climate scales – a more positive value indicates greater agricultural potential. *Climate* (SCCS #857) is a 6-scale categorical variable ordered in terms of open access to rich ecological resources. *Region* dummies represent dummy variables based on which of the 6 major world regions the society is located in. The associated p-values are one-tailed when a signed prediction is present and are based on heteroskedasticity-consistent standard errors adjusted for residual correlation among observations belonging to the same major language family.

Table 4*The Association Between Societal Outcomes, Economic Institutions, and Recordkeeping*

This table presents evidence of how economic institutions mediate the effect of recordkeeping on economic outcomes.

The following ordered logistic models (1-3) are each estimated for different economic outcomes where the independent variable *Outcome* is replaced by the appropriate economic outcome variable from SCCS.

$$(1) \text{ Outcome}_i = \alpha_0 + \beta_1 \text{MKT}_i + \beta_2 \text{DIV}_i + \beta_3 \text{HIER}_i + \beta_4 \text{DEMOG} + \beta_5 \text{AgPotential}_i + \beta_6 \text{Climate}_i +$$

$$\text{Community Controls}_i + \text{Region Dummies}_i + \varepsilon_i$$

$$(2) \text{ Outcome}_i = \alpha_0 + \beta_1 \text{RK}_i + \beta_2 \text{MKT}_i + \gamma_3 \text{DIV}_i + \beta_4 \text{HIER}_i + \beta_5 \text{DEMOG} + \beta_6 \text{AgPotential}_i + \beta_7 \text{Climate}_i +$$

$$\text{Community Controls}_i + \text{Region Dummies}_i + \varepsilon_i$$

$$(3) \text{ Outcome}_i = \alpha_0 + \beta_1 \text{RK}_i + \beta_2 \text{AgPotential}_i + \beta_3 \text{Climate}_i + \text{Community Controls}_i + \text{Region Dummies}_i + \varepsilon_i$$

Outcome Measure	N	RK	MKT	DIV	HIER	DEMOG	Pseudo R²
<i>Agricultural Success</i>							
Resource base	176		1.25 (0.00)	0.17 (0.66)	0.70 (0.00)	0.67 (0.08)	0.41
	176	-0.16 (0.55)	1.33 (0.00)	0.19 (0.63)	0.76 (0.00)	0.67 (0.09)	0.41
	176	0.50 (0.01)					0.27
Cropping Index	155		0.39 (0.11)	3.34 (0.00)	0.27 (0.18)	0.11 (0.79)	0.43
	155	0.17 (0.25)	0.30 (0.20)	3.31 (0.00)	0.22 (0.27)	0.11 (0.77)	0.44
	155	0.70 (0.00)					0.18
Occurrence of famine	161		0.17 (0.62)	0.02 (0.95)	-0.38 (0.19)	-0.23 (0.60)	0.15
	161	0.01 (0.94)	0.16 (0.64)	0.02 (0.96)	-0.38 (0.18)	-0.22 (0.60)	0.15
	161	-0.11 (0.55)					0.14
<i>Warfare/Political Stability</i>							
Military success	165		0.15 (0.53)	0.14 (0.68)	0.37 (0.12)	0.13 (0.62)	0.06
	165	0.11 (0.46)	0.07 (0.80)	0.11 (0.73)	0.34 (0.15)	0.15 (0.56)	0.06
	165	0.28 (0.04)					0.05
Frequency of internal warfare	154		0.11 (0.69)	-0.10 (0.74)	0.10 (0.69)	-0.10 (0.76)	0.11
	154	-0.21 (0.18)	0.25 (0.42)	-0.07 (0.82)	0.18 (0.47)	-0.13 (0.71)	0.12
	154	-0.09 (0.53)					0.11
Political autonomy	176		0.14 (0.73)	0.35 (0.06)	1.46 (0.00)	-0.49 (0.01)	0.17
	176	0.29 (0.14)	-0.05 (0.91)	0.32 (0.08)	1.35 (0.00)	-0.47 (0.01)	0.17
	176	0.65 (0.00)					0.11

Table 4 (cont.)

