

## Transaction Records, Impersonal Exchange, and Division of Labor

Sudipta Basu<sup>1</sup>, Marcus Kirk<sup>2</sup>, Greg Waymire<sup>2\*</sup>

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

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

Draft as of February 24, 2009

---

### Abstract

Adam Smith hypothesized that impersonal exchange was necessary for a society to develop specialized division of labor and create wealth. Douglass North and Vernon Smith argue that successful developed economies are the result of institutions. We hypothesize and provide evidence from ethnographic data that the basic accounting technology of recording transactions is associated with more extensive impersonal exchange and increased specialization in the division of labor. Our intuition is that extensive impersonal exchange requires reliable memory of trading partners' past behavior to sustain trust and encourage reciprocity when a group expands beyond the size of traditional hunter-gatherer groups. Our findings are consistent with the hypothesis that transaction records are necessary for the emergence of complex economies as suggested by the archaeological evidence of recordkeeping in Mesopotamian societies 10,000 years ago.

*Keywords:* Extent of market, accounting history, economic development.

---

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

*Email address:* Gregory\_Waymire@bus.emory.edu

We acknowledge helpful comments received from Mark Kohlbeck, Eric Press, Richard Sansing, Denise Schmandt-Besserat, participants in the Emory University Anthropology Department Workshop Series on Human Behavior and Evolution, the 2007 University of Oklahoma Accounting Research Conference, the Fifth *Accounting History* International Conference, the 2008 FARS Midyear Meeting, the 2008 Annual Meeting of the International Society for New Institutional Economics, the 2008 Annual Meeting of the American Accounting Association, and accounting seminars at Arizona State, Chicago, Florida, Minnesota, Northwestern, Southern California, Temple, and Wisconsin. The Goizueta Business School at Emory University provided financial support for this research. This paper previously circulated under the title "Recordkeeping and Economic Development."

Human economies vary considerably in scale, complexity, and performance; some generate great wealth while others remain mired in poverty. Adam Smith (1776/1976, Part I, Chapter II) argued that the growth of economies derived from extensive impersonal exchange, which grew out of a human “propensity to truck, barter, and exchange one thing for another.” Humans sustain cooperation better than other primate species in part because we can remember and communicate information about the cooperative acts of others, which is a prerequisite for reciprocity and reputation formation (Axelrod and Hamilton 1981; Nowak and Sigmund 2005). At the same time, the evolved proclivities and abilities of the brain that favor exchange and cooperation can account for human groups only up to a size of about 200 persons (Dunbar 1992). What role did the institution of recordkeeping play in allowing some economies to circumvent the biological constraints of memory to expand impersonal exchange and produce great wealth?

The institutions societies use to govern economic and social interaction have been suggested as necessary for economic development (North 2005; Smith 2008).<sup>1</sup> These institutions include legal codes that support property rights and money that relaxes constraints inherent to barter exchange, both of which date back thousands of years (Saggs 1989, 156-175; Redish 2003). Recordkeeping for exchange transactions is an even older institution found in the first human settlements of Mesopotamia circa 8000 BCE (Schmandt-Besserat 1992). Humans first invented writing to keep records (Nissen *et al.* 1993), which coincided in time (c. 3000 BCE) with the emergence of the first cities, underscoring the central importance of transaction records.

Today’s accounting standards require widespread use of fair value accounting, which eschews accounting values established through past “arms length” exchange for estimates of a price that would hypothetically prevail if the same transaction were consummated today (FASB 2006). Debates about fair

---

<sup>1</sup> We use “institution” in the broad sense of Douglass North (1991, 97): “Institutions are the humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct) and formal rules (constitutions, laws, property rights). Throughout history, institutions have been devised by human beings to create order and reduce uncertainty in exchange ... They evolve incrementally, connecting the past with the present and the future; history in consequence is largely a story of institutional evolution in which the historical performance of economies can only be understood as part of a sequential story.”

value accounting have focused on the usefulness and reliability of fair value estimates, but have not considered what information is lost when the historical record of consummated exchange is discarded. This is an important issue since, in the absence of any theory and evidence about why humans recorded economic transactions in the first place, there is little scientific basis for asserting that price estimates in hypothetical transactions provide “better” information that is superior to that acquired from previously consummated exchanges.

Basu and Waymire (2006) hypothesize that transaction records emerge to symbolically represent the history of exchange in a more permanent manner external to the human brain. External records lessen the chances of individual memory failure and are valuable in tracking a trading partner’s past behavior as a basis for current decisions. Records can also establish reliable social memory and common knowledge useful to two or more parties in structuring an exchange. For example, “hard” records that are verified by witnesses can make it “difficult for people to disagree” later about whether past promises have been fulfilled (Ijiri 1975, 36). As recordkeeping evolves to encode more information, it enables drafting and enforcing contracts that govern complex exchange transactions across time and geographical boundaries – e.g., reliable records are needed in establishing the property rights that facilitate modern capitalism (De Soto 2000).

Basu and Waymire (2006) predict that (1) recordkeeping emerges because increasing exchange complexity taxes the brain’s memory resources, and (2) accounting records work in tandem with other fundamental institutions to promote economic development. These predictions can be investigated in several complementary ways. One is to conduct experiments using neuroscientific methods to investigate whether the human brain’s evaluation of exchange parallels culturally evolved accounting practices (Dickhaut *et al.* 2009a; 2009b). A second avenue is to investigate whether the causal links inherent in the Basu and Waymire (2006) story are observed in a controlled experimental setting (Basu *et al.* 2009). Another possibility, which we explore in this paper, is to use naturally occurring data to see whether institutional and economic development is greater in those societies that have developed technologies for recording transactions.

We present evidence on whether the association between recordkeeping technology and societal size and complexity in ancient Mesopotamia generalizes to other human societies, and how strongly the prevalence of recordkeeping is associated with the presence of other fundamental economic institutions. We explore these issues using field data collected by ethnographers and archaeologists from a broad cross-section of human societies, and subsequently coded into machine-readable data by Murdock and White (1969). Murdock and White's Standard Cross-Cultural Sample (SCCS) provides extensive coded data for a variety of cultural variables – presently over 2,000 – for 186 societies selected to maximize the cross-society independence of observations. SCCS societies are “pinpointed” to specific dates that vary across societies. The SCCS data include a variable that measures a society's recordkeeping technology as well as numerous measures of economic, social, and institutional development.

We use the SCCS data to empirically evaluate whether recordkeeping is a necessary institution for unleashing the economic forces of impersonal exchange and division of labor hypothesized by Adam Smith to be the ultimate source of economic wealth. We document that recordkeeping use and sophistication is greater in societies that have surpassed the modest levels suggested by Dunbar (1992), and also that recordkeeping is present as early as or earlier in economic development than other basic institutions such as money, property rights, hierarchical organizations, a judiciary, and the use of credit. This evidence suggests that basic accounting institutions are a precursor to rather than a result of economic complexity. Our analyses also demonstrate that the extent of impersonal exchange is positively associated with the use of recordkeeping, and that specialized division of labor and the level of capital accumulation are more extensive in societies with greater opportunities for market exchange. Collectively, our findings are consistent with the hypothesis that basic accounting institutions are necessary to foster the extensive impersonal exchange and complex economic interactions that characterize modern developed economies.

Our analysis complements other recent studies on the origins and consequences of basic accounting institutions (Basu and Waymire, 2006). First, Dickhaut *et al.* (2009a, 2009b) review the neuroscientific evidence for the proposition that the antecedent conditions of accounting records are

mental operations that parallel subsequent culturally evolved accounting principles. Second, Basu *et al.* (2009) show experimentally that people start recording transactions when their brains are “taxed” by increasing exchange complexity, and that these external records alleviate within-brain constraints to increase reciprocity and trust in exchanges between strangers. These parallel studies provide evidence for the causal relations that we argue generate our cross-societal associations. These papers, along with the evidence we report, collectively suggest that verifiable historical transaction records play a foundational role in the development of market economies.

As with all studies, ours is subject to important caveats. Because we examine naturally occurring data that are subject to measurement error and do not directly measure intertemporal change in economies, our analysis does not speak directly to causality in the relations between recordkeeping, exchange, and economic development. Thus, our paper is an attempt to investigate whether the experimental evidence presented in Basu, *et al.* (2009) is consistent with cross-cultural statistical associations between recordkeeping and patterns of economic interaction observed in societies at early stages of their development.

We first discuss the history of recordkeeping and describe how recordkeeping systems vary across the SCCS societies. We then present our hypotheses. We next offer evidence on the emergence of recordkeeping in the course of social and economic development. Following that, we present evidence on the association between recordkeeping, impersonal exchange, and the division of labor. Conclusions from and implications of our findings are summarized in the paper’s final section.

## **I. The History of Transaction Records and Recordkeeping in SCCS Societies**

### *A. Historical Background on the Origins and Nature of Transaction Records*

Eric Kohler’s (1952, 356) *A Dictionary for Accountants* defines a “record” as “A book or document containing or evidencing some or all of the activities of an enterprise or containing or supporting a transaction, entry, or account.” Examples include “a book of account; subsidiary ledger; invoice; voucher; contract; correspondence; internal report; minute book.” This definition and examples

evoke images of a “paper trail” where writing symbolically portrays the types and quantities of goods exchanged, the persons buying and selling the goods, and their obligations under the exchange. Implicit in this characterization is that a written language, numbers, and a system of weights and measures already exist that shape the specifics of a transaction record.

Yet, this assumes more than existed in the earliest recordkeeping systems. Indeed, the earliest transaction records precede writing by thousands of years (Schmandt-Besserat, 1992). The sophistication of records is directly tied to how well various properties of exchange goods can be categorized, described and measured. A transaction record is merely an artifact that does not *per se* require written language or the use of refined weights and measures, although such things are useful (Hutchins 1999; Schmandt-Besserat 1999). A record is valuable because it allows a person to remember important attributes of a transaction; two or more persons can also use a transaction record to state their common knowledge about the nature of the transaction. Preserving exchange information on records outside the brain increases the life of common knowledge – that is, shared understandings can be carried forward in time to a greater extent than would be the case with the spoken word.

The oldest-known recordkeeping systems were used in Mesopotamian villages in 8000 BCE, with baked clay tokens and stones symbolizing individual agricultural commodities transferred between two parties (see the left-hand side of Panel A in Figure 1). By 4000 BCE, transfers of different manufactured goods were recorded with newer complex tokens with various shapes and incisions (Nissen *et al.* 1993; Schmandt-Besserat 1995, 1996). Tokens were sealed within baked hollow clay balls (“bullae”) by 3500 BCE. By 3200 BCE, personal seals of the transacting parties and witnesses, along with indentations of the enclosed tokens, were impressed on the exterior of the bulla before it was baked (see the right-hand side in Panel A of Figure 1).

Schmandt-Besserat (1995, 2100) sees the Mesopotamian token as a “mnemonic device by which to handle and store an unlimited quantity of data without risking the damages of memory failure.” Tokens and bullae stored data on several transaction attributes long before writing was invented. First, the unique token shapes allowed the type and quantity of commodities exchanged to be clearly identified. Second,

personal seals enabled identification of the exchange parties and witnesses from the affixed “signatures” on a bulla. Third, the external token impressions let everyone know the commodities involved without breaking open the bulla. This was advantageous since the bulla need then be broken only at the transaction settlement, thereby facilitating complex intertemporal exchange. Fourth, the baking of bullae and their storage in a secure location rendered the information “hard” both literally and also metaphorically in that it made it “difficult for people to disagree” later (Ijiri 1975, 36).

Another non-written recordkeeping system was the Incan quipu, first documented after the Spanish conquered that large and wealthy civilization around 1,500 AD. The Incan quipu (shown in panel B of Figure 1) was a “knotted string” on which transaction attributes were symbolized by thread colors and length as well as the number of knots and their location on the cord (Urton 2002). Like the early Mesopotamian tokens, the quipus kept track of tribute paid by citizens to the Incan government (Assadourian 2002, 120; Pollock 2004, 78-116).

The “tally stick” (see Panel C of Figure 1), relied on by the English Treasury as recently as the 19<sup>th</sup> century, was a receipt for tax collections by Royal agents (Robert 1956). The tally stick differed from tokens and quipus in that some writing was employed (Robert 1956, 76). Tally sticks have been used all over the world, at least as early as 500 BC by the Chinese (Goetzmann and Williams 2005), and as recently as the 1970s in rural France (Ifrah 2001). These pre-literate recordkeeping systems are similar to the vouchers, contracts and other written material that are used to generate “journal entries” in double-entry bookkeeping systems developed in 13<sup>th</sup> century Italy. An ancient direct analog to the receipt is the Cuneiform tablet, which Schmandt-Besserat (1992) has hypothesized to have evolved from the earlier token system (see Panel D of Figure 1).

