Informal insurance in the presence of poverty traps: Evidence from southern Ethiopia

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Abstract:
Recent empirical work finds evidence of highly nonlinear wealth dynamics among Boran pastoralists of southern Ethiopia, consistent with the hypothesis of poverty traps. This paper explores the consequences of such dynamics for informal inter-household transfers. Using original primary data on social networks and transfers, we find that asset transfers respond to recipients' losses, but only so long as the recipients are not "too poor". The persistently poor are excluded from social networks and do not receive transfers in response to shocks. We also find some evidence that the threshold at which wealth dynamics bifurcate may serve as a focal point at which transfers are concentrated. This suggests that asset transfers, in the context of poverty traps, may aim to insure the permanent component of income generation, rather than the transitory component, as standard insurance models assume.

Keywords: risk, informal insurance, social networks, poverty traps, Ethiopia

JEL codes: Z13, I3, O13

1. Introduction

Risk is a central feature of life in rural areas of developing countries. Economic theories of risk sharing, rooted in the work of Arrow (1964), Diamond (1967) and Wilson (1968), posit that individuals will use a variety of instruments – most notably for our purposes, informal insurance based on interhousehold transfers (Townsend 1994, Lim and Townsend 1998) – to shield consumption from the idiosyncratic variation in income that is commonplace in these settings. Models of informal insurance are based on the strong, if often only implicit, assumption that the income generating process is stationary or, in other words, that shocks only have transitory effects. For example, Coate and Ravallion (1993, p.4) justify their focus on symmetric insurance arrangements with the assumption that "either player could end up 'rich' or 'poor' in any period" with equal probability.[1] The assumption that income processes are stationary provides the basis for an all-inclusive insurance pool.[2]

Yet a growing literature, recently reviewed by Azariadis and Stachurski (2004), emphasizes the possibility of nonstationary income processes that may yield multiple dynamic equilibria, with one or more stable equilibria below the poverty line – a low-level equilibrium (poverty) trap.[3] What implications, if any, might poverty traps have for the functioning of informal insurance networks?

[1] The same assumption is true in Ligon et al. (2002) in the case of nonstationary transfers.
[2] The next section discusses some models that emphasize limits on the size of the insurance group without abandoning the assumption of stationary income processes.
[3] Some of this literature emphasizes the role of uninsured risk as a as a root of poverty, generally emphasizing the role of ex ante choices and intended to diminish the impact of shocks (e.g., Binswanger and Rosenzweig 1993, Bardhan, Bowles and Gintis 2000, Carter and Barrett 2006). See Dercon (2004) for a review of this relation.

The theoretical literature on poverty traps posits the rational exclusion of the poor from welfare-improving opportunities, such as informal insurance contracts. This occurs because, under limited commitment, agents must use informal sanctions to ensure that contracts are respected and sanctions have less "bite" for those who have little to lose (Banerjee and Newman 1995). This is not, however, the only possible rationale for being selective about with whom to insure.

In the presence of multiple dynamic equilibria, small transfers can have large welfare impacts if, in the wake of a shock with potentially long lasting or permanent effects,[4] they succeed in making the recipient cross the unstable dynamic equilibrium at which path dynamics bifurcate. If a poverty trap exists, then the unstable dynamic equilibrium may serve as a focal point for interhousehold asset transfers since this is the point at which the long-term welfare impact of a transfer is greatest. Transfers might then be appropriately conceptualized as a mechanism to defend households from falling onto a path of sustained asset loss and eventual destitution. Although the available data do not allow a conclusive test between these two models, we present evidence based on simulations of expected wealth dynamics that seems to favor this latter explanation.

The remainder of the paper proceeds as follows. Section 2 briefly outlines a simple model of informal insurance in the presence of poverty traps that shows how the resulting patterns of interhousehold transfer may differ from the stationary case of an all-inclusive insurance pool, with wealth playing a central role in determining who is and is not included. Section 3 then introduces the setting we study and the data we use,

[4] The possibility that shocks may have long lasting or even permanent effects is addressed in, for example, Martorell (1999), Ravallion and Lokshin (2005), Dercon (2004) and Dercon and Hoddinott (2004). In our case, such shocks would be those that leave the individual below the path dynamic threshold.

collected from southern Ethiopian Boran pastoralists, a population among which nonlinear wealth dynamics characterized by poverty traps has been reasonably well established (Lybbert et al. 2004, Santos and Barrett 2006a). In section 4 we study informal insurance links among the Boran and find that respondents' decision to give cattle to an individual is not unconditionally triggered by the prospective recipient's losses – as it would in the canonical insurance model – but depends on the match's losses conditional on herd size – as a model that takes into consideration the existence of poverty traps would predict. This result is robust to a series of additional controls, namely for individual-specific ability that Santos and Barrett (2006a) find influences herd dynamics. We further explore whether these decisions seem to be influenced by a prospective transfer recipient's position relative to the unstable asset equilibrium – the accumulation threshold identified by Lybbert et al. (2004) and corroborated by Santos and Barrett (2006a) – by analyzing the effect of two variables that may drive the propensity to reciprocate gifts (expected wealth and expected gains from gifts). We find evidence of non-monotonic relation between matches' wealth and the formation of insurance links. In section 5 we then study patterns of social acquaintance and find that wealth plays a role in explaining who is known within a community and thus who can mobilize transfers in response to shocks. Being destitute has a strong, negative impact on the probability of being known and, since cattle transfers only occur between people who know each other, persistent poverty thereby becomes socially invisible. Finally, section 6 summarizes these results and draws out the policy consequences of our findings.

2. Transfers in the context of poverty traps

A simplified version of the intertemporal decision problem facing a risk-averse agent i, in which utility is defined over wealth and we rule out bequest motives for accumulation can be written as:

(1) $\max_{\{\tau t\}} E \{ \sum_{t=0\ldots T} \beta^t U(k^i_t) \mid \phi(\bullet)\}$

subject to: $k^i_t = g(k^i_{t-1} (1+ \phi^i_t (k^i_{t-1})) + \tau^{ij}_t + \tau^{ji}_t)$

k^i_0 given

$k^i_T = 0$

where k^i_t stands for the agent's assets, our state variable, τ_t represents transfers (negative if given to some other agent j, τ^{ij}_t, positive if received from another, τ^{ji}_t) and $\phi^i_t (k^i_{t-1})$ is a shock drawn from the distribution $\phi(\bullet)$ with support on the interval [-1, 0], reflecting losses that could range from 0-100% of i's initial asset stock. This formulation highlights both the importance of self-insurance (through ex ante asset levels, that affect the probability distribution function of shocks[5]) and the role of informal insurance. Because theoretical models of poverty traps emphasize the role of asset accumulation in shaping welfare dynamics, we focus on asset shocks and transfers rather than on income shocks, as is more common in the literature on informal insurance.[6]

The growth function that underlies the asset law of motion, g(•), must be general enough to incorporate two possibilities, identified in earlier work in this environment

[5] As Lybbert et al. (2004) report, sales and slaughtering are tiny, less than two percent of herd, on average, among the population we study Thus shocks (mainly mortality) are almost the unique reason for decreases in herd size, while increases are mostly due to biological reproduction. The importance of asset levels in determining the level of risk has the paradoxical effect that asset levels, in this economy, are (to a large extent) exogenously determined. Clearly, the simplicity of this economy facilitates the econometric analysis to a degree that would be harder to achieve in other contexts, where we may suppose that the role of agency in dealing with shocks (in choosing the level of risk to which one is exposed or to invest in formal financial instruments, for example) is potentially much larger.

[6] An exception is the analysis in McPeak (forthcoming). McPeak (2004) also argues that income and asset shocks, albeit correlated, can have different (and offsetting) impacts on household behavior (asset sales).