Outcome	N	RK	MKT	DIV	HIER	DEMOG	Pseudo R ²
<i>Investment in Tangible and Human Capital</i>							
Large or impressive structures	176		− 0.52 (0.25)	0.47 (0.14)	0.66 (0.08)	1.41 (0.00)	0.25
	176	0.03 (0.85)	− 0.54 (0.25)	0.46 (0.15)	0.65 (0.08)	1.40 (0.00)	0.25
	176	0.35 (0.01)					0.15
Education investment	168		0.58 (0.01)	0.57 (0.02)	0.08 (0.35)	0.36 (0.06)	0.08
	168	0.28 (0.08)	0.41 (0.08)	0.55 (0.01)	− 0.03 (0.68)	0.36 (0.05)	0.09
	168	0.56 (0.00)					0.06

This sample is derived from the 186 societies of the Standard Cross Cultural Sample (SCCS), with N reporting the number of observations in each regression. The models are estimated using OLS or Order Logit depending on the dependent variable. The reported R² is the pseudo R². The dependent variable in each model is listed in column one with expanded definitions in the Appendix. *RK* is *Recordkeeping* (SCCS #149). *MKT*, *DIV*, *HIER*, and *DEMOG* represent the four factors (*Market Exchange*, *Hierarchies*, *Division of Labor*, and *Demographics*) derived from the factor analysis in Table 3. *AgPotential* represents the Agricultural Potential (SCCS #921) of the society's region and is defined as the sum of land slope, soils, and climate scales – a more positive value indicates greater agricultural potential. *Climate* (SCCS #857) is a 6-scale categorical variable ordered in terms of open access to rich ecological resources. *Community Controls* denotes a set of variables added to the model to control for community cultures and norms beyond the factors. These variables are *Compactness of Settlement* (SCCS #62), *Community Integration* (SCCS #73), *Prominent Community Ceremonials* (SCCS #74), *Family Size* (SCCS #80), *Domestic Organization* (#210), and *Jurisdictional Hierarchy of the Local Community* (SCCS #236). *Region* dummies represent dummy variables based on which of the 6 major world regions the society is located in. The associated p-values are two-tailed and are based on heteroskedasticity-consistent standard errors adjusted for residual correlation among observations belonging to the same major language family.

Table 5*Factor Analysis of Economic Development and its Use as a Measure of Societal Outcome***Panel A: Economic Development (Iterated principal factors)**

Factor	Eigenvalue	Proportion explained	Cumulative explained
1	1.89	0.56	0.56
2	0.64	0.19	0.75
3	0.33	0.10	0.85
4	0.21	0.06	0.91
5	0.16	0.05	0.96
6	0.11	0.03	0.99
7	0.03	0.01	1.00
8	−0.00	−0.00	1.00

Panel B: Factor loadings for Economic Development (One factor retained)

Factor 1 (Economic Development)	
Resource base	0.55
Military success	0.26
Political autonomy	0.39
Cropping index	0.75
Frequency of internal warfare	0.04
Large or impressive structures	0.52
Investment in education	0.58
Occurrence of famine	−0.11
N = 130	

Panel C: OLS Estimation Results for Model of Association Between Economic Development, Economic Institutions, and Recordkeeping

The following models (1-3) are each estimated using OLS:

- (1) $Economic\ Development_i = \alpha_0 + \beta_1 MKT_i + \beta_2 DIV_i + \beta_3 HIER_i + \beta_4 DEMOG_i + \beta_5 AgPotential_i + \beta_6 Climate_i + Community\ Controls_i + Region\ Dummies_i + \varepsilon_i$
- (2) $Economic\ Development_i = \alpha_0 + \beta_1 RK_i + \beta_2 MKT_i + \gamma_3 DIV_i + \beta_4 HIER_i + \beta_5 DEMOG_i + \beta_6 AgPotential_i + \beta_7 Climate_i + Community\ Controls_i + Region\ Dummies_i + \varepsilon_i$
- (3) $Economic\ Development_i = \alpha_0 + \beta_1 RK_i + \beta_2 AgPotential_i + \beta_3 Climate_i + Community\ Controls_i + Region\ Dummies_i + \varepsilon_i$