### *B. Recordkeeping in SCCS Societies*

We use the Standard Cross-Cultural Sample (SCCS) constructed by George Murdock and Douglas White (1969) in all of our empirical analyses. The SCCS comprises 186 societies sampled from a

wide range of time periods (including two from before the Common Era) and geographical locations. The SCCS societies include contemporary hunter-gatherers, early historic states, and contemporary industrial societies. This wide coverage reflects Murdock and White's (1969) conscious decision to mitigate selection biases that favored societies with English language ethnographic sources. Appendix 1 provides an in-depth description of how the SCCS database was constructed.

Murdock and Morrow (1970) coded 22 variables related to subsistence economy and related practices, and these variables are the first listed in SCCS. Additional variables are added to the database as researchers code new variables by reading the pre-specified primary and secondary ethnographic studies.<sup>2</sup> The SCCS presently provides data on more than 2,000 categorical variables coded nominally or ordinally.

Our primary variable of interest is *Recordkeeping* (SCCS variable #149, entitled "Writing and Records"), which is coded on an ordinal scale from 1 to 5 (Murdock and Provost 1973, 379-380).<sup>3</sup> Panel A of Figure 2 describes how this variable is categorized and shows the number of SCCS societies classified into each category (see also Panel A of Appendix 2). We defer the introduction of several other SCCS variables until the later sections in which we analyze them.

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. One such society is of the Mbuti, who are nomadic, gathering Pygmies living in Central/East Africa. Panel B of Figure 2 shows that non-recordkeeping societies are less prevalent than recordkeeping societies (those with a score of 2 or more) in each sub-sample classified by the society's pinpointed year. Panel C of Figure 2 demonstrates that a greater number of non-recordkeeping cultures are located in Sub-

---

<sup>2</sup> The construction of data for a single variable in SCCS is a painstaking process. Data coders typically read one or more primary sources and several secondary sources to determine whether a given society follows a particular practice. The specific coded values are then compiled and included in SCCS after additional checks are made on their accuracy. SCCS often includes additional code indicating when categorization of a specific data point is more ambiguous. A quality-ordered bibliography of reference sources is included in the database, and the coding sheets indicate which particular sources were used for a particular society's code, so that subsequent researchers can assess data reliability (White 1986). Murdock and Morrow (1970, 312-330) describe this process in detail for the first variables included in SCCS and the individual sources used in creating these data for each specific society.

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



Saharan Africa and South America. Conversely, the frequency of cultures possessing records is highest in the Circum-Mediterranean and Eurasia.<sup>4</sup>

The next *Recordkeeping* value of 2 indicates that “writing and significant records are lacking but the people employ mnemonic devices, e.g., simple tallies.” Forty-nine SCCS societies (26.3%) are coded as using mnemonic devices. Examples include the ancient Mesopotamian tokens, shown in Panel A of Figure 1, or the shells used as wampum by American Indians (Schmandt-Besserat 1992; Szabo 2005). A specific SCCS example is that of the Kapauku Papuans of New Guinea, who use shell artifacts extensively in exchange (Pospisil 1963, 291-293 and 300-311).

A value of 3 for *Recordkeeping* indicates that the societies “lacks true writing but possess significant non-written records in the form of picture writing, quipus, pictorial inscriptions, or the like.” Twenty-one SCCS societies (11.3%) are coded as having non-written records. One of these societies is that of the Incas, who were pinpointed in 1530 AD shortly after the Spanish invasion of the Americas. The Incan quipu shown in Panel B of Figure 1 has long been recognized as an accounting device to record transactions (Keister 1964; Urton 2002).

A value of 4 for *Recordkeeping* indicates a society that “has an indigenous system of writing but lacks any significant accumulation of written records or alternatively has long used the script of alien people.” Twelve SCCS societies (6.5%) fall into this category.<sup>5</sup> The ethnographic texts on which this code is based indicate that written records exist but provide few specifics. 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 drafted 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.

---

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

<sup>5</sup> Although these societies are ranked higher than those in the *Recordkeeping* category 3, their order could arguably be reversed. To reduce such ranking ambiguity, we redid all our analyses excluding all societies in Recordkeeping category 4 and found very similar results.

The highest category for *Recordkeeping* (coded as 5) applies to 31 SCCS societies (16.7%) where the “society has an indigenous system of true writing and possess records of at least modest significance.” 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 information on transactions and contracts was regularly stored on Cuneiform clay tablets (Van De Mieroop 2002; 2004). Panel D of Figure 1 shows an example of a Cuneiform tablet.

## II. Hypotheses

The simplest accounting systems provide a historical record of 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.<sup>6</sup> Transaction records are common to large-scale societies, even those that are pre-literate. The oldest known accounting records using “tokens” appear at the same time and place (circa 8,000 BCE Mesopotamia) as the emergence of agriculture and permanent human settlements (Schmandt-Besserat 1992). The Sumerians invented writing to keep records and accounts (circa 3,200 BCE), which 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 increased societal and economic complexity, suggesting a potential causal connection.

Our focus in this paper is on whether the tight coupling between accounting advances and economic development in the ancient Near East was unique, or a pattern that describes human societies more generally. We are also interested in the extent to which recordkeeping expands the scope of impersonal exchange and promotes increasingly specialized division of labor. We investigate three hypotheses that are depicted in Figure 3. Each hypothesis is stated in the lower portion of the figure.

---

<sup>6</sup> Accounting scholars 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).

Our first hypothesis concerns the emergence of recordkeeping as a society expands in size. We investigate two implications of the hypothesis. First, recordkeeping is more likely to emerge once a society has reached the size implied by mental memory constraints. Second, recordkeeping is a necessary institution for extensive impersonal exchange. As such, recordkeeping will emerge as early as or earlier than other economic institutions that support exchange. The arrow between the box labeled “Internal Memory” and the box labeled “External Records” in Figure 3 depicts our first hypothesis.

Relying solely on mental memory, humans sustain greater social exchange 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 third-party gossip helps actors identify trustworthy partners for a contemplated cooperative venture (Barkow 1992; Demsetz 2002). Hence, small groups have little need for external records because members can accurately track others’ reputations even if they cannot perfectly recall the particulars of all past interactions (Silk 2004).

Keeping physical records outside the brain allows people to reliably store greater amounts of information on past interactions and better evaluate the desirability of exchange with a specific partner (Basu and Waymire 2006; Dickhaut *et al.* 2008a, 2008b). Recordkeeping 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).<sup>7</sup> This suggests that sole reliance on mental records will constrain societal expansion beyond a modest group size.

---

<sup>7</sup> 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 (Allman 2000, 3-8).

The evolved human brain can sustain stable cooperative groups to an upper limit of between 125 and 200 members.<sup>8</sup> 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 economic and social interactions outside the human brain. However, transaction records serve as an (expandable) external hard drive for the mental computer. This suggests that external recordkeeping should become increasingly prevalent for groups that exceed 200 persons. Thus, our first hypothesis is that the extent of recordkeeping and group size will be associated nonlinearly, with little relation for groups of 200 or fewer persons and a positive relation for groups exceeding 200 persons.

As a group grows in size, repeated interaction with familiar partners occurs less often. In addition, individual cooperation with members of other groups cannot rely on familiarity or repeated interaction. Recordkeeping helps people successfully consummate impersonal exchange and it subsequently enables the emergence of other exchange-supporting institutions that rely on hard evidence of past transactions. For example, hard transaction records often provide a basis for establishing and enforcing property rights subsequent to property transfers (VerSteeg 2000; de Soto 2000, 46-66). Records also provide the basis for compiling an individual’s exchange and credit histories, either in a specific market (e.g., eBay) or more generally with credit ratings like Moody’s. Thus, our first hypothesis implies also that recordkeeping is a

---

<sup>8</sup> “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 (Dunbar, 1992, 1998). Dunbar validated his predicted number by studying the historical maximum sizes of hunter-gatherer tribes, Neolithic villages, Hutterite settlements, Roman army units, and other human groups. Edney (1981, 27) independently estimated that “the upper limit for a simple, self-contained, sustaining, well-functioning commons may be as low as 150 people.”

precursor to other exchange-supporting institutions. As such, recordkeeping is expected to appear as early as or earlier than other exchange-supporting institutions as an economy expands.

Our second hypothesis is about how essential recordkeeping is for a market to expand and encompass larger numbers of impersonal exchange transactions. This hypothesis is depicted by the curved arrow in Figure 3 connecting “External Records” to “Market.” Within human families, many resource transfers are unidirectional grants that can be motivated by love (by parents for children), fear (by low status members of alpha males) and ignorance (not recognizing that an object is valuable) (Boulding *et al.* 1972).<sup>9</sup> Most primitive human societies are extended kin groups with a norm of generalized reciprocity, where help is expected from and is available to all group members (Sahlins 1972).

These societies begin to transcend the bounds of the immediate group through gift exchanges with neighboring groups. Such complex interactions inevitably entail rigid norms of behavior that reduce cheating and any resultant misinterpretation of intentions (Malinowski 1922; Mauss 1925). As a by-product of formal gift exchange, trading in less elaborate economic goods often develops. The scope of exchange expands to include items that are not “gifts” *per se* but rather are given outside the elaborate rituals of gift exchange, with informal norms of balanced or symmetrical reciprocity in which a fair return is expected from individual recipients in the future (Sahlins 1972). Thus, as the size of an exchange network grows, economic interaction with less-closely-related acquaintances occurs more often.<sup>10</sup>

At some point in the recent human past, a new form of economic interaction arose in the form of bilateral impersonal exchange or barter between strangers (Seabright 2005), with an associated norm of negative reciprocity where each person gives up valuable things and expects to be reciprocated immediately in a *quid pro quo* manner (Sahlins 1972). Basu’s *et al.* (2009) experimental results suggest that recordkeeping may be crucial to this transformation towards market exchange, in that experimental

---

<sup>9</sup> 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 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.

<sup>10</sup> In industrialized societies, generalized reciprocity typically characterizes interactions between parents and children, while balanced reciprocity characterizes transactions with cousins, neighbors and co-workers.

economies with recordkeeping exhibited stronger patterns of negative reciprocity in impersonal exchange than non-recordkeeping economies. Thus, our second hypothesis is that recordkeeping will be associated with more extensive and more complex exchange transactions within a given society.

Our third hypothesis is that the expanded exchange enabled by recordkeeping is associated with increased specialization in division of labor. Adam Smith (1776/1976, 17) first articulated the relation between exchange and division of labor in *The Wealth of Nations* (see also Stigler 1951):

This division of labour, from which so many advantages are derived, is not originally the effect of any human wisdom, which foresees and intends that general opulence to which it gives occasion. It is the necessary, though very slow and gradual, consequence of a certain propensity in human nature which has in view no such extensive utility; the propensity to truck, barter, and exchange one thing for another.

If this proposition is correct, then the extent of exchange will also be associated with more specialized division of labor. We depict this hypothesis with the arrow from “Market” to “Division of Labor” in Figure 3. If recordkeeping promotes market expansion (our second hypothesis), which in turn enables division of labor, we can also expect a positive association between recordkeeping and division of labor when market extent is excluded from the regression.

### **III. Recordkeeping Emerges as Group Size Increases**

Our first hypothesis is that recordkeeping becomes more prevalent after a group reaches the maximum size achievable under biological constraints and that recordkeeping emerges as early as or earlier than other economic institutions. A direct test of this hypothesis requires a measure of group size that reflects the total number of people in the group taking account of network ties with non-group members.<sup>11</sup> The closest proxy within SCCS for this construct is variable #63, *Community Size*, which is available for all but one of the 186 SCCS societies. *Community Size* is only a proxy for the overall size of a networked group since it refers to the size of a typical community (i.e., city or village) in the society being studied (Murdock and Wilson 1972). This is an imperfect proxy to the extent that a community may

---

<sup>11</sup> 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).

have network links to individuals outside the local community. *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 consist of more than 50,000 people. Panel B of Appendix 2 shows the various categories of *Community Size*.

Panel A of Figure 4 shows a plot of the frequency of each *Recordkeeping* score for a given level of *Community Size*, where bubble sizes are proportional to frequency. A line connects the mean *Recordkeeping* score for each of the eight *Community Size* categories. Consistent with our first hypothesis, the association between the *Recordkeeping* and *Community Size* is positive and non-linear with a monotonically increasing mean once *Community Size* reaches the level of 200 persons or more. This relation is reliably positive and significantly different from zero (Spearman  $\rho = 0.32$ ;  $p < 0.01$ ).