(Santos and Barrett 2006a). First, household characteristics (*e.g.*, intrinsic ability) may sort cross-sectional units into distinct cohorts or clubs, *c*. Second, within each club, agents might face nonstationary dynamics – in particular, and as hypothesized by multiple equilibrium models, the possibility of a critical threshold value, γ^c, at which the welfare dynamics bifurcate, with one path, subscripted ℓ, leading to a low-level equilibrium and another, subscripted *h*, leading to a high-level equilibrium. These possibilities imply that for each club *c*=1,…, *C* , the asset law of motion is

(2) $$k^c_t = \begin{cases} g^c_\ell(k_{t-1}\,(1+\phi^i_t\,(k_{t-1})) + \tau^{ji}_t + \tau^{ij}_t) \text{ if } i\in c,\ k_{t-1} < \gamma^c \\ g^c_h(k_{t-1}\,(1+\phi^i_t\,(k_{t-1})) + \tau^{ji}_t + \tau^{ij}_t) \text{ if } i\in c,\ k_{t-1} \geq \gamma^c \end{cases}$$

Borrowing the terms from the growth literature, this specification can be simplified into a club convergence approach (as in Quah 1997) if there are no asset thresholds at which asset dynamics bifurcate (that is, $\gamma^c=0, \forall c$), or into a threshold model (as in Azariadis and Drazen 1990) if there is only one club (that is, *C*=1).[7] If one assumes that g(•) is concave, and that there are no convergence clubs or thresholds, we're back to the convergence model of Solow (1956) that, implicitly, underlies the consumption smoothing literature with its assumption of a stationary income process.

The insurance contract available to these agents is very simple and formally defined by $\tau^{ij}_t = \{\tau, 0\}$ that is, at each period t, agent i can transfer to agent j a fixed amount of assets (τ) or nothing at all. This dichotomous treatment of transfers is a reasonably accurate description of the reality of asset transfers in the setting we study

[7] Several approaches have been recently suggested to identify convergence clubs (for example, Canova 2004) and thresholds (for example, Hansen 2000) but not, to our knowledge, both. In the empirical section we'll build on previous work (Lybbert et al. 2004, Santos and Barrett 2006a) to identify both convergence clubs and accumulation thresholds.

(see section 3) and reduces the demand for insurance to a binary decision of whether to insure with a specific partner or not – in other words, to a process of dyad formation.

Keeping with the extant literature on informal insurance, we assume that the motivation for entering such contract is "balanced reciprocity" (Platteau 1997), ruling out altruistic reasons for such transfers. The simplest structure that allows for such a motivation must span two periods. In period 1, agents play a two-stage game. In the first stage, shocks are revealed to each agent and an agent j who has suffered a herd loss approaches i with a request for a transfer of τ. In the second stage, i decides whether or not to accept the request – that is, whether to form an insurance link with an agent.[8] Growth then occurs. Then in period 2, transfers are reversed and j transfers τ back to i.[9] This is obviously a simplification of complex informal insurance systems, but it captures the essential elements: dependence on the conscious choice to form and/or activate a dyadic link, state-contingent transfers, and eventual reciprocation.

Given this structure, transfers will be made if the expected gains from transfer over autarky are strictly positive

(3) $\tau^{ij}{}_1 = \tau \text{ iff } EU^i(\tau) > EU^i(0)$

where

(4) $EU^i(\bullet) = EU^i{}_1(\bullet) + \beta\, EU^i{}_2(\bullet) * \Theta(\tau^{ji}{}_2=\tau)$

[8] Note that we model the insurance link formation as occurring ex post of the shock – rather than ex ante of the shock, as is more common in the literature – in order that the structure of the model matches that of the data we use in section 4.
[9] One can equally conceptualize τ as a loan, a gift or an insurance payment. As we discuss below, these are observationally equivalent in the data we use.

and $\beta < 1$ is the time discount rate. Uncertainty about whether such gifts will be reciprocated, given their informal nature, is usually addressed through an appeal to the theory of repeated games. We summarize such game-theoretic structure by the function $\Theta(\tau^{ji}_2=\tau)$ that expresses the probability that, in period 2, agent j will reciprocate the original gift as a result of the rules in place, with $\Theta(\tau^{ji}_2=\tau) = 1$ meaning that such contracts are perfectly enforceable.

This paper explores what changes in the structure of insurance networks might arise from the introduction of multiple equilibria, as in equation (2). More concretely, we ask: do herd dynamics guide the selection of insurance partners?[10] In what follows, we'll see that the answer is "no" in the convergence model and "yes" in a model with multiple equilibria.

2.1 Stationary dynamics: convergence towards one equilibrium

Let k_e be the dynamic equilibrium asset value for which $k_t=k_{t-1}$ and consider the case of no clubs, $g(\bullet)$ a strictly concave function on assets and $g(0) > 0$. It is easy to show that k_e is unique and it is clear that, as $T\rightarrow\infty$, the distribution of assets among the population will converge to a degenerate distribution characterized by $prob(k=k_e)=1$, regardless of the initial distribution of assets among the population. Starting from that

[10] At least three recent papers explore similar questions. Zimmermann and Carter (2003) show that in the face of income shocks, individuals near a critical asset threshold will tend to preserve or smooth their assets, destabilizing consumption in order to avoid an intertemporally costly collapse below the threshold. Following the same argument, Hoddinott (2006) shows that asset sales (oxen and cows/heifers) by Zimbabwean farmers depend on their position relative to an asset threshold (of two oxen, in this sample), with those above the threshold selling far more frequently in response to idiosyncratic shocks. Barrett et al. (2006) show, using data on pastoralists from northern Kenya, that income and consumption smoothing behavior are differentiated by wealth, with poorer households suppressing income variability while wealthier ones smooth consumption, a pattern consistent with the idea that the most vulnerable households destabilize consumption in order to protect crucial productive assets on which their future survival depends.

equilibrium, we need only to concern ourselves with negative shocks: in a way analogous to the discretization applied above to the possible contracts, let the shock be defined by the pair $\phi^i_t \in \{0, \phi\}$, with $-1 < \phi < 0$, each state occurring with non-zero probability. Let the growth function be defined by

(5) $g(k_e (1+ \phi^i_t (k^i_{t-1})) \mid \phi^i_t =0) = g(k_e - \tau^{ij}) = k_e$

(6) $g(k_e (1+ \phi^i_t (k^i_{t-1})) \mid \phi^i_t = \phi) = k_e + \phi + \varsigma$

(7) $g(k_e (1+ \phi^i_t (k^i_{t-1})) + \tau^{ji} \mid \phi^i_t = \phi) = k_{e.}$

with $0 < \varsigma < |\phi|$. With agents starting at the equilibrium k_e, the value of setting $\tau_t=\tau$ is to hasten convergence towards k_e if one suffers a negative shock. Given that transfers are small relative to the equilibrium k_e, convergence reoccurs in a single period, as reflected in equation (5). It is clear that $EU^i(\tau) > EU^i(0)$ holds for any individual. Hence, the insurance pool will include all agents. The key point here is that when the underlying stochastic process is stationary (and abstracting from the costs of contracting), there is no reason to exclude prospective insurance links from one's network.

2.2 Non-stationary dynamics: the possibility of multiple equilibria

Consider now a growth club with multiple equilibria, $k_e=\{k_l, \gamma, k_h\}$, with k_l representing the low-level stable equilibrium, k_h representing the high-level stable equilibrium, and γ the (unstable) threshold at which the accumulation dynamics bifurcate, per equation (2). The transition matrix between these equilibria is presented in Table 1. Each cell represents the probability of each asset position after the period 2 shock – i.e., at the point at which j would reciprocate with a transfer of τ back to i – (the columns), given the first period shock (the rows). Table 1 thus captures the one period ahead wealth distribution at the moment i would ask j to reciprocate, conditional on asset holdings at the time j approaches i for a transfer of τ.

The speed of transition towards the nearest stable equilibrium is captured by ε. If $\varepsilon>0$, as we'll maintain throughout the analysis, then the system is ergodic.[11] In the long run, everyone has a non-zero probability of spending time in both stable equilibria and initial conditions no longer matter. In a stricter definition that equates history dependence with lack of ergodicity, this is no longer a model of poverty traps. Note however that if one starts at the low-level equilibrium, then ε is also a measure of the degree of poverty persistence. If, as we also assume, ε is small, then transitions between stable equilibria are possible but the poor may spend a long time in the low-level equilibrium.[12] This approach adds realism to the analysis, by avoiding a deterministic model where poverty traps are absolute and can never be overcome, without necessarily diminishing the policy relevance of the existence of multiple equilibria.

We also assume that δ, the probability of ending up at the low-level equilibrium if, ex post shock, one is at γ is higher than μ, the probability of the same end result if one is above the threshold when growth occurs. To make the problem interesting, we further assume that $k_l + \tau < \gamma$ (a poor agent cannot reach the threshold through transfers) and $k_h - \tau > \gamma$ (a wealthy agent does not compromise his growth capacity by transferring τ to an insurance partner).