Outcome Measure	N	RK	MKT	DIV	HIER	DEMOG	R ²
<i>Economic Development</i>	126		0.15 (0.08)	0.48 (0.00)	0.20 (0.00)	0.06 (0.33)	0.82
	126	0.09 (0.00)	0.10 (0.28)	0.46 (0.00)	0.17 (0.01)	0.06 (0.23)	0.83
	126	0.32 (0.00)					0.59

This sample is derived from the 186 societies of the Standard Cross Cultural Sample (SCCS), with N reporting the number of observations in each analysis. *Economic Development* is the retained factor from the factor analysis in Panel A & B. RK is *Recordkeeping* (SCCS #149). MKT, DIV, HIER, and DEMOG represent the four factors (*Market Exchange*, *Hierarchies*, *Division of Labor*, and *Demographics*) derived from the factor analysis in Table 3. AgPotential, Climate, *Community Controls*, and Region dummies are defined in Table 4. The associated p-values are two-tailed and are based on heteroskedasticity-consistent standard errors adjusted for residual correlation among observations belonging to the same major language family.

Appendix: SCCS Variable definitions

Constructs	SCCS Variables	Coding
Recordkeeping	V149: Records and writing	1 = None 2 = Mnemonic devices 3 = Nonwritten records 4 = True writing; no records 5 = True writing; records
Community size	V63: Community size	1 = < 50 2 = 50-99 3 = 100-199 4 = 200-399 5 = 400-999 6 = 1,000-4,999 7 = 5,000-49,999 8 = > 50,000
Market Exchange & Property Rights	V1: Intercommunity trade food source	1 = No trade 2 = No food imports 3 = Salt & minerals only 4 = < 10% of food 5 = < 50% of food/less local source 6 = > 50% of food
	V155: Money	1 = None 2 = Domestically usable particles 3 = Alien currency 4 = Elementary forms 5 = True money
	V154: Land transport	1 = Humans only 2 = Pack animals 3 = Draft animals 4 = Animal-drawn vehicles 5 = Automotive vehicles
	V244: Predominant use of animal husbandry ¹²	1 = Absence or near absence of large domestic animals 2 = Pigs the only large domestic animals 3 = Sheep and/or goats without larger domestic animals 4 = Equine animals (horses, donkeys); deer (reindeer); camels, alpacas, or llamas 5 = Bovine animals (cattle, mithun, water buffalo, yaks)
	V21: Food surplus via storage	1 = None or barely adequate 2 = Simple or adequate 3 = Complex or more than adequate
	V919: Recent large-scale slaveholding	1 = Not present 2 = Present at or immediate prior to pinpointing date 3 = Present within past fifty years 4 = Present within past one hundred years 5 = Present within past two hundred years 6 = Present within past three hundred years

¹² In the SCCS, Predominant use of animal husbandry separates Equine animals; Deer; and Camels, alpacas or llamas into three separate categories.

Appendix: SCCS Variable definitions (cont.):