Visual inspection of Panel A in Figure 4 indicates that most of the SCCS societies without recordkeeping cluster in the lower *Community Size* communities. However, this effect is not uniform as 14 SCCS societies containing fewer than 200 persons in the typical community also have recordkeeping systems based on a written language (i.e., *Recordkeeping* = 4 or 5 and *Community Size* = 1, 2, or 3). These 14 societies include some cultures where the size of the total population in the society is quite large. For example, these SCCS societies include both Korea and Japan, which were subjected to ethnographic study in 1947 and 1950, respectively.

To reduce the impact of measurement error in *Community Size*, we also estimated a more comprehensive measure of a society's demographics. We performed a factor analysis on four SCCS variables: (1) *Community Size*, (2) *Settlement Patterns* (SCCS Variable #234), (3) *Population Size* (SCCS Variable #1122), and (4) *Population Density* (SCCS Variable #1130). *Settlement Patterns* measures the extent to which a society is nomadic versus sedentary, *Population Size* is a measure of the society's total size (based on census data when available), and *Population Density* measures the number of persons per square mile in the society. Definitions of these variables are provided in Panel B of Appendix 2.

Panel B of Figure 4 shows results from an iterated principal factor analysis using communalities among these four variables. A minimum Eigenvalue of one is used to choose factors for our subsequent

analysis. A single factor with an Eigenvalue of 2.15 explains 90% of the variation of the four variables. Accordingly, we retain a single factor to specify a variable that we refer to as *Demographics*. Factor loadings for *Demographics* with the four variables are shown in Panel B of Figure 4. The factor loading is the standardized coefficient in a regression of the variable on the factor and reflects the strength of the relationship. *Population Density* has the most positive factor loading while *Community Size* has the least positive factor loading. The weaker association between *Demographics* and *Community Size* suggests that important features of a society's demographic complexity are not fully captured by *Community Size*.

Panel C of Figure 4 shows a plot of the frequency of each *Recordkeeping* score for each of eight levels of *Demographics*, where again bubble sizes are proportional to frequency. To enable direct comparison with Panel A, we rank the societies on the basis of *Demographics*, and then partition them into eight sub-samples using the same number of societies in each of the eight ordered categories of *Community Size* used to produce Panel A. Inspection of Panel C suggests that using *Demographics* in lieu of *Community Size* modestly increases the strength of association between *Recordkeeping* and the measure of group size (Spearman  $\rho = 0.37$ ,  $p < 0.01$ ). In addition, the plotted relation between mean *Recordkeeping* score and *Demographics* shows a generally increasing trend.

Panel D of Figure 4 shows estimates from a regression model where *Recordkeeping* is the dependent variable and either *Community Size* or *Demographics* is the independent variable. The model allows a kinked relation between *Recordkeeping* and the independent variable, with the kink located at group size or complexity value equal to "4." Intuitively, this means that we allow the relation between *Recordkeeping* and *Community Size* to differ once groups have reached a level of *Community Size* greater than or equal to 200 persons (or a comparable level of complexity based on *Demographics*). The results indicate a non-linear positive relation between the extent of recordkeeping and group size. In both models, the coefficient on the interaction between group size and a 0-1 indicator for whether the society is "large/complex" is positive and significant ( $p < 0.02$  for both models). This evidence suggests that, as a society surpasses the modest group-size threshold of 200 suggested by Dunbar (1992), recordkeeping becomes more complex.



A second implication of our first hypothesis is that recordkeeping emerges as early as or earlier than other exchange-supporting institutions. We identified other exchange-supporting institutions using SCCS variables reflecting the use of money and credit in an economy, the presence of a judiciary and property rights, and the presence of administrative hierarchies. Money and property rights are likely fundamental to expansion of exchange (Menger 1892; Demsetz 2002) and the demand for accounting arises in part from the existence of complex organizations and credit markets (Kimbrough *et al.* 2008; Watts and Zimmerman 1986). We use the following five variables: *Credit* (SCCS variable #18), *Judiciary* (SCCS variable #89), *Administrative Hierarchy* (SCCS variable #91), *Money* (SCCS variable #155), and *Inheritance of Land* (SCCS variable #278). These variables are defined in Panel C of Appendix 2.

Figure 5 plots the cumulative percentage of societies in which *Recordkeeping* or each of the other five institutions is present, where societies are ordered by *Community Size* level. A specific institution is deemed to be present if the society's code for a given variable exceeds the minimum possible value. Each point on a given line represents the total number of societies up to that size level where the institution is present divided by the total number of societies with a code available for that variable.

The six SCCS variables' cumulative frequency functions cluster into three groups referenced by the capital letters on the right-hand side of the figure. The first cluster (labeled A) includes *Recordkeeping* along with *Money* and *Inheritance of Land*. These institutions are present in approximately 60% of the SCCS societies. The cumulative frequencies for *Inheritance of Land* and *Money* are not statistically different from the cumulative frequency of *Recordkeeping* ( $p > 0.10$  based on a *z-test* of proportions). This suggests that recordkeeping is a fundamental institution that, like the use of money in exchange and simple property rights systems, emerges early as an economy develops. That recordkeeping and money emerge in similar fashion is likely not surprising. 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).<sup>12</sup>

---

<sup>12</sup> Also, the tally sticks used by the British Exchequer beginning several hundred years ago evolved into bills of exchange, which served a monetary function in exchange (Robert 1956, 80; Goetzmann & Williams 2005).

The other two clusters include *Administrative Hierarchies* and *Judiciary* (cluster B) and *Use of Credit* (cluster C), which are present in about 45% and 33% of the SCCS societies, respectively. In each case, the frequency of these institutions is statistically different from *Recordkeeping* at conventional levels ( $p \leq 0.01$ ). These data indicate that more advanced institutions like hierarchies, courts, and the availability of credit beyond the family are less likely to appear in the earliest stages of an economy's development relative to recordkeeping, money and basic property rights.

The lower part of Figure 5 shows the percentage of societies with or without recordkeeping in which a given institution is present. Each institution is present more frequently in societies with recordkeeping than societies without recordkeeping. Chi-square tests reject the null of independence at  $p \leq 0.05$  for each of the five comparisons. This pattern is consistent with institutional co-evolution where multiple interdependent institutions emerge as a society grows in size and complexity.

Overall, the evidence in Figures 4 and 5 is consistent with the hypothesis that recordkeeping is a foundational institution that emerges early as an economy expands. Furthermore, recordkeeping societies are more likely to develop other exchange-supporting institutions.

#### **IV. The Influence of Recordkeeping on Impersonal Exchange and Division of Labor**

##### *A. Recordkeeping Promotes Impersonal Exchange*

We require a proxy for the extent of impersonal exchange to test our second hypothesis, which is that recordkeeping promotes impersonal exchange. We develop a multi-attribute measure based on the extent to which impersonal exchange takes place in the society as well as whether the society has other institutions that support more extensive exchange. We use a broader measure of exchange because Smith (1776/1976, 21-33) argues that the extent of the market depends on an effective infrastructure for storing and moving goods as well as a medium of exchange.

Our measure of impersonal exchange is based on a factor analysis applied to the *Money* and three other SCCS variables defined in Panel C of Appendix 2. *Intercommunity Trade as a Food Source* (SCCS Variable #1) is a direct measure of impersonal exchange as reflected in a society's food import levels.

Similarly, *Food Storage Via Surplus* (SCCS Variable #21) measures the extent to which exchange is likely to occur as a result of food production in excess of immediate consumption needs. *Land Transport* (SCCS Variable #154) reflects the extent to which a society has a transportation infrastructure necessary to support exchange with more geographically distant areas. *Money* (SCCS Variable #155) was used in our previous analyses and measures whether a medium of exchange that could support more extensive impersonal exchange is available.

We perform a principal factor analysis using the communalities among these four variables to extract underlying dimensions, and we used a minimum Eigenvalue of one to determine which factors to retain. Panel A of Table 1 shows that one factor with an Eigenvalue of 1.27 accounts for 91% of the total variance of the four SCCS variables. Thus, we retain only one factor to specify *Exchange*. The factor loadings in Panel B of Table 1 show that *Money* is strongly associated with *Exchange*. *Intercommunity Trade as a Food Source*, the most direct measure of exchange, and *Land Transport* also exert a strong effect. *Food Surplus Via Storage* shows the weakest association.

We estimate the following empirical model of the relation between *Recordkeeping* and *Exchange*:

$$Exchange_i = \alpha_0 + \beta_1 RK\_B_i + \beta_2 Large\_Comm_i + \beta_3 RK\_B * Large\_Comm_i + \beta_4 AgPotential_i + \beta_5 Climate_i + \beta_6 Region_i + \varepsilon_i$$

*Exchange* is the factor derived from the factor analysis in Panels A and B of Table 1. *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. We use a 0-1 indicator for *Recordkeeping* since we expect a bi-directional causal relation between the quantity and complexity of recordkeeping and exchange. Because *Recordkeeping* appears early in development (see Figure 5), we expect that these effects (and any resultant endogeneity problems) will be lessened with use of a 0-1 variable. *Large\_Comm* is an indicator variable that equals 0 when *Community Size* (SCCS #63) is less than 200 persons and equals 1 when *Community Size* is greater than or equal to 200 persons. Under our second hypothesis, we expect that  $\beta_1$  and  $\beta_3$  will be positive.

The model includes three control variables (defined in Panel C of Appendix 2): (1) *Agricultural Potential* (SCCS #921) of the society's region, (2) *Climate* (SCCS #857) is an ordinal variable reflecting open access to rich ecological resources, and (3) *Region* represents a series of 0-1 variables for a society's location within one of six major world regions. These variables are included to capture cross-society differences in resource endowments, which Diamond (1997) argues are prerequisites for economic development.

The OLS models are estimated using the 182 SCCS societies where data are available for all variables. *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.<sup>13</sup>

Estimation results are shown in Panel C of Table 1. The first column shows results for the model when only *RK\_B* and the control variables are included. The estimated coefficient,  $\beta_1$ , equals 0.51, which is significantly different from zero at  $p < 0.00$  (one-tailed).  $\beta_1$  remains positive (0.26) and significant at  $p < 0.02$  for the full model (shown in the second column) and  $\beta_3$  equals .57, which is significant at  $p < 0.02$  (one-tailed). This latter effect suggests that the presence of recordkeeping exerts a substantially larger effect on the extent of impersonal exchange in larger societies. Results in the right-most column demonstrate that a significant relation between recordkeeping and exchange persists when *Demographics* is included as an additional control for social complexity. This evidence supports our second hypothesis that recordkeeping supports an expansion in impersonal exchange.

---

<sup>13</sup> An analysis of the SCCS data indicates that *Recordkeeping* is subject to stronger patterns of cultural and historical diffusion than other SCCS variables. Each SCCS culture is assigned a number from 1 to 186 where the societies are ordered according to geographical proximity and cultural similarity. Because societies with close geographical proximity are likely ones where cultural diffusion may still be a prominent force, the correlation between adjacent numbered societies within the SCCS measures the extent to which the pinpointing process did not completely eliminate cross-sectional dependence (Murdock and White 1969). *Recordkeeping* displays strong correlation ( $\rho = 0.30$ ) when comparing adjacent neighbors within the SCCS database. Thus, we estimate all models using heteroskedasticity-consistent standard errors adjusted for residual correlation among observations belonging to the same major language family.

*B. The Influence of Impersonal Exchange on Division of Labor*

Thus far we have seen that recordkeeping becomes more prevalent once a society has reached modest size levels, recordkeeping emerges early relative to other basic institutions as societies grow larger, and that the emergence of recordkeeping is associated with increased impersonal exchange. Our final hypothesis is, consistent with Smith (1776/1976, 17), that expanded opportunities for impersonal exchange are associated with increasingly specialized division of labor within an economy.

Testing this hypothesis requires first that we specify a measure of a society's division of labor. As with our tests examining market exchange, we specify a measure of division of labor using factor analysis applied to multiple SCCS variables likely related to the underlying construct. Most SCCS societies are heavily dependent on agriculture and depend far less on industrial manufacturing and complex services than modern Western economies. We thus construct division of labor using measures of the extent to which complex agriculture and other forms of occupational specialization are present in the society.

Five SCCS variables serve as inputs to a factor analysis to specify *Division of Labor*, as defined in Panel D of Appendix 2. The two agricultural measures include: (1) *Agriculture* (SCCS variable # 151), which takes on five possible values ranging from 1 indicating no agriculture is present to 5 indicating that intensive agriculture provides the primary food sources for the society, and (2) *Intensity of Cultivation* (SCCS variable # 232), which takes on six possible values ranging from 1 ("no agriculture") to 6 ("intensive irrigated agriculture"). *Technological Specialization* (SCCS variable # 153) is a variable reflecting whether specialist potters, loom weavers, or metalworkers are present in the society.