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[11] More rigorously, we could have considered $\varepsilon_l \neq \varepsilon_h$, and we would only need to assume that $\varepsilon_l > 0$ to get an ergodic system. This would overburden the notation with insignificant changes in the results.

[12] Mookherjee and Ray 2001 label this process "self-reinforcement as slow convergence". The definition of poverty trap adopted by Azariadis and Stachurski (2004, p. 33) - "A poverty trap is any self-reinforcing mechanism which causes poverty to persist" - explicitly allows for this approach.

Limited commitment translates into $\Theta(\tau^{ji}{}_2=\tau) < 1$. Can we then expect a higher probability of defaulting from particular types of prospective transfer recipients? Given that marginal utility is decreasing in k, the punishment strategies that make such contracts feasible are less effective when applied to those with less wealth. Because default on the same transfer yields greater utility for those with less wealth,[13] an ordering of agents emerges that is (weakly) monotonic in wealth space:

(8) $\Theta(\tau^{ji}{}_2=\tau| k_l) \leq \Theta(\tau^{ji}{}_2=\tau \mid \gamma) \leq \Theta(\tau^{ji}{}_2=\tau \mid k_h)$

This corresponds to the usual reasoning about incentives and behavior in the context of persistent poverty (Banerjee and Newman 1994, Banerjee 2000). McPeak (forthcoming) takes this line of argument one step further, suggesting that asset transfers in a context quite similar to the one we study can be understood as ex ante precautionary savings rather than as ex post insurance. In this case, only capacity to reciprocate the gift should matter to the decision to transfer assets that would be independent of the realization of a (negative) shock by the prospective recipient. One can test this prediction empirically, as we do below.

A plausible modification to this model explores the idea that the receiver's valuation of the original transfer may affect his decision not to default, as in the empathy formation model proposed by Stark and Falk (1989). If higher valuation of the transfer by

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[13] An extreme version of the argument follows from the (ad-hoc) assumption that $u(k_l-\tau) = -\infty$. In this case, it is clear that those with asset stocks of k_l will renege on the contract in period 2 and we only need to compute the probability of holding k_l at period 2, conditional on asset levels in period 1, to rank the agents in terms of their desirability as insurance partners:

$$[\Theta(\tau_{j2}=\tau \mid k_{j1} = k_l) = \varepsilon] < [\Theta(\tau_{j2}=\tau \mid k_{j1} = \gamma) = 1 - \delta - \delta\varepsilon] < [\Theta(\tau_{j2}=\tau \mid k_{j1}= k_h) = 1 - \mu - \mu\varepsilon].$$

Note that without such certainty about defaulting, we can only use weak inequalities, as done above.

the original recipient leads to a smaller probability of default, due to "gratitude" or similar emotions,[14] then we can write

(9) $\Theta\ (\tau^{ji}{}_{2}=\tau) = f(V^{j}(\tau^{ij}{}_{1}=\tau))$

where $V^{j}(\bullet)$ is j's valuation of the transfer made in period 1 and $f(\bullet)$ is an increasing function. We can write $V^{j}(\bullet)$ as a function of the gains, in terms of growth, from the initial transfer:

(10) $V^{j}(\tau^{ij}{}_{1}=\tau) = g^{j}{}_{1}\ (k_{j}\ (1+\ \phi^{i}{}_{t}\ (k^{i}{}_{t-1})) + \tau^{ij}{}_{1}) - g^{j}{}_{1}\ (k_{j}\ (1+\ \phi^{i}{}_{t}\ (k^{i}{}_{t-1}))$

Given the structure of the growth process, it is straightforward to show that

(11) $V(k_{l}) = 0$

(12) $V(\gamma) = (\mu - \delta)\ (1-\varepsilon)\ (k_{l} - k_{h}) > 0$

(13) $V(k_{h}) = 0$

As a consequence, $\Theta(k_{l}) = \Theta(k_{h}) < \Theta(\gamma)$. A gift will be valued if, ex post shock, the potential recipient is at γ given that only then can transfers influence the equilibrium to which the recipient converges. If the receiver's valuation of the gift affects propensity to reciprocate, the ordering of preferred agents to whom one makes transfers becomes non-monotonic in the wealth space, with the maximum at the unstable equilibrium, γ.

Several other explanations from the literature merit some attention, given their attempt to explain rational selection out of insurance contracts. The closest to our analysis is by Hoff (1997), who predicts matches along wealth levels. Individuals with high

[14] See Komter (2005) and references therein on the role of gratitude as the "moral memory of mankind" and the psychological foundation for reciprocity and Hirshleifer (1987) for a discussion of the role of emotions as guarantors of contracts.

enough expected wealth may not invest in insurance relations because the expected benefits may not compensate for expected net contributions to the insurance pool. This result implicitly depends on the lack of convergence in incomes between agents (some have higher expected income than others) and relies heavily on the impossibility of separating insurance from redistribution due to egalitarian sharing rules, an environment quite different from the one that we study. In section 4 we test this model, since we use data from both sides of the insurance contract and control for the giver's wealth.

Given that informal transfers can insure only against idiosyncratic shocks – not against covariate ones – asset covariance between potential insurance partners should matter to contracting choices, as the related literature on peer selection in micro-credit arrangements suggests (Ghatak 1999, Sadoulet and Carpenter 1999). Agents might therefore rationally opt out of insurance contracts with those whose wealth covaries strongly with their own wealth. We address this possibility below, as an additional check on our results.

Finally, Murgai et al. (2002) suggest that the costs of establishing insurance links may limit the domain of insurance links. Genicot and Ray (2003) likewise suggest that insurance groups may be bounded because risk-sharing arrangements need to be robust to deviations by sub-groups. Although these arguments do not explicitly model wealth as a source of friction that might prevent insurance links from forming, they offer complementary explanations for the behavior that we observe. In our empirical work, we therefore control for covariates that may reflect differences in the degree of enforcement of such contracts or in the monitoring of other agent's activity and, less perfectly, for the degree of alternative insurance ex ante of the link formation decision.[15]

3. Boran pastoralists in southern Ethiopia

Lybbert et al. (2004) analyze wealth dynamics among Boran pastoralists, a poor population in southern Ethiopia. Using herd history data for 55 households over a 17 year period, they show that herd dynamics follow a S-shaped curve with two stable equilibria (at approximately 1 and 35-40 cattle), separated by an unstable threshold (at 15-20 cattle). The authors suggest that this threshold results from a minimum critical herd size necessary to undertake migratory herding to deal with spatiotemporal variability in forage and water availability. Those with smaller herds are forced to stay near their base camps, where pasture conditions soon get degraded, leading to a collapse of herd size towards the low-level stable equilibrium, while those with bigger herds can migrate in search of adequate water and pasture, enabling them to sustain far larger herds.

Two other findings presented in Lybbert et al. (2004) help motivate this paper. First, they show that asset risk is predominantly idiosyncratic. This creates conditions conducive to the implementation of welfare-improving insurance contracts among pastoralist households. Second, they find that insurance operationalized through inter-

[15] The relevance of Genicot and Ray (2003) is questionable in our context, given that we address the issue of network formation. Groups differ from networks because of the existence, in the latter, of a common boundary: if A establishes a link with B, the fact that B already has a link with C does not mean that A will also have a (direct) link with C. Hence considerations about sub-group deviations may be less of a concern here than in more formalized institutions such as, for example, the funeral insurance groups studied by Bold (2005).

household gifts and loans of cattle are conspicuously limited. On average, a household must lose 30 cattle more than the community average herd loss in order to trigger the transfer of a single cattle.

This meager insurance payment, corroborated by other recent studies from semi-arid African systems (Kazianga and Udry 2006, Lentz and Barrett 2005, McPeak 2005), seems paradoxical in the face of overwhelmingly idiosyncratic insurance risk: why would people bypass so many opportunities to trade? We hypothesize that one of the reasons may be the rational exclusion of some of members of society from such contracts due to a correct understanding of the nonlinear wealth dynamics in this economy.[16]

We employ two datasets. The first consists of household survey data collected from 119 randomly selected Boran pastoralist households in four communities of southern Ethiopia.[17] These data on pastoral risk management (PARIMA) were collected every three months, March 2000-June 2002, and then annually each September-October starting in 2003, and include rich detail on household composition, education attainment (although very few respondents are literate or attended any school), migration histories, changes in herds, shocks, etc.