Constructs	SCCS Variables	Coding
Specialized Production & Division of Labor	V153: Technological specialization ¹³	1 = No pottery, loom weaving, metalwork 2 = One of pottery, loom weaving, or metalwork 3 = Smiths, weavers, and potters
	V151: Agriculture	1 = None 2 = 10% of food supply 3 = 10%; secondary 4 = primary; not intensive 5 = primary; intensive
	V232: Intensity of cultivation	1 = No agriculture 2 = Casual agriculture, incidental to other 3 = Extensive or shirting agriculture 4 = Horticulture 5 = Intensive agriculture 6 = Intensive irrigated agriculture
Use of Hierarchies & Govt	V91: Administrative hierarchy	1 = Absent 2 = Popular Assemblies 3 = Heads of kin groups 4 = Heads of decentralized territorial divisions 5 = Heads of centralized territorial divisions 6 = Part of centralized system
	V237: Jurisdictional Hierarchy beyond local community	1 = No levels (no political authority beyond community) 2 = One level (e.g., petty chiefdoms) 3 = Two levels (e.g., larger chiefdoms) 4 = Three levels (e.g., states) 5 = Four levels (e.g., large states)
	V85: Executive	1 = Absent 2 = Council 3 = Executive and council 4 = Plural executive 5 = Single leader
	V89: Judiciary	1 = Absent 2 = Not local 3 = Executive 4 = Appointed by executive 5 = Priesthood 6 = Hereditary
	V157: Political integration	1 = None 2 = Autonomous local communities 3 = 1 level above community 4 = 2 levels above community 5 = 3 levels above community
	V270: Class stratification	1 = Absence among free men 2 = Wealth distinctions 3 = Elite 4 = Dual 5 = Complex

¹³ Technological specialization is coded in SCCS as 1 = None, 2 = Pottery only, 3 = Loom weaving only, 4 = Metalwork only, 5 = Smiths, weavers, potters.

Appendix: SCCS Variable definitions (cont.)

Constructs	SCCS Variables	Coding
Demographics	V1130: Population density ¹⁴	1 = < 1 per square mile 2 = 1 - 4.9 per square mile 3 = 5 - 24.9 per square mile 4 = 25 - 99.9 per square mile 5 = 99 - 499.9 per square mile 6 = 500 + per square mile
	V61: Fixity of settlement	1 = Migratory 2 = Seminomadic-fixed then migratory 3 = Rotating among 2+ fixed 4 = Semisedentary – fixed core, some migratory 5 = Impermanent – periodically moved 6 = Permanent
	V234: Settlement Patterns	1 = Nomadic or fully migratory 2 = Seminomadic 3 = Semisedentary 4 = Compact but impermanent settlements 5 = Neighborhoods of dispersed family homesteads 6 = Separated hamlets, forming a single community 7 = Compact and relatively permanent settlements 8 = Complex settlements
	V152: Urbanization	1 = Fewer than 100 persons 2 = 100 – 199 persons 3 = 200 – 399 persons 4 = 400 – 999 persons 5 = Greater than 1000 persons
Societal Outcomes	V859: Resource base ¹⁵	1 = Low resources (ex. hunting, gathering, fishing) 2 = Unstable resources (ex. mounted hunting, shifting cultivation, intensive agriculture with no plow) 3 = High resources (ex. advanced horticulture with metal hoes, intensive agriculture with plow, pastoralism)
	V908: Military success ¹⁶	1 = No – its boundaries/population are shrinking 2 = Breaking even – what it loses in territory it takes from others 3 = No change – boundaries/population stationary (the population is able to replace those lost in war) 4 = Yes – its boundaries/population are expanding

¹⁴ Population density was changed from a 2-7 scale to a 1-6.

¹⁵ Resource base was collapsed from a 12-point scale to a 3-point scale.

¹⁶ The coding of Military success was reversed from the SCCS coding to facilitate interpretation.

Appendix: SCCS Variable definitions (cont.)