*Administrative Hierarchy* (SCCS variable #91) measures the extent to which decision-making in the society is delegated to heads of sub-groups and *Class Stratification* (SCCS variable #270) measures the extent to which social status arises from resources or power possessed by an individual or group.

Panel A of Table 2 shows that one factor with an Eigenvalue of 2.86 accounts for 81% of the total variance of the five SCCS variables used; we therefore retain only one factor to specify *Division of Labor*. Panel B of Table 2 indicates that *Intensity of Cultivation* and *Agriculture* exert more influence on

*Division of Labor* than do *Technological Specialization*, *Administrative Hierarchy*, and *Class Stratification*.

We estimate a model of the relation between *Division of Labor* and *Exchange* as follows:

$$\text{Division of Labor}_i = \alpha_0 + \beta_1 \text{Exchange}_i + \beta_3 \text{Controls}_i + \varepsilon_i$$

*Division of Labor* is the factor obtained from the analysis described in Panels A and B of Table 2 and *Exchange* is the factor derived from the analysis in Panels A and B of Table 1. The model includes the same control variables used in the regressions in Table 1: *AgPotential* (SCCS #921), *Climate* (SCCS #857), and *Region* (definitions are in Appendix 2). We hypothesize that  $\beta_1$  will be positive. The sample includes the 180 SCCS societies for which data for all variables are available. Models are estimated using OLS and  $p$ -values are one-tailed and are based on heteroskedasticity-consistent standard errors adjusted for residual correlation among observations belonging to the same major language family.

The results in Panel C of Table 2 support the hypothesis that *Exchange* exhibits a positive association with *Division of Labor*. The coefficient on *Exchange* ( $\beta_1$ ) equals .44 ( $p < 0.00$ , one-tailed), and remains significantly positive ( $\beta_1 = .29$ ,  $p < 0.00$ ) when *Community Size* is used as an additional control. The relation between *Division of Labor* and *Exchange* becomes weakly significant ( $p = 0.06$ ) when *Demographics* is added as a control. This is the artifact of *Exchange* being strongly correlated with variables included in *Demographics* other than *Community Size*. In particular, variables capturing the dispersion and density of a population such as *Settlement Patterns* (SCCS Variable #234) and *Population Density* (SCCS Variable #1130) reflect the location of individuals within a society who can take advantage of exchange opportunities. The final two columns indicate that the coefficient on *RK\_B* is positive and statistically significant (coefficient = 0.30,  $p = 0.04$ ) when included with *Exchange* as an independent variable. In contrast, *RK\_B* is positive and highly significant when included on a stand-alone basis (coefficient = 0.50,  $p < 0.00$ ). The 40% decline from 0.50 to 0.30 for the coefficient on *RK\_B* suggests that the effect of *Recordkeeping* on *Division of Labor* flows partially through *Exchange*.

The causal force hypothesized to act upon division of labor when impersonal exchange is possible is that individuals invest in human capital that affords them a comparative advantage in producing specialized goods and services. More generally, this is part of a broader investment pattern within the society where the emergence of impersonal exchange leads to greater investment in all forms of capital – e.g., tangible capital and improvements to land (Smith 1776/1976, 351-371). Accordingly, we also examined the relation between impersonal exchange and the level of capital stock accumulated by a society.

We estimate a measure of a society's accumulated capital stock using six SCCS variables that reflect physical, human, and social capital. Three measures pertain to accumulated physical capital: *Large or Impressive Structures* (SCCS #66), *Resource Base* (SCCS #859), and *Cropping Index* (SCCS #1128). *Large or Impressive Structures* reflects the extent to which physical structures have been erected in the society and ranges from 1 (“none”) to 6 (“economic or industrial buildings”). *Resource Base* measures whether complementary techniques or assets have been developed that improve agricultural productivity. This variable takes on three possible values with a code of 1 representing “low resources (ex, hunting, gathering, fishing)” and a code of 3 representing “high resources (ex, advanced horticulture with metal hoes, intensive agriculture with plow, pastoralism).” *Cropping Index* is a measure of land utilization in agriculture ranging from 1 (“no agriculture or confined to non-food crops”) to 6 (“100% or more of land used per year”).

*Education* is a measure of accumulated human capital and represents the sum of several variables (SCCS #'s 425, 426, 427, and 428) measuring the extent to which children of the society receive training and education. Each of these four variables is coded on a six-point scale from 1 (“informal training, with minimal guidance”) to 6 (“formal schooling typical and frequent”). *Political Autonomy* (SCCS #81) and *Military Success* (SCCS #908) are included as measures of the extent to which the society has developed a government that protects against external threats. The ability to repel external threats can enhance productivity by reducing the extent to which another group expropriates the fruits of labor by a society. *Political Autonomy* is coded on a six-point scale that ranges from 1 (“dependent totally”) to 6 (“fully

autonomous”). *Military Success* is coded on a scale that ranges from 1 (“no – its boundaries/population are shrinking”) to 4 (“yes – its boundaries/population are expanding”).

These six variables provide the inputs to a factor analysis used to identify a variable we label *Capital Stock*. As before, we conduct a principal factor analysis using the communalities among these variables, along with a minimum Eigenvalue of one to determine which factors to retain. Panel A of Table 3 shows that one factor with an Eigenvalue of 1.85 accounts for 71% of the total variance of the six SCCS variables used to identify *Capital Stock*. Panel B of Table 3 shows that *Cropping Index* is the most influential variable and *Education*, *Resource Base*, and *Large Impressive Structures* are also of importance. The political variables, *Political Autonomy* and *Military Success*, are the least important variables in specifying *Capital Stock*.

We estimate a model of the relation between *Capital Stock* and *Exchange* as follows:

$$Capital\ Stock_i = \alpha_0 + \beta\ Exchange_i + \beta_4\ Controls_i + \varepsilon_i$$

*Capital Stock* is the variable identified in the factor analysis in Panels A and B of table 3 and all other variables are as previously defined for purposes of our prior analyses. Each model includes the control variables used previously (*AgPotential*, *Climate*, and *Region*). Definitions of all variables are provided in Panel E of Appendix 2. The sample used to estimate Models (3), (4), and (5) includes the 143 SCCS societies where data for all variables are available.

The hypothesis of interest is that *Capital Stock* is associated with the emergence of impersonal exchange after controlling for other factors. Thus, we expect that  $\beta_1$  will be positive. As with the previous models, OLS estimation is used, *p*-values are one-tailed, and heteroskedasticity-consistent standard errors adjusted for residual correlation among observations belonging to the same major language family are used.

The evidence in Panel C supports the hypothesis that cross-society differences in *Capital Stock* are associated with differences in *Exchange*. The first column of results indicates that the coefficient on *Exchange* equals 0.56 ( $p < 0.00$ ). Further, this result is highly robust. *Exchange* remains significant after controlling for factors already captured by *Division of Labor* (see second column). The third column



indicates that *RK\_B* shows no significant association with *Capital Stock* after controlling for *Exchange* and *Division of Labor*. This suggests that recordkeeping's role is one of an enabling technology that supports expanded exchange and division of labor. The final two columns demonstrate that the relation between *Exchange* and *Capital Stock* is not capturing purely an effect due to size and demographic complexity.

Viewed collectively, the evidence presented in Tables 2 and 3 provides strong support for our final hypothesis that the expansion of impersonal exchange facilitated by recordkeeping is also associated with increasingly specialized division of labor and greater overall investment in physical, tangible, and political capital. These results accord with prior experimental evidence that recordkeeping is associated with greater trust (Basu *et al.*, 2009), and that trust is associated with investment and economic growth, both analytically and in cross-country growth regressions (Knack and Keefer, 1997; Zak and Knack, 2001). In other words, recordkeeping enables strangers to trust each other in complex inter-temporal exchange, which then facilitates division of labor and greater productivity, which in turn enable greater investment and even faster economic growth.

## V. Conclusions and Implications

Our evidence suggests that recordkeeping is more likely in large groups that cannot sustain cooperative interaction based solely on mental memory, and that recordkeeping, like money and inheritance of land, emerges at relatively early stages of an economy's development. The emergence of recordkeeping precedes the appearance of a judiciary, administrative hierarchies and the extension of credit, suggesting that accounting is a foundational institution. Our evidence also suggests that economies where recordkeeping is possible are characterized by more extensive impersonal exchange. Consistent with hypotheses by Smith (1776/1976) and Stigler (1951), we also find that the level of specialization in division of labor and accumulated capital are strongly influenced by the extent of the market. These findings suggest that the basic accounting function of recordkeeping is a precursor to economic development through impersonal exchange and division of labor.

More broadly, our evidence is consistent with the hypothesis that transaction records external to the human brain are necessary to extend the scale of human cooperation from small primitive groups to large-scale modern societies characterized by extensive market exchange and complex division of labor (Basu and Waymire 2006). Our analysis also broadly accords with conjectures offered by an earlier generation of scholars (i.e., Sombart, Weber, Schumpeter, and von Mises) that capitalist economic development would be impossible without accounting institutions like double-entry bookkeeping (Most 1972; Carruthers and Espeland 1991). Thus, considerably more research on how recordkeeping and more advanced analysis of accounting's transactional data promote economic development is warranted.

Economic development varies considerably across continents and countries (e.g. World Bank 2006), as well as within countries among different ethnic and sociolinguistic groups. Our evidence is consistent with De Soto's (2000) argument that accurate property records are a prerequisite for the success of capitalistic societies. The crucial role of verifiable transaction records for legal enforcement of property rights is explicitly indicated in legal codes ranging from the ancient Code of Hammurabi (c. 1750 BCE) through Athenian, Roman and French legal codes to the recent Sarbanes-Oxley Act of 2002 (Basu and Waymire, 2006). Thus, verifiable transaction records are a necessary part of the foundations that lie behind the exchange-supporting institutions upon which capitalist economies have been built.

Accounting is likely an ecologically rational institution that coordinates economic interaction through market exchange (Waymire 2009). To adapt a metaphor from Simon (1990), historical cost accounting and today's exchange agreements are like two blades of scissors that have become increasingly effective together over time through co-evolution. Institutional changes such as 'fair value' accounting that overwrites historical records of consummated transactions may make the scissors less effective unless a matching blade is produced.<sup>14</sup> For instance, debt contracts and regulations rely on a set

---

<sup>14</sup> Similarly, Ball (2001) argues that accounting harmonization is unlikely to produce higher quality financial reports unless contracts and enforcement mechanisms are also changed to provide incentives for better reporting. While Ball focuses on whether developing countries can improve their accounting quality, we worry that developed countries are in danger of reducing their economic effectiveness.

of common expectations about how performance is measured, and wholesale changes to this performance measure may entail costly “unintended consequences.”

## References

- Allman, J., 2000. *Evolving Brains*, New York, NY: Scientific American Library.
- Assadourian, C., 2002. String registries: native accounting and memory according to the Colonial sources, in Quilter J. and G. Urton, (eds.), *Narrative Threads: Accounting and Recounting in Andean Khipu*, Austin, TX: University of Texas Press.
- Axelrod, R., and W. Hamilton, 1981. The evolution of cooperation, *Science* 211 (4489): 1390–1396.
- Ball, R., 2001. Infrastructure Requirements for an Economically Efficient System of Public Financial Reporting and Disclosure, in R. E. Litan and R. Herring (Eds.), *Brookings-Wharton Papers on Financial Services: 2001*, Washington, DC: Brookings Institute Press, 127-182.
- 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., and G. Waymire, 2006. Recordkeeping and human evolution. *Accounting Horizons* 20 (3): 1-29.
- Basu, S., J. Dickhaut, G. Hecht, K. Towry, and G. Waymire, 2009. Recordkeeping alters economic history by promoting reciprocity, *Proceedings of the National Academy of Sciences of the USA* 106 (4): 1009-1014.
- Boulding, K.E., M. Pfaff, 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.
- 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.