The second data set includes observations of these same households' stated choices of insurance matches. In order to identify the determinants of interhousehold transfer arrangements, we randomly matched each respondent with other respondents

[16] Santos and Barrett (2006a).show that our respondents indeed perceive such dynamics .

[17] The data were collected by the Pastoral Risk Management (PARIMA) project of the USAID Global Livestock Collaborative Research Support Program. Barrett et al. (2004) describe the location, survey methods and available variables.

from the PARIMA sample and asked two types of questions:[18] the first about (real) social acquaintance ("Do you know (name of the match)?"), the other on the possibility of transferring cattle as a gift if the match asked for it.[19] The latter question provides information on potential transfer networks and is the subject of study in the next section.

This approach offers one major advantage and two prospective disadvantages relative to previous studies of informal transfers. Because we know the characteristics of both giver and recipient, no questions of bias arise with respect to the estimates of the transfer function due to lack of knowledge about one end of this relation (Rosenzweig 1988, Cox and Rank 1992). However, there are two prospective problems with this approach. First, by studying links between individuals rather than the transfers themselves, one risks errors due to excessive discretization. However, this is not a problem in our data because informal asset transfers among Boran pastoralists are quite small. In our sample, over the period 2000-03, there were 15 such transfers, out of which 12 (i.e., 80%) were of 1 or 2 cattle.[20] For that reason, and with only a slight abuse of language, we use the terms "network formation" and "transfers" interchangeably in what follows.

Second, one might reasonably wonder how well potential transfer networks elicited in this manner reflect the decision process underlying the formation of real

[18] This approach follows closely the one used by Goldstein and Udry (1999) in Ghana. Granovetter (1976) had earlier proposed a similar approach.

[19] We asked also about the possibility of transferring cattle as loans but the pattern of answers is virtually identical and gifts and loans seem empirically indistinguishable. Out of 561 matches, in only 13 (2.3%) does the decision differ between loans and gifts. We therefore concentrate on transfers deemed "gifts" in what follows.

[20] A separate survey of cattle transfers motivated by shocks, conducted in 2004, in the same geographical area but with different respondents, suggests even greater dominance of small transfers: out of 112 transfers, 102 (or 91%) were of 1 cattle, 8 (or 7%) were of 2 cattle and the remaining less than 2% were more than 2 cattle.[0]

insurance networks. In a separate paper (Santos and Barrett 2006b) we show that inference with respect to the determinants of insurance networks derived from the approach used in this paper closely match those obtained from analysis of real social relations among the same population. The appeal of using randomly matched respondents thus seems to outweigh the prospective pitfalls of using discrete data on hypothetical transfers.[21]

4. Poverty traps and social transfer networks

The basic pattern of answers to the stated insurance link questions is described in Table 2. Three key facts emerge clearly. First, not everyone knows everyone else, even in this rural, ethnically homogeneous setting in which households pursue the same livelihood and there is very little in- or out-migration. Although most people know the random match presented to them, almost 14% of the matches were unknown by the respondent. Second, social acquaintance is, for our respondents, clearly a necessary condition for willingness to make a transfer.[22] In only 3/68 cases did a respondent indicate that they would be willing to give livestock to someone they did not know. This makes the explanation of who knows whom – and, its corollary, social invisibility, i.e., who is unknown by others – an important question unto itself, one that we explore in section 5. It also implies an apparently sequential problem that leads us to estimate the

[21] The benefits of using experimental data in the study of social capital (a concept closely related with that of social networks) is emphasized by Durlauf and Fafchamps (2004). Glaeser et al. (2000) and Barr (2003) both conclude that experimental evidence is mirrored by reality.

[22] Of course one can imagine situations where this would not hold (for example, someone may address a local patron and seek to put himself under his protection or someone may seek the help of friends of friends, even when they were not previously acquainted). Although theoretically possible, these do not seem to find support in our data.

determinants of transfer networks only on the subsample of those who know their match (Amemiya 1974, Maddala 1983). Finally, knowing people is by no means a sufficient condition for pastoralists to be willing to transfer animals to a match. In just under one quarter of the cases where the respondent knew the match was he or she willing to give an animal to the match. The acquaintance between giver and receiver seems therefore to be necessary but insufficient for mobilizing support.

The intuition behind these responses is that respondents perform a cost-benefit analysis with respect to each potential link/gift before deciding whether to give cattle when asked for it, answering "yes" if their subjective evaluation of the benefits exceeds the costs. The question then becomes what process governs that calculus.

Under the canonical model of informal insurance and consumption smoothing, assuming a stationary asset process, transfers should be unrelated to one's asset stocks and depend solely on a prospective recipient's losses relative to the insurance group mean. Thus matches with different herd sizes should be equally likely to receive transfers conditional on a similar loss experience, following the simple model in section 2.1. Transfers would depend on above-average losses alone. Under McPeak's (forthcoming) alternative formulation, the likelihood of making a transfer should be increasing in a match's herd size since wealthier partners are more likely able to reciprocate in the future, and past experience of shocks by the match should have no effect on transfers.

The model of informal insurance under non-stationary dynamics, sketched out in section 2.2, offers a different set of predictions: transfers should respond to shocks conditional on ex post herd size. And unlike McPeak's precautionary transfers model, they should be invariant with respect to herd size in the absence of a shock. These contrasting predictions, summarized in Table 3, enable us to test which model of informal insurance seems to best fit these data in an area where the existence of a poverty trap has now been reasonably well established.

Because these households have been observed repeatedly since 2000, we can use actual herd size observations for each respondent and his random match to test between these competing hypotheses. The key variables then become (i) herd position with respect to the different equilibria identified in Lybbert et al. (2004) and corroborated in Santos and Barrett (2006a), (ii) whether or not the match lost cattle, and (iii) match's herd size. As described in Table 4, we get at (i) by constructing four dummy variables that provide a categorical representation of household-level expected herd growth in the period after the survey on social transfers. A household falls in category E_1 if it lies in the neighborhood of the low-level stable equilibrium, with a herd of less than five cattle in 2003. It belongs in category E_2 if it lies just below the threshold at which herd dynamics bifurcate, with a herd of 5-14 cattle. If the herd size was above the unstable equilibrium but beneath the high-level equilibrium (15-39 head), the household was classified as belonging to group E_3. Finally, households with herd sizes at or above the high-level stable equilibrium (40 or more) were assigned to E_4. We capture variable (ii), herd loss, through a dummy variable, L_j, taking value one if the match (j) had a smaller herd in 2003 than in 2000, and zero otherwise.[23]

[23] Note also that given that in all communities, growth was positive in this period, there would be no change in results if we had defined this variable has taking the value 1 if the respondent had registered a loss above the one registered by the community, since all communities experienced net herd gains over this period. This would be a more precise way of defining idiosyncratic risk, although at the cost of making the implicit assumption of equivalence between insurance pool and the community used in the sampling strategy.

We then study respondents' decision to make a gift or not using a model that nests the different explanations/motives for asset transfers under the reduced form

(14) $l_{ij}^* = \alpha_i + \gamma_1 f(h_j) + \varsigma L_j + \Sigma_{t=1\ldots4} \beta_t E_{tj} + \delta X_{ij} + \lambda Z_i + \varepsilon_{ij}$

where l_{ij}^* is the propensity to establish a link between i (the respondent) and j (the match), h_j is the match's herd size, the X vector captures a range of covariates describing the relation between i and j, and the Z vector reflects attributes of the respondent, such as age, household labor supply and village of residence. If we define $l_{ij} = 1$ as the actual realization of the variable l_{ij}^* when a link is formed and assume that

(15) $\varepsilon_{ij} \sim \log(0, \pi^2/3)$

(16) $E(\varepsilon_{ij}, \varepsilon_{ih}) \neq 0$ if $j \neq h$

(17) $E(\varepsilon_{ih}, \varepsilon_{jh}) = 0$ if $i \neq j$

we can estimate this as a logit model through clustering of the observations on the identity of the respondent, premised on the idea that relations are nested within individuals.