Constructs	SCCS Variables	Coding
Societal Outcomes (cont)	V81: Political autonomy	1 = Dependent totally 2 = Semi-autonomous 3 = Tribute paid 4 = De facto autonomy 5 = Equal status in pluralistic society 6 = Fully autonomous
	V1128: Cropping index	1 = No Agriculture or confined to non-food crops 2 = < 10% of land used per year 3 = 10%-29% of land used per year 4 = 30%-49% of land used per year 5 = 50%-99% of land used per year 6 = 100% or more of land used per year
	V891: Frequency of internal warfare	1 = continual 2 = frequent 3 = infrequent
	V66: Large or impressive structures	1 = None 2 = Residences of influential individuals 3 = Secular or public building(s) 4 = Religious or ceremonial building(s) 5 = Military structure(s) 6 = Economic or industrial buildings
	V425: Guidance of formal schooling (Early boys) ¹⁷ V426: Early girls V427: Late boys V428: Late girls	1 = Informal training, with min guidance 2 = Apprenticeship atypical or occasional 3 = Apprenticeship typical & frequent but informal training more prevalent 4 = Apprenticeship predominant 5 = Formal schooling atypical or occasional 6 = Formal schooling typical and frequent
	V170: Occurrence of famine ¹⁸	1 = Very High 2 = High 3 = Low 4 = Very low
Controls: Endowments	V921: Agricultural potential: sum of Land slope, soils, climate scales	4 = poorest potential, 5-22 = graded scale 23 = richest potential
	V200: Region	1 = Africa: Exclusive of Madagascar and Sahara 2 = Circum-Mediterranean: North Africa, Europe, Turkey, Caucasus, Semitic Near East 3 = East Eurasia: including Madagascar and Islands in Indian Ocean 4 = Insular Pacific: including Australia, Indonesia, Formosa, Phillipines 5 = North America: indigenous societies to the Isthmus of Tehuantepec 6 = South America: including Antilles, Yucatan, Central America

¹⁷ Variables 425-428 were summed to create a new variable “Education” that proxies for a society’s investment in education

¹⁸ The coding for Occurrence of famine was reversed from the SCCS coding to facilitate interpretation.

Appendix: SCCS Variable definitions (cont.)

Constructs	SCCS Variables	Coding
Controls: Endowments (cont.)	V1696: Biome	1 = Tundra, taiga, boreal forest 2 = Temperate deciduous, scrub, or temperate rain forest 3 = Tropical or temperate grassland 4 = Tropical rain forest 5 = Desert
	V857: Climate type: ordered in terms of open access to rich ecological resources	1 = Polar 2 = Desert or cold steppe 3 = Tropical rainforest 4 = Moist temperate 5 = Tropical savanna 6 = Tropical highlands
Controls: Community	V236: Jurisdictional Hierarchy of local community	1 = Two levels (theoretical minimum, e.g. family and band) 2 = Three levels 3 = Four levels (e.g. nuclear family, extended family, clan barrios, village levels)
	V73: Community integration	1 = Lacking/low compared to segments or larger polity 2 = By common residence only 3 = Common identity, dialect, subculture 4 = Overlapping kin ties 5 = Common social or economic status 6 = Common political ties 7 = Common religious ties
	V74: Prominent community ceremonials	1 = Rites of passage 2 = Calendrical 3 = Magical or religious 4 = Individual sponsored and communally attended (e.g. potlatch)
	V80: Family size	1 = Nuclear monogamous 2 = Nuclear polygynous 3 = Stem family 4 = Small extended 5 = Large extended
	V62: Compactness of settlement ¹⁹	1 = Dispersed 2 = Spatially separated sub-settlements 3 = Partially dispersed with central core 4 = Compact
	V210: Domestic organization	1 = Nuclear family, monogamous 2 = Nuclear family, occasional polygyny 3 = Polyandrous families 4 = Polygynous: unusual co-wives 5 = Polygynous: usual co-wife 6 = Minimal extended families 7 = Small extended families 8 = Large extended families

¹⁹ Compactness of settlement was recoded to be ordinal as suggested in the SCCS

Appendix: SCCS Variable definitions (cont.)

Constructs	SCCS Variables	Coding
Other Variables from Figure 4, Panel B		
	V18: Credit source	1 = Personal loans between friends or relatives 2 = Internal money lending specialists 3 = External money lending specialists 4 = Banks or comparable institutions
	V278 Inheritance of real property (land) ²⁰	0 = Absence of individual property rights or rules 1 = Inheritance based on familial ties

²⁰ Inheritance of real property was transformed from the seven level SCCS coding based on nature of descent dictating inheritance to a 0 – 1 variable.