- Dickhaut, J. W., S. Basu, K. A. McCabe, and G. B. Waymire, 2009a. NeuroAccounting, part I: The primate brain and reciprocal exchange. Working paper, January. Available at: <http://ssrn.com/abstract=1336526>
- Dickhaut, J. W., S. Basu, K. A. McCabe, and G. B. Waymire, 2009b. NeuroAccounting, part II: Consilience between accounting principles and the primate brain. Working paper, January. Available at: <http://ssrn.com/abstract=1336517>
- Donald, M., 1991. *Origins of the Modern Mind: Three Stages in the Evolution of Culture and Cognition*. Cambridge, MA: Harvard University Press.
- 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.
- Edney, J. J., 1981. Paradoxes on the Commons: Scarcity and the Problem of Equality. *Journal of Community Psychology* 9: 3-34.
- Financial Accounting Standards Board (FASB), 2006. *Statement of Financial Accounting Standards No. 157, Fair Value Measurements*, Norwalk, CT: Financial Accounting Standards Board.
- Gamble, D. P., 1967. *The Wolof of Senegambia*, London: International African Institute.
- Goetzmann, W. N., and L. Williams, 2005. From tallies and chirographs to Franklin's Printing Press at Passy: The evolution of the technology of financial claims. In Goetzmann, W.N. and Rouwenhorst, K. G. (Eds.) *The Origins of Value: The Financial Innovations that Created Modern Capital Markets*. Oxford University Press: New York, NY: 105-122.
- Gray, J., 1996. Is the standard cross-cultural sample biased? A simulation study. *Cross-Cultural Research* 30: 301-315.
- Hatfield, H., 1924. An historical defense of bookkeeping, *Journal of Accountancy* 37 (4): 241-253.
- Hutchins, E., 1999. Cognitive artifacts. In Wilson, R. A. and Keil, F. C. (Eds.) *The MIT Encyclopedia of the Cognitive Sciences*. Cambridge, MA: The MIT Press: 126-128.
- Ifrah, G., 2001. *The Universal History of Numbers*, Wiley: New York, NY.
- 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.

- Kimbrough, E., V. Smith, and B. Wilson, 2008. Historical property rights, sociality, and the emergence of impersonal exchange in long-distance trade, *American Economic Review* 98 (3): 1009-1039.
- Kocherlakota, N., 1998. The technological role of fiat money, *Federal Reserve Bank of Minneapolis Quarterly Review* 22 (3): 2-10.
- Knack, S., and P. Keefer. 1997. Does social capital have an economic payoff? A cross-country investigation, *The Quarterly Journal of Economics* 112 (4): 1252-1288.
- Kohler, E., 1952. *A Dictionary for Accountants*, Englewood Cliffs, NJ: Prentice-Hall.
- La Porta, R., and A. Shleifer, 2008. The unofficial economy and economic development, *Brookings Papers on Economic Activity* Conference Draft, Fall.
- 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.
- Menger, C. 1892. On the origins of money, *The Economic Journal* 2 (6): 239-255.
- 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.
- Murdock, G., and S. Wilson, 1972. Settlement patterns and community organization: cross-cultural codes 3, *Ethnology* 11 (3): 254-295.
- 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., 1991. Institutions, *Journal of Economic Perspectives* 5 (1): 97-112.
- North, D., 2005. *Understanding the Process of Economic Change*, Princeton, NJ: Princeton University Press.

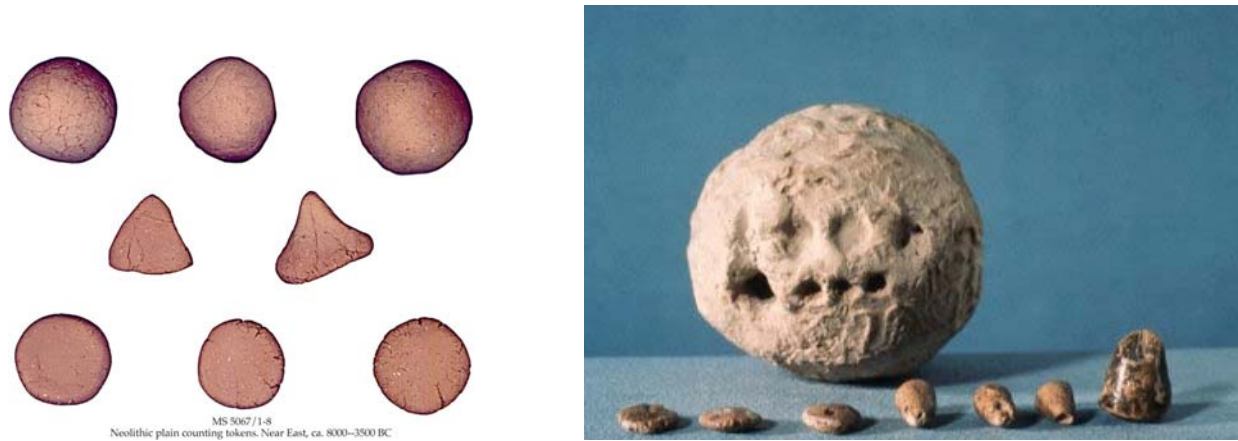
- Nowak, M. and K. Sigmund, 2005. Evolution of indirect reciprocity, *Nature* 437 (7063): 1291-1298, October 27.
- Pollock, S., 2004. *Ancient Mesopotamia*, Cambridge, UK: Cambridge University Press.
- Pospisil, L., 1963. *Kapauku Papuan Economy*, New Haven, CT: Yale University Publications in Anthropology #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.
- Redish, A., 2003. Money and coinage, in Mokyr, J. (ed.), *The Oxford Encyclopedia of Economic History*, Volume 3, Oxford, UK: Oxford University 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.
- Saggs, H. W. F., 1989. *Civilization Before Greece and Rome*, New Haven, CT: Yale University Press.
- 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.
- Schmandt-Besserat, D., 1995. Record keeping before writing," pp. 2097–2106 in *Civilizations of the Ancient Near East, Vol. 4*, Jack Sasson (ed.), New York: Scribner.
- Schmandt-Besserat, D., 1996. *How Writing Came About*, University of Texas Press, Austin, TX.
- Schmandt-Besserat 1999. Artifacts and civilization, in Wilson, R. A. and Keil, F. C. (Eds.) *The MIT Encyclopedia of the Cognitive Sciences*. Cambridge, MA: The MIT Press. pp. 35-37.
- 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.
- Simon, H. A. 1990. Invariants of human behavior, *Annual Review of Psychology* 41 (1), 1-19.
- Smith, A., 1776. *The Wealth of Nations*, Chicago, IL: University of Chicago Press (Reprinted 1976).
- Smith, V., 2008. *Rationality in Economics: Constructivist and Ecological Forms*, Cambridge, UK: Cambridge University Press.
- Stigler, G., 1951. The division of labor is limited by the extent of the market, *Journal of Political Economy* 59 (3): 185-193.
- 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.
- VerSteeg, R., 2000. *Early Mesopotamian Law*, Durham, NC: Carolina Academic Press.
- Watts, R., and J. Zimmerman. 1986. *Positive Accounting Theory*. Prentice-Hall: Englewood Cliffs, NJ.
- Waymire, G., 2009. Exchange guidance is the fundamental demand for accounting. *The Accounting Review* 84 (1): 53-62.
- White, D. R., 1986. Ethnographic bibliography for the Standard Cross-Cultural Sample. *World Cultures* 2 (1), 16-125.
- Wilson, E., 2000. *Sociobiology: The New Synthesis (25<sup>th</sup> Anniversary Edition)*, Cambridge, MA: Harvard University Press.
- Zak, P. J., and S. Knack. 2001. Trust and growth, *The Economic Journal* 111 (470): 295-321.

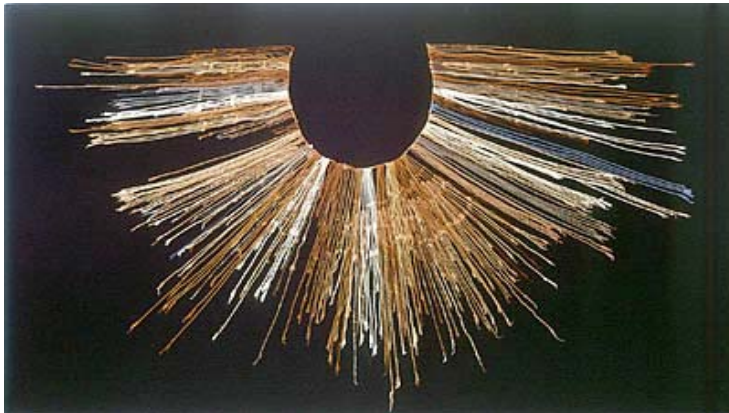


**Figure 1: Examples of Recordkeeping Technologies Present in Human History**

*A: Tokens of ancient Mesopotamia circa 8000 BC (left). Bullae and tokens circa 3200 BC (right)*



*B: Incan Quipu Dating from 1,500 AD and Earlier*



*C: Tally sticks used by British Exchequer circa 1,440 AD*



*D: Cuneiform receipt for unnamed objects by five named people (c. 3,200 BCE)*



MS 3008  
Account of commodities. Sumer, ca. 3200 BC.  
The earliest continuous writing known

#### Picture Sources:

Left hand side of Panel A in Figure 1: Schøyen Collection, Oslo and London.

[http://www.schoyencollection.com/math\\_files/ms5067.jpg](http://www.schoyencollection.com/math_files/ms5067.jpg)

Right hand side of Panel A in Figure 1: Louvre Museum, Paris, France. <http://www.humanities-interactive.org/ancient/mideast/index.html?collectionVar=AncientCulturesStop&pageVar=2>

Panel B in Figure 2: Larco Museum, Lima, Peru.

[http://www.inkas.com/tours/jpg\\_files/jpg\\_photos/lima/larco/museo\\_larco/QUIPU\\_INCA.jpg](http://www.inkas.com/tours/jpg_files/jpg_photos/lima/larco/museo_larco/QUIPU_INCA.jpg)

Panel C in Figure 2: Science Museum, London, UK.

[http://www.scienceandsociety.co.uk/Pix/SOC/19/10327719\\_T.JPG](http://www.scienceandsociety.co.uk/Pix/SOC/19/10327719_T.JPG)

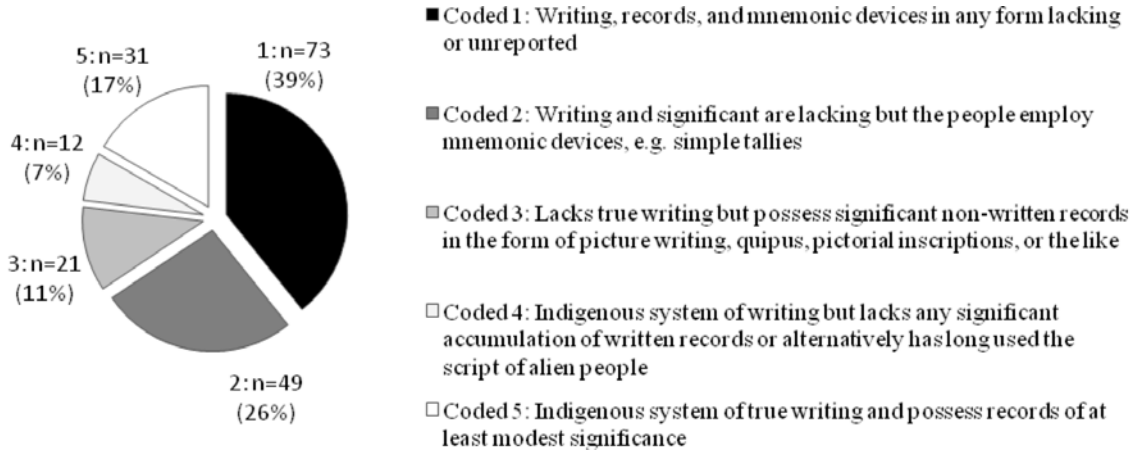
Panel D in Figure 2: Schøyen Collection, Oslo and London.