One alternative way of modeling the error term is to incorporate the effect of match's unobservables. Both Udry and Conley (2005) and Fafchamps and Gubert (forthcoming) correct the variance matrix for the possible effect of match's unobservables, using Conley's (1999) estimator, and find that the corrected standard errors do not differ significantly from estimates that do not account for this effect. We follow a slightly different strategy, using a nonparametric permutation test known as Quadratic Assignment Procedure (QAP) (Hubert and Schultz 1976, Krackhardt 1987,

1988) to obtain correct p-values.[24] We too find that this added control for potential correlation on unobservables makes no significant difference to our results when explaining the formation of transfer dyads. However, it does matter when explaining who knows whom.

The elements of X – clan membership, gender, age, land holdings, cattle holdings, and household size – are expressed not as the Euclidean distance between the pair but rather, following Santos and Barrett (2005), using a measure of distance that allows for ordinal differences in the relative position of respondent and match to play a role in explaining the respondent's decision.[25] This approach offers an intuitively more appealing interpretation of the effects of social and economic distance than the more conventional Euclidean measure of social distance that (implicitly) would impose symmetry in the effect of these variables upon the dyad formation decision.

Table 5 presents the estimates of the logit regression when the dependent variable is the decision to give cattle to the match if he/she asked for it. We present several specifications of this model that differ in the way we express the effects of herd losses and match's wealth, thereby allowing testing among the different models outlined above.

[24] The basic intuition behind this procedure is that the permutation of the data on the dependent variable must maintain its clustered nature. In practice, this means that the same permutation must be applied to respondents and matches. We can then estimate the above model when all correlation between dependent and independent variables is broken through resampling – that is, when the null hypothesis that all slopes equal zero is known to be true – and compare our first estimates with their empirical distribution obtained through the repetition of this exercise (in our case, 1000 times), to generate a sampling distribution for the parameter estimates.

[25] To be more concrete, consider the case of a categorical variable such as gender: we can think of whether match and respondent share the same gender and estimate a dummy variable "same gender" – implicitly imposing that the effect of a female-female match is the same of a male-male one – or we can consider the set of all possible matches (female-female, female-male,…) and estimate a dummy variable for each specific combination. *Mutatis mutandis*, the same reasoning applies to continuous variables. With a different formalization, the same idea is captured in Fafchamps and Gubert (2006).

First, however, let us note a few results with respect to the X and Z variables defining relational characteristics between i and j and attributes of i, respectively. These results reflect possible frictions and associated costs of establishing an insurance link (Murgai et al. 2002) and are robust to the various specifications we report with respect to herd losses and herd size. The propensity to give a gift is strongly, positively influenced by belonging to the same clan. Variables that measure social distance in terms of gender are clearly asymmetric. Men are more willing to give cattle (either to women or to other men) than are women. The larger one's household, the more likely the respondent is to give a gift, although that effect is attenuated when the giver's household has more members than the prospective recipient's. Physical proximity and age have no statistically significant effect on transfer patterns in these data.[26]

We now turn to the core hypotheses of interest: the relation between asset transfers, wealth and asset shocks. Let us start with the simplest specification, in column (1), in which we test for a relation between herd size and the propensity to make a gift.[27] There seems to be no relation between j's herd size and the likelihood that i gives j cattle. That result is robust to the inclusion of dummy variables for the various expected herd dynamics (column 2). These two specifications test the precautionary transfers model (McPeak forthcoming), for which these data offer no support. Differences in a match's expected capacity to reciprocate the transfer do not seem to matter to a respondent's propensity to transfer cattle when considered independently of the experience of herd loss by the prospective recipient. Notice also that by controlling for differences in wealth

[26] To conserve space we omit the estimates of some of these variables from Table 7. The complete set of estimates is available from the authors upon request.

[27] Note that we include a dummy variable for j having no cattle. This controls for the intrinsic discontinuity in the growth function due to biological reproduction when the match has no cattle. Failure to control for the match having no cattle leads to a marked drop in precision of estimates.

between match and respondent, we implicitly test and reject Hoff's (1997) suggestion that wealthier givers would be less interested in entering such insurance contracts. This result holds for all specifications of our model.[28]

In column (3), we introduce the effect of herd loss by the match.[29] While j's herd size continues not to matter, recent herd loss by j has a pronounced positive effect on the probability that the respondent makes a transfer to j, with p-values below 0.05. Cattle transfers appear to respond to losses, as standard informal insurance models would predict.

However, when we unpack this further, we find strong support for the predictions of the model of asset transfers in the presence of poverty traps. When we interact herd loss with the appropriate expected growth path dummy variables, we find that the effects of losses differ markedly depending on the match's herd size relative to the different equilibria (column 4). Of course, transfers conditional on ex post asset stocks are incompatible with the canonical model of informal insurance based on stationary asset dynamics, under which all losses should trigger transfers, regardless of ex-post wealth, as outlined in section 2.1.

Table 5 also presents the p-values derived from the Quadratic Assignment Procedure to allow for two-way correlation in errors. Our results conform with previous work (Udry and Conley 2005, Fafchamps and Gubert forthcoming); we do not find substantial changes in the p-values of these estimates, a conclusion that does not hold in

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[28] Results that specifically estimate the effect of respondent's wealth (at the cost of dropping match's wealth, due to multicollinearity given that we also control for differences in wealth) are available from the authors.

[29] One gets qualitatively identical results when we interact herd size with the dummy variables for expected herd dynamics categories, thereby looking at variation within categories, in all specifications of this model. We omit those results in the interest of brevity but they are available from the authors.

the next section. There is nevertheless one change that deserves to be mentioned. The negative coefficient associated with recipients who lost their entire herd in the period 2000-2003 is now statistically significant, a result that further reinforces our interpretation regarding the exclusion of those who fall into destitution and is consistent with the historical record, which underscores that cutting off the destitute has traditionally been a standard response to dire poverty among East African pastoralists (Iliffe 1987; Anderson and Broch-Due 1999).[0][30]

In section 2, we allowed for the possibility that wealth dynamics may be characterized by club convergence as well as by multiple equilibria and Santos and Barrett (2006a) indeed find that differences in herding ability affect expected herd dynamics, in particular that lower ability herders do not exhibit multiple equilibria and are expected to fall into the low-level equilibrium regardless of the herd size with which they start. Transfers to low ability herders are thus ineffective at insuring against the permanent effects of shocks irrespective of ex post herd size and should not occur in equilibrium under the model we developed in section 2.2. By contrast, medium- or high-ability herders exhibit multiple equilibria with a similar critical threshold (at 12-15 cattle) at which herd dynamics bifurcate, although they exhibit different high level equilibria.

We therefore repeat the previous exercise, now controlling for estimated herder ability, which we generated using the data on herd evolution in the period 2000-2003, and stochastic parametric frontier estimation methods for panel data. The efficiency parameter estimates from such a frontier provide at least a coarse proxy for herder-

[30] One possible explanation, following the results of Monte Carlo simulation presented in Krackhardt (1988), is that the correlation between the error terms of respondent and match is relatively small in our regression. Clearly, this is a result of the detailed data that we use and may not hold in other datasets and contexts.

specific ability that is not otherwise directly observable.[31] Using the predicted average technical inefficiency – i.e., estimated herding ability – for each herder, we divided our sample into three sub-samples: low ability (those in the 4th quartile), high ability (those in the 1st quartile) and a residual medium ability category (the 2nd and 3rd quartiles).

Assuming herders perceive the ability of the match's similarly to our estimates of the match's ability group – a hypothesis we unfortunately cannot test – a match's ability should therefore matter to a respondent's likelihood of making a transfer. This is precisely what we find in Table 6, column (1), which replicates column (4) from the previous table, now conditioning the interaction of cattle loss and membership in the E2 herd size interval by the prospective recipient's ability. As one would predict based on any of the models in section 2.2, low estimated herding ability perfectly predicts exclusion from asset transfers, while medium and high ability matches are statistically significantly more likely to receive transfers of cattle than other matches.

The results in columns (2) and (3) reinforce this finding. The match's ability does not seem to matter either unconditionally (column 2), nor for those herders near the threshold who didn't suffer any losses (column 3). Furthermore, ability does not seem to matter independently of one's expected herd evolution (column 1).

Having established that the existence of a poverty trap seems to matter to agents' decision to form insurance links, we now explore which one of the two models outlined in section 2.2 seems to find support in our data. Our data are somewhat more limited for

[31] More precisely, we estimated the herd growth function frontier using a composed error term that includes a symmetric random component reflecting standard sampling and measurement error and a one-sided term reflecting observation-specific inefficiency, which we assume to follow a truncated normal distribution. We then take advantage of multiple initial herd sizes for each herder to compute herder-specific mean efficiency measures, i.e., each pastoralist's proximity to the herd growth frontier. See Santos and Barrett (2006a) for details and estimation results.

the purpose of investigating the role of the accumulation threshold in this process, in particular whether it may function as a focal point where transfers are concentrated, thereby leading to a non-monotonic transfer function. Because the period for which we have data was one of relatively good rainfall, the dominant trend in our sample is one of herd growth and herders who experienced asset loss are concentrated in categories E1 and E2, preventing us from using the same approach as above to directly test whether a loss that would leave an herder at E3 or E4 would make him a more attractive gift recipient – due to superior capacity to reciprocate – than those at E2 and E1, as the more familiar model would suggest, or less attractive – because the wealthier recipient values the transfer less – as the non-monotonic transfers model would suggest.

We can, nevertheless, use differences in the variables that directly measure the motivation to reciprocate the original transfer. Recall that in the first model in section 2.2, the probability of reciprocity increases monotonically in wealth because future defection is less valuable to the wealthy. We capture that effect through the variable "expected wealth" defined as the probability that future herd size, post transfer, will be larger than a specified value. In what follows, we present the results when considering the probability of having a herd of 30 or more cattle ten years after the transfer of one cattle, given actual herd size at 2003.[32] In the non-monotonic transfers model, growth gains drive this propensity to reciprocate. We capture that effect through the variable "expected gains", defined as the difference in expected herd size, 10 years ahead, due to the transfer of 1 cattle given actual herd size at 2003. Both variables were created following the simulation procedure described in detail in Santos and Barrett (2006a) and are graphically

[32] Other herd sizes (10, 15, 20, 25, 35) were tried and lead to similar conclusions. We also experimented with the *change* in the probability of having a herd size above 30 due to the transfer of one cattle. The results are qualitatively similar to the ones discussed below, thus we omit them.

represented in Figure 1. The solid line displays the probability that the recipient's herd size is greater than 30 cattle ten years after the transfer, while the dashed line shows the expected change in herd size 10 years after receiving 1 cattle, inclusive of the transfer.[33] Two features merit particular attention. First, the probability that a recipient's herd size will reach the high-level asset equilibrium (>30 cattle) is S-shaped, with values less than 1% below 7 head and reaching a plateau in the 35-45% range beginning at 22 head. Second, that initial herd size interval of 7-22 cattle is the only asset range over which a transfer is expected to yield dividends to the recipient, i.e., expected gains exceed the 1 cattle transfer. Our hypothesis is that this corresponds to the focal point for transfers.

This step in our analysis is guided primarily by the very different policy implications of the two models. If only matches' expected wealth drives transfer behavior, it would signal that, although persistent poverty plays a role, the dynamic threshold *per se* does not seem to be important. On the other hand, if expected gains guide the allocation of transfers, that would suggest that informal transfer arrangements in the presence of multiple dynamic equilibria are best understood as a safety net – a mechanism to prevent participants from falling into persistent poverty, as transfers may enable recovery onto a growth path after shocks that might otherwise cast one below the

[33] Because our simulation procedure only considers initial herd sizes between 1 and 60 cattle, we face a problem in assigning values to these variables outside of that interval. We chose not to assign any values to these variables when herd size in 2003 is bigger than 60 given that we only lose 9 of 463 observations and the degree of arbitrariness in that decision would be unacceptable. The decision on what values to assign to the case when the match has no cattle is much more straightforward. For expected wealth, we assumed that Pr(herd size10 years ahead > 30| match has no cattle, gift of 1 cattle)= Pr(herd size10 years ahead > 30 | match has 1 cattle) = 0. For expected gains, we assumed that (expected herd size after 10 years | match has no cattle, gift of 1 cattle) = (expected herd size 10 years ahead | match has 1 cattle) = 1.612, and that, in case they receive no gift, 10 years ahead their herd size will remain 0. Clearly the interpretation of the dummy "match has no cattle" will now include the effect of our assumptions together with the behavioral component identified in our previous results.

threshold point at which herd dynamics bifurcate.[34] Although data limitations prevent interpreting our result as firm evidence in favor of one explanation over the other, we think this is an important question worth addressing.

Table 7 presents the estimation results. The first column, where we replace match's herd size by the corresponding value of expected wealth, offers a more direct test of the precautionary transfers explanation than we presented earlier. The results confirm our conclusion from Table 5, columns (1) and (2). We do not find support for the interpretation of interhousehold transfers as a form of precautionary savings in these data. We also find no support for the hypothesis that unconditional expected gains drive transfers behavior (column (2)).

The results in columns (3) and (4) are more interesting. As in Table 5, only the interactions of the expected wealth or expected gains with the dummy variable "Loss" are statistically significant at the 5% level but, when we include both variables and their interactions (column (5)), our estimates reveal that the transfer decision seems to conform better with a model of ex post insurance in which transfers take into account the recipient's expected gains but not his/her expected wealth, giving limited support to the model that suggests a non-monotonic relation between recipient's wealth and transfers.

[34] Given the standard transfer of one animal from one household to another, individual transfers can clearly serve this safety net purpose only for those herders quite close the unstable equilibrium. One needs to recognize, however, that this limitation is purely an artifact of the two person, dyadic model we employ in section 2. Anecdotal evidence from a survey of life histories collected by one of the authors suggests that coordinated transfers are commonly sought and obtained, raising the potential for transfers to perform the safety net function over a wider herd size range. This is further corroborated by anthropological work among the Boran (Dahl, 1979; Bassi, 1990) on the functioning of *busa gonofa*, an indigenous institution through which such coordination is achieved. Similar institutions have been analyzed among other east African pastoralist societies (for example, Potkanski 1999). Coordination of transfers raises a separate set of questions – e.g., how are the obvious free rider problems resolved? – that we cannot pursue here.

Finally, we check whether our central result – that transfers seem to be concentrated on those who lost cattle, so long as those losses do not put them “too close” the low-level stable equilibrium – is robust to the inclusion of additional controls suggested by the alternative models identified in the close of section 2. We already addressed the concerns of the Hoff (1997) and Murgai et al. (2002) in Table 5. In Table 8 column (1) we include, as additional controls, the correlation between asset levels of our respondents and their random matches in the nine rounds for which we have data. As with other covariates, we allow for the possibility of different effects upon the propensity to transfer cattle as a gift depending on whether this correlation is positive or negative. We find that these additional controls are not statistically significant and that they do not affect our previous estimates of the effect of match’s wealth upon the propensity to give cattle. The same is true when we include, in column (2), the number of siblings and its square as a proxy for the size of the ex ante insurance network. Our main result appears robust to the inclusion of additional controls suggested by alternative models of exclusionary contracting for informal insurance.

5. Who knows whom: Social exclusion and poverty traps

The fact that the poorest members of the community are less likely to receive transfers than those near the accumulation threshold suggests a process of social exclusion. If, as Santos and Barrett (2006a) claim, multiple dynamic equilibria arise only because of asset shocks, then insurance against asset shocks is critical to maintaining a viable livelihood for those of medium and high herding ability. Yet if the asset poor cannot get transfers, their ability to climb out of poverty is negligible. The results reported in the preceding section may even understate this effect because they are based only on transfer decisions relating to the subsample of random matches with whom respondents were already acquainted. Given that social acquaintance logically precedes establishment of a transfer link, as shown in table 2, this section explores the possibility of wealth-dependent "social invisibility", the implicit exclusion from transfer networks of those who are unknown by prospective mutual insurance partners.

We use the same logit estimation approach from equation (1) to examine patterns of social acquaintance among the individuals in our sample, now using the "know" variable from table 5 as the regressand. Because this variable is certainly the result of past processes, we incorporate the effect of past dynamics (in practice, herd size transitions between 2000 and 2003) and not the position with respect to the different equilibria that we previously interpreted as a measure of future herd size. We also disregard own social and economic position – the Z vector – and express it as a function of the differences between individuals only. The results are presented in table 9.