[http://www.schoyencollection.com/firstalpha\\_files/ms3008.jpg](http://www.schoyencollection.com/firstalpha_files/ms3008.jpg)

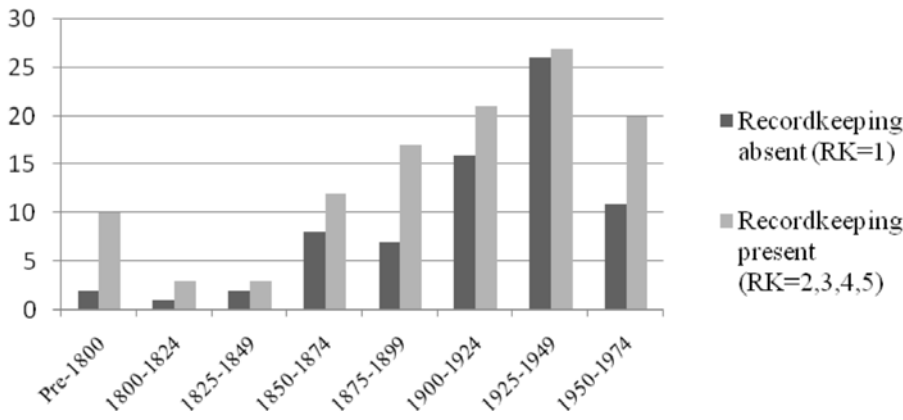
**Figure 2: Description of Recordkeeping Variable from Standard Cross-Cultural Sample (SCCS)**

*A: Recordkeeping Variable Coding, Description, and Frequency*

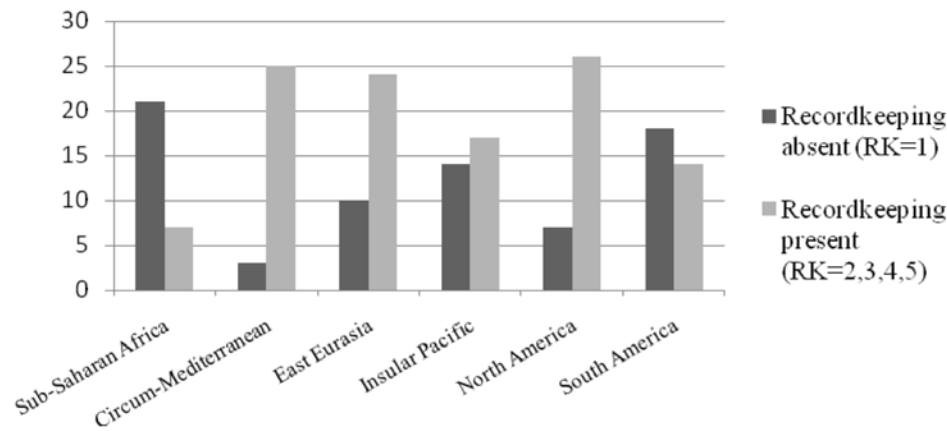
(Writing and Records; SCCS Variable #149; n=186)



*B: Frequency of Recordkeeping Scores by Year of Pinpointing*

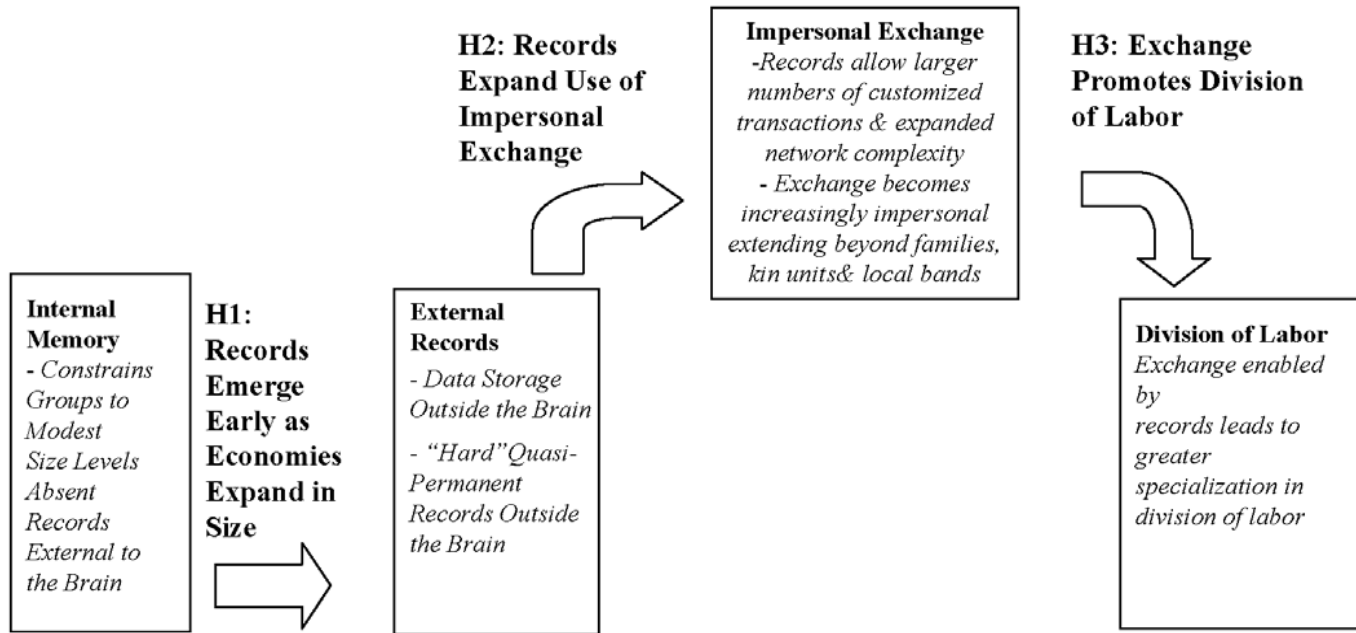


*C: Frequency of Recordkeeping Scores by Geographical Region*



**Figure 3**

*Graphical Depiction of Hypotheses on the Emergence of Recordkeeping and its Relation to Exchange, Division of Labor, & Economic Development*



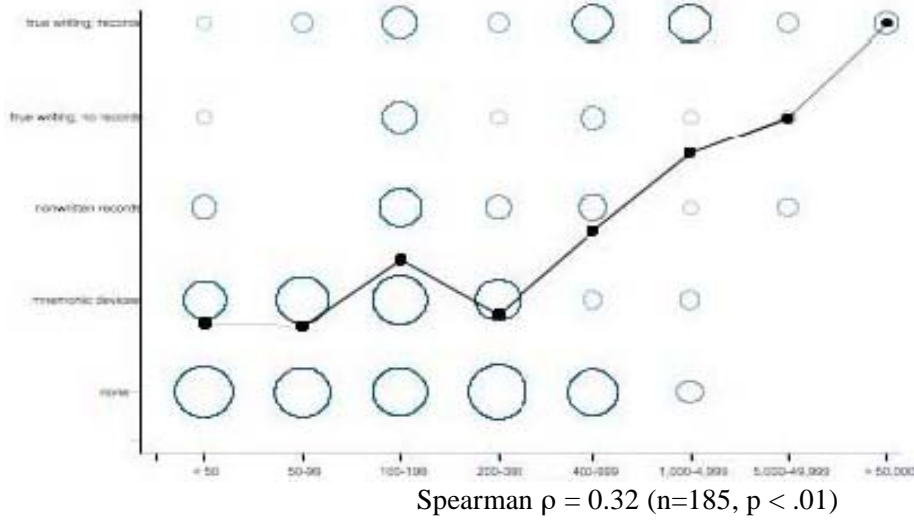
**H1:** Recordkeeping emerges when group size reaches the modest levels where constraints on human memory and cognition become binding. Because recordkeeping is a necessary institution for extensive impersonal exchange, it emerges early relative to other exchange-supporting institutions

**H2:** Recordkeeping fosters expansion in the scale, scope and complexity of impersonal exchange.

**H3:** If recordkeeping fosters an expansion of the market, then the expansion of exchange enabled by recordkeeping will also be associated with increased specialization in division of labor.

**Figure 4**

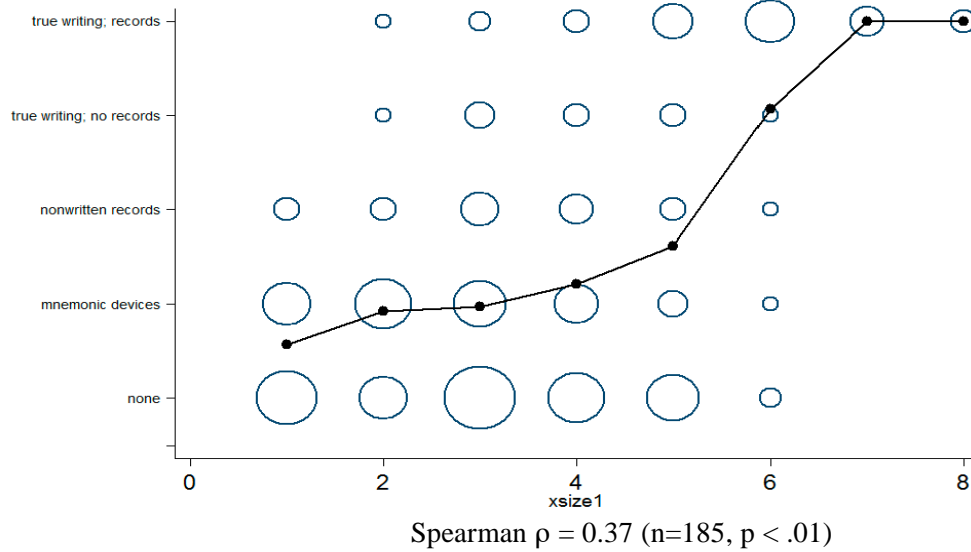
*A: Mean and Frequencies of Recordkeeping Score Plotted Against Community Size*



*B: Factor Estimation for Demographics (Iterated principal factors) & Factor Loadings (One factor retained)*

| Factor | Eigenvalue | Proportion Explained | Cumulative Explained | Factor Loadings                  |      |
|--------|------------|----------------------|----------------------|----------------------------------|------|
| 1      | 2.15       | 0.90                 | 0.90                 | Population Density (SCCS #1130)  | 0.88 |
| 2      | 0.19       | 0.08                 | 0.98                 | Total Population (SCCS #1122)    | 0.69 |
| 3      | 0.04       | 0.02                 | 1.00                 | Settlement Patterns (SCCS #1130) | 0.68 |
| 4      | -0.00      | -0.00                | 1.00                 | Community Size (SCCS #1130)      | 0.62 |

*C: Mean and Frequencies of Recordkeeping Score Plotted Against Demographics*



*D: Statistical Relation Between Recordkeeping and Size/Demographic Complexity*

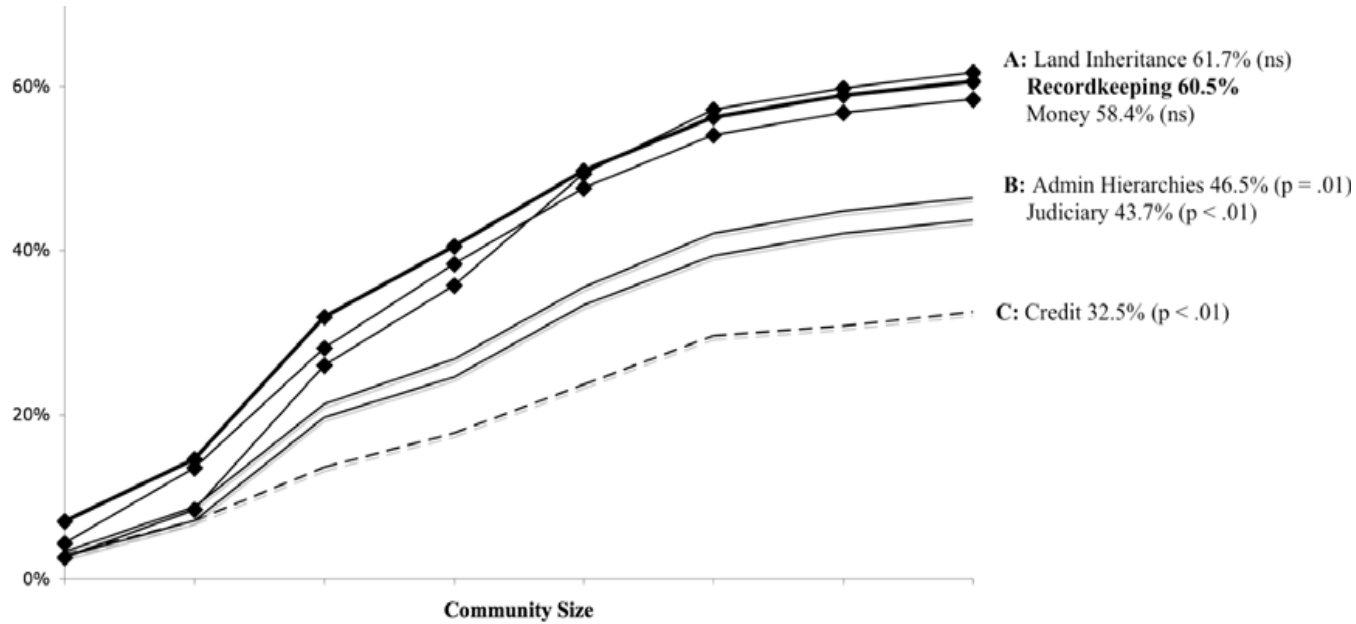
$$\text{RECORDKEEPING}_i = \alpha + \beta_1 \text{SIZE}_i + \beta_2 \text{SIZE}_i * \text{LARGE\_SIZE}_i + \beta_3 \text{LARGE\_SIZE}_i + \varepsilon_i$$

| Variable              | Predicted sign | Community Size |         | Demographics |         |
|-----------------------|----------------|----------------|---------|--------------|---------|
|                       |                | Coefficient    | p-value | Coefficient  | p-value |
| Size                  | +              | 0.54           | 0.01    | 0.21         | 0.17    |
| Size *                | +              | 0.52           | 0.02    | 1.15         | 0.00    |
| Large Size            |                |                |         |              |         |
| Large Size            | -              | - 3.35         | 0.00    | - 4.88       | 0.00    |
| Pseudo R <sup>2</sup> |                | 0.07           |         | 0.10         |         |
| N                     |                | 185            |         | 185          |         |

RECORDKEEPING is SCCS variable #149 (Writing and Records) with categories defined on the y-axis in Panel A. In the model using Community Size as an independent variable, SIZE is SCCS variable #63 (Community Size) with categories defined on the x-axis in Panel A. LARGE\_SIZE 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. *Demographic Factor* refers to the factor estimated in the lower portion of Panel B. For purposes of this test, the societies were ranked on *Demographic* and placed into eight groups where the total number of societies assigned to each group was identical to the number of societies in each of the eight groups corresponding to different values for *Community Size*. When *Demographics* is used as an independent variable, SIZE equals a number from one to eight corresponding to which of the ranked groups that the society has been assigned (lowest = 1 and highest = 8). LARGE\_SIZE in this model equals 0 if the society is in groups 1 – 3 and equals 1 if the society is in groups 4 – 8. The model is estimated using Ordered Logit. *P*-values are one-tailed when the sign is directionally predicted and are based on heteroskedasticity-consistent standard errors adjusted for residual correlation among observations belonging to the same major language family.