Being from the same clan and having less assets (cattle and land) than one's match increases the probability of knowing the random match, while having more cattle has a negative impact, a clear demonstration of the asymmetric effects of wealth on the structure of social acquaintance, similar to the patterns found among crop cultivators in Ghana by Santos and Barrett (2005). This effect is even clearer when we consider the effect of a match being destitute, i.e., having no cattle. Destitution is strongly associated with exclusion from social networks, as reflected in a large, negative, highly statistically significant coefficient estimate. A herd size consistently at the low-level equilibrium appears associated with social invisibility that prevents one from entering into potentially beneficial relationships. Informal insurance arrangements cannot function for the poorest members of a society if they are not part of the social networks that mediate transfers.

The nature of the channels through which this process operates is not entirely clear, although the anthropological literature on the Boran offers some suggestions. Dahl (1979), for example, refers that traditional offices are occupied by the wealthy and that these individuals quite often delegate the daily tasks of herd management to someone else, a precondition for full participation in the social and political life of the Boran. Lybbert et al. (2004) hypothesize that multiple herd size equilibria result from the involuntary sedentarization of the destitute while those with viable herds migrate. Seasonal migration might thereby create sufficient physical separation and differences in lifestyle that the poorest become invisible to many of the larger herders. Regardless of the precise causal mechanisms by which the apparent social invisibility of the poor arises, what seems clear from historical accounts is that exclusion generated by persistent poverty is not something new. For example, Iliffe (1987, p.42) notes that "[t]o be poor is one thing, but to be destitute is quite another, since it means the person so judged is outside the normal network of social relations and is consequently without the possibility of successful membership in ongoing groups, the members of which can help him if he requires it. The Kanuri [in the West African savannah] say that such a person is not to be trusted".

We should note, however, that the evidence that we find for the importance of social invisibility in this environment is weakened once we use the QAP to obtain correct p-values for the variables in our model. In particular, persistently having no cattle is no longer significant at the 5% level (although the p-value increases only to 0.07) and the asymmetries in the effects of difference in wealth become less pronounced. There are two possible explanations for this. First, knowing one's match may be a less "rational" process than is choosing an insurance partner, leading to a greater role for unobserved heterogeneity for both respondent and match. Second, even if we are using all the relevant variables to eliminate the two-way unobserved heterogeneity concern, we only observe them for a relatively short period and there can be no presumption that the process from destitution to social invisibility is an automatic one. For example, the decision to move to a larger urban center as a consequence of utter destitution is not quickly or easily undertaken. This raises the theoretically and empirically interesting question of describing the dynamics of these networks, a topic that, unfortunately we cannot address with these data and therefore leave to future research.

6. Conclusions and Policy Implications

This paper presented a simple analytical model of the implications of nonstationary wealth dynamics for patterns of informal insurance and established that data from a population among which poverty traps have been previously identified support the hypothesis that informal insurance follows this hypothesized process rather than that of the standard informal insurance model or a model of precautionary transfers. Livestock transfers among these herders appear to be triggered by herd losses so long as those losses leave the prospective transfer recipient not "too poor". For the poorest herders, their destitution induces prospective partners to rationally exclude them from informal insurance arrangements, even though they know each other. These patterns of interhousehold transfers differ significantly from those predicted by the informal mutual insurance model that has become the workhorse of economic analysis of interhousehold transfers. Under the informal insurance model, and controlling for losses, transfers should be a function of losses only and independent of ex post wealth. The data reject this hypothesis in favor of the ex post wealth dependence that our model predicts.

This wealth-differentiated insurance effect is compounded by the fact that the poor are less socially visible than somewhat wealthier neighbors. Because being known is a necessary condition for receiving transfers, the social invisibility of the destitute compounds their rational exclusion from informal insurance networks, leaving them vulnerable to shocks and largely without informal networks to fall back on in times of need.

Although, the existence of asset thresholds at which wealth and welfare dynamics bifurcate highlights the criticality of safety nets designed to catch people suffering shocks so as to enable them to recover and to keep them from falling into long-term destitution, data limitations prevent us from presenting conclusive evidence regarding such a direct role for this threshold in shaping informal transfers. For that reason, we use simulated herd dynamics data to distinguish between two models, one in which transfers are guided by post-transfer expected wealth, against an alternative model in which recipients' expected gains from a transfer affect giving patterns. Our results favor the latter explanation. The testing between these competing explanations is a point that we hope pursue later, with other data that might allow for more direct testing.

Nonstationary wealth dynamics have profound repercussions for public policies to address problems of persistent poverty and asset loss. Because transfers have, literally, life or death consequences in contexts such as the rangelands of southern Ethiopia, it is hard to derive conclusions about optimal redistributive policies simply from our econometric results (Cohen-Cole, Durlauf and Rondina 2005). Nevertheless, our results speak to the widespread concern that external transfers from governments, donors or international nongovernmental organizations may crowd out existing informal arrangements. Boran pastoralists seem to act in such a way that clearly marginalizes those who are trapped into poverty. In this context, worries about the crowding out effect of public interventions seem misplaced, as the poorer members are clearly left uninsured, a result also supported by the historical evidence on east African pastoralist societies. In fact, our model and empirical results suggest that, up to some wealth level, public transfers may even lead to the crowding-in of private transfers, as a recent analysis of private transfers in the Philippines likewise suggests (Cox, Hansen and Jimenez 2004). This result is no surprise in a context where transfers are risk-sharing mechanisms motivated by exchange/reciprocity considerations, in which case there may be a positive correlation between the welfare of the recipient and a private transfer because better-off recipients will be better placed to reciprocate a transfer in the future.

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Figure 1 : Herd size impacts of a transfer

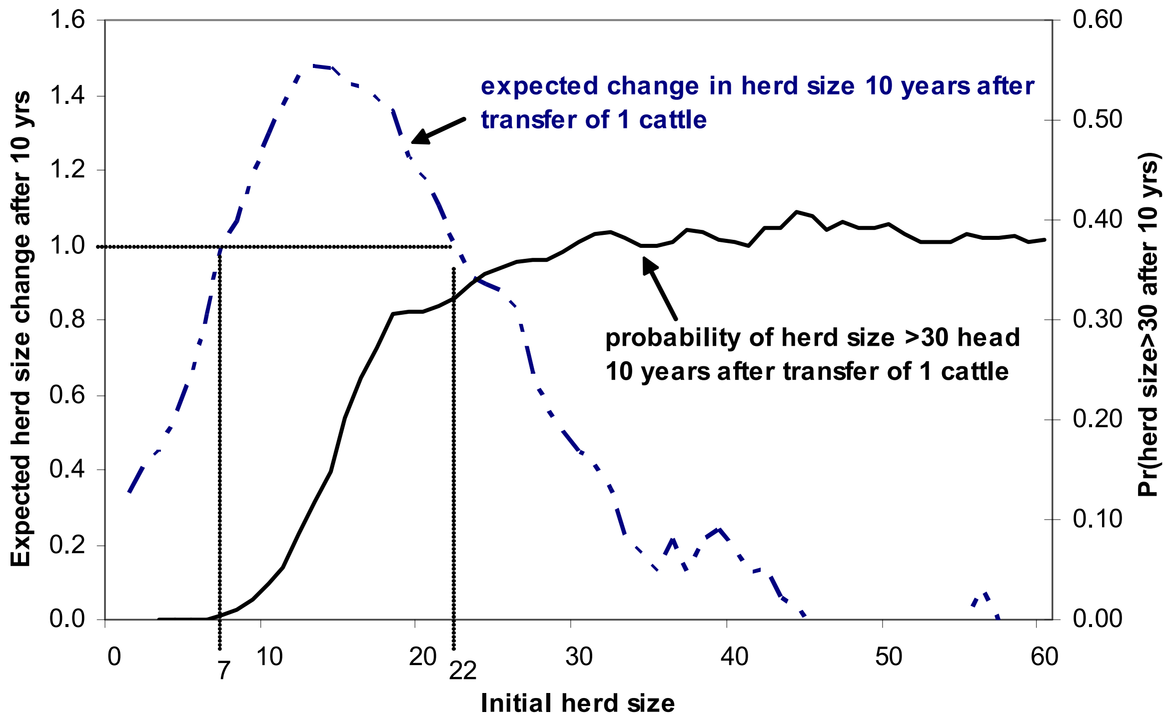

Table 1: Wealth transition matrix

$k^i_1 (1+\phi^i_1)$ \ $g(k^i_1 (1+\phi^i_1)) + \phi^i_2$	k_l	γ	k_h
k_l	$1-\varepsilon$	ε	0
γ	$\delta (1-\varepsilon)$	ε	$(1-\delta) (1-\varepsilon)$
k_h	$\mu (1-\varepsilon)$	ε	$(1-\mu) (1-\varepsilon)$

Table 2: Knowing and Giving: A Sequential Process

Give gift Know	No	Yes	Total
No	65	3	68
Yes	370	123	493
Total	435	126	561

Table 3: Models of informal insurance

		Conditional on losses?	
		Yes	No
Conditional on ex-post wealth?	Yes	Poverty traps model	Precautionary transfers
	No	Convergence model	?