**Figure 5**

*Cumulative % of SCCS Societies Where an Institution is Present at a Given Level of Community Size*



**Percentage of Societies Where an Institution is Present**

|                   | Recordkeeping | No Recordkeeping | Chi-Square p-value |
|-------------------|---------------|------------------|--------------------|
| Land Inheritance  | 72            | 47               | 0.002              |
| Money             | 68            | 44               | 0.001              |
| Admin Hierarchies | 53            | 36               | 0.024              |
| Judiciary         | 50            | 33               | 0.016              |
| Credit            | 44            | 17               | < 0.001            |

**Table 1 Tests of Association between Recordkeeping and Impersonal Exchange***A: Exchange Factor Estimation (Iterated principal factors)*

| Factor | Eigenvalue | Proportion explained | Cumulative explained |
|--------|------------|----------------------|----------------------|
| 1      | 1.27       | 0.91                 | 0.91                 |
| 2      | 0.08       | 0.06                 | 0.97                 |
| 3      | 0.04       | 0.03                 | 1.00                 |
| 4      | -0.00      | -0.00                | 1.00                 |

*B: Factor loadings for Exchange (One factor retained)*

|                                       |      |
|---------------------------------------|------|
| Money                                 | 0.84 |
| Intercommunity Trade as a Food Source | 0.51 |
| Land transport                        | 0.50 |
| Food surplus via storage              | 0.24 |

*C: Association Between Recordkeeping and Exchange (p-values)*

| Variable               | Predicted Sign |             |              | Model with Demographics |
|------------------------|----------------|-------------|--------------|-------------------------|
| <i>RK_B</i>            | +              | 0.51 (0.00) | 0.26 (0.02)  | 0.13 (0.07)             |
| <i>Large_Comm</i>      |                |             | -0.01 (0.93) | -0.41 (0.00)            |
| <i>RK_B*Large_Comm</i> | +              |             | 0.57 (0.02)  | 0.48 (0.01)             |
| <i>Demographics</i>    |                |             |              | 0.56 (0.00)             |
| Adj. R <sup>2</sup>    |                | 0.32        | 0.38         | 0.63                    |
| N                      |                | 182         | 182          | 182                     |

Model:  $Exchange_i = \alpha_0 + \beta_1 RK\_B_i + \beta_2 Large\_Comm_i + \beta_3 RK\_B*Large\_Comm_i + Controls + \epsilon_i$

The sample used in Panel C includes the 183 SCCS societies where data for all variables were available. The models are estimated using OLS. *Exchange* is the factor derived from the factor analysis in Panels A and B. *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* (SCCS #63) is less than 200 persons and equals 1 when *Community Size* is greater than 200 persons. *Demographics* refers to the factor estimated in Figure 4, Panel C. Controls included in all models are: (1) *Agricultural Potential* (SCCS #921) of the society's region, (2) *Climate* (SCCS #857, a 6-scale categorical variable ordered in terms of open access to rich ecological resources), and (3) *Region* dummies that represent 0-1 variables based on the society's location within one of six major world regions. 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 2 Tests of Association Tests between Division of Labor and Impersonal Exchange***A: Division of Labor Factor Estimation (Iterated principal factors)*

| Factor | Eigenvalue | Proportion explained | Cumulative explained |
|--------|------------|----------------------|----------------------|
| 1      | 2.86       | 0.81                 | 0.81                 |
| 2      | 0.62       | 0.17                 | 0.98                 |
| 3      | 0.06       | 0.02                 | 1.00                 |
| 4      | 0.01       | 0.00                 | 1.00                 |
| 5      | -0.00      | -0.00                | 1.00                 |

*B: Factor loadings for Division of Labor (One factor retained)*

|                              |      |
|------------------------------|------|
| Intensity of Cultivation     | 0.87 |
| Agriculture                  | 0.82 |
| Technological Specialization | 0.71 |
| Administrative Hierarchy     | 0.62 |
| Class Stratification         | 0.62 |

*C: Association of Division of Labor with Exchange (p-values)*

| Variable            | Predicted Sign |                | With Community Size as a Control | With Demographics as a Control | With RK_B      |                |
|---------------------|----------------|----------------|----------------------------------|--------------------------------|----------------|----------------|
| <i>Exchange</i>     | +              | 0.44<br>(0.00) | 0.29<br>(0.00)                   | 0.10<br>(0.06)                 | 0.39<br>(0.00) |                |
| <i>RK_B</i>         | +              |                |                                  |                                | 0.30<br>(0.04) | 0.50<br>(0.00) |
| Adj. R <sup>2</sup> |                | 0.50           | 0.60                             | 0.69                           | 0.52           | 0.43           |
| N                   |                | 180            | 180                              | 180                            | 180            | 180            |

Model:  $Division\ of\ Labor_i = \alpha_0 + \beta_1 Exchange_i + Controls + \beta_2 RK\_B_i + \varepsilon_i$ 

The sample used in Panel C includes only the 174 SCCS societies where data for all variables were available. The models are estimated using OLS. *Division of Labor* is the factor derived from the factor analysis in Panels A and B. *Exchange* is the factor for the extent of market exchange derived from the factor analysis in Panels A and B of Table 1. Controls include: (a) *AgPotential* represents the Agricultural Potential (SCCS #921) of the society's region, (b) *Climate* (SCCS #857) is a 6-scale categorical variable ordered in terms of open access to rich ecological resources, and (c) *Region* dummies represent 0-1 variables based on the society's location within one of six major world regions. *Community Size* is used as an additional control variable in the second column and *Demographics* is used as the additional control variable in the third column in lieu of either *Community Size*. *Community Size* is SCCS variable #63 and *Demographics* is the factor estimated in Panel C of Figure 4. *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. *RK\_B* is added as an additional regressor in the fourth column. The final column shows the results using *RK\_B* as an independent variable on a stand-alone basis. P-values are one-tailed and are based on heteroskedasticity-consistent standard errors adjusted for residual correlation among observations belonging to the same major language family.

**Table 3 Tests of Association between Capital Stock and Impersonal Exchange***A: Capital Stock Factor Estimation (Iterated principal factors)*

| Factor | Eigenvalue | Proportion explained | Cumulative explained |
|--------|------------|----------------------|----------------------|
| 1      | 1.85       | 0.71                 | 0.71                 |
| 2      | 0.47       | 0.18                 | 0.89                 |
| 3      | 0.18       | 0.07                 | 0.96                 |
| 4      | 0.08       | 0.03                 | 0.99                 |
| 5      | 0.02       | 0.01                 | 1.00                 |
| 6      | -0.00      | -0.00                | 1.00                 |

*B: Factor loadings for Capital Stock (One factor retained)*

|                             |      |
|-----------------------------|------|
| Cropping Index              | 0.75 |
| Investment in Education     | 0.58 |
| Resource Base               | 0.55 |
| Large Impressive Structures | 0.53 |
| Political Autonomy          | 0.38 |
| Military Success            | 0.29 |

*C: Association of Capital Stock with Exchange (p-values)*

| Variable                     |                |                | With<br><i>RK_B</i> | With<br><i>Community<br/>Size</i> | With<br><i>Demographics</i> |
|------------------------------|----------------|----------------|---------------------|-----------------------------------|-----------------------------|
| <i>Exchange</i>              | 0.56<br>(0.00) | 0.21<br>(0.00) | 0.20<br>(0.00)      | 0.19<br>(0.00)                    | 0.17<br>(0.01)              |
| <i>Division of<br/>Labor</i> |                | 0.65<br>(0.00) | 0.64<br>(0.00)      | 0.60<br>(0.00)                    | 0.58<br>(0.00)              |
| <i>RK_B</i>                  |                |                | 0.07<br>(0.24)      |                                   |                             |
| Adj. R <sup>2</sup>          | 0.53           | 0.78           | 0.78                | 0.79                              | 0.79                        |
| N                            | 143            | 143            | 143                 | 143                               | 143                         |

Model:  $Capital\ Stock_i = \alpha_0 + \beta_1 Exchange_i + Controls + \varepsilon_i$

The sample used in Panel C includes the 143 SCCS societies where data for all variables were available. The models are estimated using OLS. *Capital Stock* is the factor derived from the factor analysis in Panels A and B, *Exchange* is the factor for the extent of impersonal exchange derived from the factor analysis in Panels A and B of Table 1, and *Division of Labor* is the factor derived from the factor analysis in Panels A and B of table 2. *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. Controls included in all models are: (1) *Agricultural Potential* (SCCS #921) of the society's region, (2) *Climate* (SCCS #857) is a 6-scale categorical variable ordered in terms of open access to rich ecological resources, and (3) *Region* dummies represent 0-1 variables based on the society's location within one of six major world regions. *Community Size* equals SCCS variable #63 and *Demographics* is the factor estimated in Panel C of Figure 4. P-values are one-tailed and based on heteroskedasticity-consistent standard errors adjusted for residual correlation among observations belonging to the same major language family.

**APPENDIX 1**  
*Construction of the Standard Cross-Cultural Sample (SCCS)*

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.

George Murdock and Douglas White (1969) constructed the SCCS to standardize the data used in cross-cultural research and facilitate statistical analysis.<sup>1</sup> Paying careful attention to ethnographic distributions, Murdock and White identified 186 cultural provinces in dispersed geographical locations and time periods (including two from before the Common Era). Murdock and White then chose one society to represent each cultural province, picking the earliest well-described societies to the extent practicable. The SCCS societies include contemporary hunter-gatherers, early historic states, and contemporary industrial societies. This wide coverage reflects Murdock and White’s (1969) conscious decision to mitigate biases that favored societies with English language ethnographic sources.

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 (a.k.a. *Galton’s Problem*) for over a century. The SCCS was specifically designed to minimize cross-society dependence because statistical corrections such as Fama-MacBeth or White-Huber standard errors had yet to be devised.

Murdock and White (1969) addressed this problem by “pinpointing” their societies to specific

---

<sup>1</sup> 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.

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.

Murdock (1967) initiated the pinpointing process when he analyzed nearly 1,300 societies chosen for the completeness of their ethnographic coverage to construct his *Ethnographic Atlas*. He classified these societies into clusters based on the similarity of the cultures and categorized groups of clusters into 200 “sampling provinces” (Murdock 1967; 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.<sup>2</sup> The cultures in SCCS are assigned a number from 1 to 186, which facilitate statistical identification of those cultural practices that originate from a common cultural heritage. This is done because societies with close geographical 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*.

The initial study using the SCCS coded 22 variables related to subsistence economy and related practices (Murdock and Morrow 1970). The electronic database includes a bibliography of ethnographic sources for each society-year, ranked on a scale from 1 “Principal Authority(ies)” to

---

<sup>2</sup> Some have argued that the 186 SCCS societies constitute a sample biased in favor of those studied more intensively by Murdock, his colleagues, and their students (Otterbein 1976). Subsequent research demonstrates that such bias is not present in the SCCS (Gray 1996). Rather, the predominant bias in the SCCS is towards societies that have been more intensively studied by ethnographers, as previously noted by Murdock and White (1969, 332).

6 “Sources to be Avoided” (White 1986). The hard copy archives include coding sheets indicating which individual sources were relied on most for each culture for coding different groups of variables. 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 each new variable 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.<sup>3</sup> Unlike the usual market studies, the data we use are limited to only one observation per culture; thus, SCCS does not provide a pooled time-series cross-sectional data set. The SCCS was designed to ensure that standard errors are not inflated by multiple observations from the same unit.

---

<sup>3</sup> An online journal, *World Cultures*, founded by Douglas 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>.

## Appendix 2

*Definitions of SCCS Variables Used in Empirical Tests*

| <b>Panel A: SCCS Variables First Introduced in Section I</b>   |   |
|--|---|
| <b>SCCS VARIABLE</b>   | <b>CODING</b>   |
| <b>V149: Records and writing</b><br><i>Variable #149 coded by Murdock and Provost (1973, 379-380).</i>         | 1 = None<br>2 = Mnemonic devices<br>3 = Nonwritten records<br>4 = True writing; no records<br>5 = True writing; records   |
| <b>Panel B: SCCS Variables First Introduced in Section III</b>   |   |
| <b>SCCS VARIABLES</b>  | <b>CODING</b>   |
| <b>V18: Credit source</b><br><i>Variable #18 first coded by Murdock and Morrow (1970, 306).</i>                | 1 = Personal loans between friends or relatives<br>2 = Internal money lending specialists<br>3 = External money lending specialists<br>4 = Banks or comparable institutions   |
| <b>V63: Community size</b><br><i>Variable #63 first coded by Murdock (1967, 159-160).</i>                      | 1 = < 50<br>2 = 50-99<br>3 = 100-199<br>4 = 200-399<br>5 = 400-999<br>6 = 1,000-4,999<br>7 = 5,000-49,999<br>8 = > 50,000   |
| <b>V89: Judiciary</b><br><i>Variable #89 first coded by Tuden and Marshall (1972, 441).</i>                    | 1 = Absent<br>2 = Not local<br>3 = Executive<br>4 = Appointed by executive<br>5 = Priesthood<br>6 = Hereditary  |
| <b>V91: Administrative Hierarchy</b><br><i>Variable #91 first coded by Tuden and Marshall (1972, 441-442).</i> | 1 = Absent<br>2 = Popular Assemblies<br>3 = Heads of kin groups<br>4 = Heads of decentralized territorial divisions<br>5 = Heads of centralized territorial divisions<br>6 = Part of centralized system   |
| <b>V155: Money</b><br><i>Variable #155 coded by Murdock and Provost (1973, 381).</i>                           | 1 = None<br>2 = Domestically usable particles<br>3 = Alien currency<br>4 = Elementary forms<br>5 = True money   |
| <b>V234: Settlement patterns</b><br><i>Variable #234 first coded by Murdock (1967, 159).</i>                   | 1 = Nomadic or fully migratory<br>2 = Semimigratory<br>3 = Semisedentary<br>4 = Compact but impermanent settlements<br>5 = Neighborhoods of dispersed family homesteads<br>6 = Separated hamlets, forming a single community<br>7 = Compact and relatively permanent settlements<br>8 = Complex settlements |
| <b>V278: Inheritance of land<sup>4</sup></b><br><i>Variable #278 first coded by Murdock (1967, 167).</i>       | 0 = Absence of individual property rights or rules<br>1 = Inheritance based on familial ties  |

<sup>4</sup> Inheritance of land was transformed from the seven level SCCS coding based on nature of descent dictating inheritance to a 0 – 1 variable.

**Appendix 2, Panel B (cont'd.)**

|  |  |
|--|--|
| <b>V1122: Population size</b><br><i>Variable #1122 coded by Douglas White and is described in Standard Cross-Cultural Codes, edited by White, Burton, Divale, Gray, Korotayev, and Khalturina at: <a href="http://eclectic.ss.uci.edu/~drwhite/courses/SCCCodes.htm">http://eclectic.ss.uci.edu/~drwhite/courses/SCCCodes.htm</a>.</i> | 1 = 10-99<br>2 = 100-999<br>3 = 1,000-9,999<br>4 = 10,000-99,999<br>5 = 100,000+<br>6 = 1,000,000+<br>7 = 10,000,000+<br>8 = 100,000,000+  |
| <b>V1130: Population density</b><br><i>Variable #1130 coded by Pryor (1984).</i>   | 2 = less than 1 per square mile<br>3 = 1 - 4.9 per square mile<br>4 = 5 - 24.9 per square mile<br>5 = 25 - 99.9 per square mile<br>6 = 99 - 499.9 per square mile<br>7 = 500 or more per square mile |

**Panel C: SCCS Variables First Introduced in Section IV****Variables used to measure *Exchange***

|  |  |
|--|--|
| <b>V1: Intercommunity trade as food source</b><br><i>Variable #1 coded by Murdock and Morrow (1970).</i> | 1 = No trade<br>2 = No food imports<br>3 = Salt & minerals only<br>4 = < 10% of food<br>5 = < 50% of food/less local source<br>6 = > 50% of food |
| <b>V21: Food surplus via storage</b><br><i>Variable #21 coded by Murdock and Morrow (1970).</i>          | 1 = None or barely adequate<br>2 = Simple or adequate<br>3 = Complex or more than adequate   |
| <b>V154: Land transport</b><br><i>Variable #154 coded by Murdock and Provost (1973).</i>                 | 1 = Humans only<br>2 = Pack animals<br>3 = Draft animals<br>4 = Animal-drawn vehicles<br>5 = Automotive vehicles                                 |

**Variables used to measure *Division of Labor***

|   |  |
|---|--|
| <b>V151: Agriculture</b><br><i>Variable #151 coded by Murdock and Provost (1973).</i>                               | 1 = None<br>2 = 10% of food supply<br>3 = 10%; secondary<br>4 = primary; not intensive<br>5 = primary; intensive   |
| <b>V153: Technological specialization</b> <sup>5</sup><br><i>Variable #153 coded by Murdock and Provost (1973).</i> | 1 = No pottery, loom weaving, metalwork<br>2 = One of pottery, loom weaving, or metalwork<br>3 = Smiths, weavers, and potters  |
| <b>V232: Intensity of cultivation</b><br><i>Variable #232 coded by Murdock (1967, 159).</i>                         | 1 = No agriculture<br>2 = Casual agriculture, incidental to other<br>3 = Extensive or shirting agriculture<br>4 = Horticulture<br>5 = Intensive agriculture<br>6 = Intensive irrigated agriculture |
| <b>270: Class stratification</b><br><i>Variable #270 first coded by Murdock (1967, 165-166).</i>                    | 1 = Absence among freemen<br>2 = Wealth distinctions<br>3 = Elite (based on control of land or other resources)<br>4 = Dual (hereditary aristocracy)<br>5 = Complex (social classes)               |

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

**Appendix 2, Panel C (cont'd.)****Variables used to measure *Capital Stock***

|  |   |
|--|---|
| <b>V66: Large or impressive structures</b><br><i>Variable #66 coded by Murdock and Wilson (1972).</i>  | 1 = None<br>2 = Residences of influential individuals<br>3 = Secular or public building(s)<br>4 = Religious or ceremonial building(s)<br>5 = Military structure(s)<br>6 = Economic or industrial buildings  |
| <b>V81: Political autonomy</b><br><i>Variable #81 coded by Tuden and Marshall (1972).</i>  | 1 = Dependent totally<br>2 = Semi-autonomous<br>3 = Tribute paid<br>4 = De facto autonomy<br>5 = Equal status in pluralistic society<br>6 = Fully autonomous  |
| <b>V425 – V428: Investment in Education</b><br>(Sum of Four Education Variables Each Coded Identically)<br>V425: Guidance of formal schooling (Early boys)<br>V426: Early girls<br><br>V427: Late boys<br>V428: Late girls<br><i>Variables #425-428 coded by Barry, et al. (1977).</i>   | 1 = Informal training, with min guidance<br>2 = Apprenticeship atypical or occasional<br>3 = Apprenticeship typical & frequent but informal training more prevalent<br>4 = Apprenticeship predominant<br>5 = Formal schooling atypical or occasional<br>6 = Formal schooling typical and frequent |
| <b>V859: Resource base<sup>6</sup></b><br><br><i>Variable #859 coded and added to database by White, Whiting, and Burton in 1986. The variable is described in <i>Standard Cross-Cultural Codes</i>, edited by White, Burton, Divale, Gray, Korotayev, and Khalturina at:<br/><a href="http://eclectic.ss.uci.edu/~drwhite/courses/SCCCodes.htm">http://eclectic.ss.uci.edu/~drwhite/courses/SCCCodes.htm</a>.</i> | 1 = Low resources (ex. hunting, gathering, fishing)<br>2 = Unstable resources (ex. mounted hunting, shifting cultivation, intensive agriculture with no plow)<br>3 = High resources (ex. advanced horticulture with metal hoes, intensive agriculture with plow, pastoralism)                     |
| <b>V908: Military success<sup>7</sup></b><br><i>Variable #908 coded by Otterbein (1970).</i>   | 1 = No – its boundaries/population are shrinking<br>2 = Breaking even – what it loses in territory it takes from others<br>3 = No change – boundaries/population stationary (the population is able to replace those lost in war)<br>4 = Yes – its boundaries/population are expanding            |
| <b>V1128: Cropping index</b><br><i>Variable #1128 coded by Pryor (1985).</i>   | 1 = No Agriculture or confined to non-food crops<br>2 = < 10% of land used per year<br>3 = 10%-29% of land used per year<br>4 = 30%-49% of land used per year<br>5 = 50%-99% of land used per year<br>6 = 100% or more of land used per year  |

**Control Variables**

|   |  |
|---|--|
| <b>V200: Region</b><br><i>Variable #200 first coded by Murdock (1967, 154).</i> | 1 = Africa: Exclusive of Madagascar and Sahara<br>2 = Circum-Mediterranean: North Africa, Europe, Turkey, Caucasus, Semitic Near East<br>3 = East Eurasia: including Madagascar and Islands in Indian Ocean<br>4 = Insular Pacific: including Australia, Indonesia, Formosa, Phillipines<br>5 = North America: indigenous societies to the Isthmus of Tehuantepec<br>6 South America: including Antilles, Yucatan, Central America |
|---|--|

<sup>6</sup> Resource base was collapsed from a 12-point scale to a 3-point scale.

<sup>7</sup> The coding of Military success was reversed from the SCCS coding to facilitate interpretation.



**Appendix 2, Panel C (cont'd.)****Control Variables (cont'd.)**

|  |                           |
|--|---------------------------|
| <b>V857: Climate type: ordered in terms of open access to rich ecological resources</b>  | 1 = Polar                 |
| <i>Variable #857 coded and added to database by White and Burton in 1986. The variable is described in Standard Cross-Cultural Codes, edited by White, Burton, Divale, Gray, Korotayev, and Khalturina at:</i> | 2 = Desert or cold steppe |
| <a href="http://eclectic.ss.uci.edu/~drwhite/courses/SCCCodes.htm">http://eclectic.ss.uci.edu/~drwhite/courses/SCCCodes.htm</a> .  | 3 = Tropical rainforest   |
|  | 4 = Moist temperate       |
|  | 5 = Tropical savanna      |
|  | 6 = Tropical highlands    |
| <b>V921: Agricultural potential: sum of land slope, soils, climate scales</b>  | 4 = poorest potential     |
| <i>Variable #200 first coded by Pryor (1986).</i>  | 5-22 = graded scale       |
|  | 23 = richest potential    |

**References for Appendix 2**

- Barry, H., Lili Josephson, Edith Lauer, and Catherine Marshall, 1977. Agents and techniques of child training. *Ethnology* 16: 191-230.
- Murdock, G., 1967. Ethnographic Atlas: A Summary. *Ethnology* 6: 109-236.
- Murdock, G. and D. Morrow, 1970. Subsistence economy and supportive practices. *Ethnology* 9: 302-330.
- Murdock, G. and C. Provost, 1973. Measurement of cultural complexity. *Ethnology* 12: 379-392.
- Murdock, G. and S. Wilson, 1973. Settlement patterns and community organization. *Ethnology* 11: 254-295.
- Otterbein, K., 1970. *The Evolution of War: A Cross-Cultural Study*. New Haven, CT: HRAF Press.
- Pryor, F., 1984. *The Transition to Agriculture: Some Empirical Evidence*. Unpublished manuscript, cited in White, et al. *Standard Cross-Cultural Codes*.
- Pryor, F., 1985. The invention of the plow. *Comparative Studies in Society and History* 27: 740-744.
- Pryor, F., 1986. The adoption of agriculture: Some theoretical and empirical evidence. *American Anthropologist* 88:894-897.
- Tuden, A. and C. Marshall, 1972. Political organization. *Ethnology* 11: 436-464.
- White, D., M. Burton, W. Divale, P. Gray, A. Korotayev, and D. Khalturina eds., 2005. *Standard Cross-Cultural Codes* (SCCCodes.doc 3-09-05), available online at <http://eclectic.ss.uci.edu/~drwhite/courses/SCCCodes.htm>.