Table 4: Variable definitions and descriptive statistics

Variable	Description	Mean (std dev)
Distance	Absolute value of the distance between i and j, in km	37.07 (55.78)
Same clan	Dummy variable, equal to 1 if both i and j belong to the same clan	0.19 (0.39)
Male, male	Dummy variable, equal to 1 if both i and j are male	0.41 (0.49)
Male, female	Dummy variable, equal to 1 if i is male and j is female	0.24 (0.43)
Female, male	Dummy variable, equal to 1 if i is female and j is male	0.22 (0.41)
Older	Absolute value of the age difference between i and j if i is older, 0 otherwise	8.48 (12.92)
Younger	Absolute value of the age difference between i and j if i is younger, 0 otherwise	8.18 (12.91)
More land	Absolute value of the difference in land between i and j if i has more land than j, 0 otherwise	0.39 (1.27)
Less land	Absolute value of the difference in land between i and j if i has less land than j, 0 otherwise	0.37 (1.11)
More cattle	Absolute value of the difference in cattle between i and j if i has more cattle than j, 0 otherwise	5.53 (13.61)
Less cattle	Absolute value of the difference in cattle between i and j if i has less cattle than j, 0 otherwise	5.24 (12.87)
Bigger family	Absolute value of the difference in family size between i and j if i has a bigger family than j, 0 otherwise	1.59 (2.40)
Smaller family	Absolute value of the difference in family size between i and j if i has a smaller family than j, 0 otherwise	1.66 (2.50)
Match has no cattle	Dummy variable, equal to 1 if j has no cattle in September 2003	0.15 (0.36)
E1: poor	Dummy variable, equal to 1 if j has more than 0 cattle but less than 5 cattle in September 2003	0.15 (0.36)
E2: intermediate herd size, below threshold	Dummy variable, equal to 1 if j has more than 4 but less than 15 cattle in September 2003	0.54 (0.50)
E3: intermediate herd size, above threshold	Dummy variable, equal to 1 if j has more than 14 but less than 40 cattle in September 2003	0.12 (0.33)
E4: wealthy	Dummy variable, equal to 1 if j has more than 39 cattle in September 2003	0.03 (0.16)
Lj: herd loss	Dummy variable, equal to 1 if j's herd diminished between September 2000 and September 2003	0.21 (0.40)
Family size	Number of people in the household	6.00 (3.15)
Herd size	Number of cattle in September 2003	10.79 (14.75)
Expected wealth	Probability that the match will have a herd bigger than 30 cattle, 10 years after having received a gift of one cattle, given current (2003) herd size.	0.065 (0.101)
Expected gains	Difference in match's expected herd size, after 10 years, conditional on receiving a gift of one cattle, given current (2003) herd size	1.063 (0.327)
Dida Hara	Dummy variable, equal to 1 if the respondent lives in Dida Hara	0.258 (0.438)
Dillo	Dummy variable, equal to 1 if the respondent lives in Dillo	0.258 (0.438)

Qorate	Dummy variable, equal to 1 if the respondent lives in Qorate	0.261 (0.439)

Table 5: Logit Estimates of Gift Giving Patterns

	(1)	(2)	(3)	(4)
match has no cattle	0.357	0.275	0.140	1.207
	[0.517]	[0.653]	[0.828]	[0.226]
	(0.237)	(0.321)	(0.419)	(0.103)
match's herd size	-0.014	-0.021	-0.024	-0.020
	[0.592]	[0.564]	[0.535]	[0.594]
	(0.388)	(0.330)	(0.306)	(0.252)
E2		-0.092	0.275	-0.387
		[0.848]	[0.580]	[0.588]
		(0.444)	(0.299)	(0.286)
E3		0.203	0.655	0.005
		[0.801]	[0.429]	[0.996]
		(0.377)	(0.201)	(0.469)
E4		-0.611	-0.019	-0.734
		[0.777]	[0.993]	[0.757]
		(0.410)	(0.518)	(0.382)
cattle loss			**0.919**	
			[0.048]	
			(0.016)	
cattle loss * E1				0.465
				[0.538]
				(0.277)
cattle loss * E2				**1.711**
				[0.001]
				(0.001)
cattle loss * no cattle				***-1.188***
				[0.146]
				(0.046)
more cattle	0.006	0.007	0.005	0.005
	[0.520]	[0.422]	[0.568]	[0.579]
	(0.303)	(0.286)	(0.327)	(0.293)
less cattle	0.018	0.030	0.032	0.034
	[0.530]	[0.341]	[0.310]	[0.290]
	(0.387)	(0.245)	(0.235)	(0.143)
same clan	**1.828**	**1.825**	**1.872**	**1.920**
	[0.000]	[0.000]	[0.000]	[0.000]
	(0.000)	(0.000)	(0.000)	(0.000)
male, male	**1.123**	***1.105***	***1.163***	**1.413**
	[0.040]	[0.056]	[0.056]	[0.016]
	(0.036)	(0.045)	(0.034)	(0.009)
male, female	**1.234**	**1.229**	**1.226**	**1.259**
	[0.027]	[0.028]	[0.030]	[0.019]
	(0.026)	(0.026)	(0.027)	(0.011)
female, male	0.650	0.580	0.618	***0.963***
	[0.225]	[0.308]	[0.303]	[0.099]
	(0.091)	(0.118)	(0.105)	(0.014)

Observations	493	493	493	493
Number of clusters	115	115	115	115
Log pseudolikelihood	-211.19	-210.60	-208.03	-204.29
Pseudo R-squared	0.237	0.240	0.249	0.262
Adjusted count R-squared	0.293	0.285	0.285	0.341

Values within brackets are robust p-values. Values within parentheses are QAP-corrected p-values. Values in **Bold** are statistically significant at the 5% significance level or lower. Values in ***Bold*** are statistically significant at the 5% significance level or lower when p-values are obtained through the QAP. Distance, differences in age, land owned, family size, and respondent's age and family size, together with village-specific dummy variables and a constant were included in the estimation but are not reported.

Table 6: Logit Estimates of Gift Giving Patterns: The effect of herder ability

	(1)		(2)		(3)	
	Coefficient	Bootstrapped standard errors	Coefficient	Bootstrapped standard errors	Coefficient	Bootstrapped standard errors
Low	1.137	1.638	0.376	0.490	1.334	3.767
Medium	2.542	1.695	0.435	0.347	2.616	3.710
E2 * low	1.372	1.679			-0.248	0.717
E2 * medium	-1.145	1.777			1.528	0.941
E2 *high	1.607	2.353			2.720	3.713
cattle loss * E2 * low	**dropped***					
cattle loss * E2 * medium	**2.856**	1.123				
cattle loss * E2 * high	**2.500**	0.925				

Note: Bootstrapped standard errors obtained using 200 replicates. All the covariates present in table 5, column 4, were included, but are not reported. Variables in bold are statistically significant at the 5% significance level or lower.

* In the model presented under column (1), the variable "cattle loss * E2 * low" predicts failure perfectly – the variable was dropped and 8 observations were not used.

Table 7: Logit Estimates of Gift Giving Patterns:
Expected wealth vs. Expected gains

	(1)	(2)	(3)	(4)	(5)
Expected wealth	-0.669		-0.865		-0.501
	(1.705)		(1.683)		(1.764)
	[3.353]		[2.381]		[2.419]
Expected gains		0.139		0.229	0.353
		(0.569)		(0.580)	(0.624)
		[0.644]		[0.688]	[0.768]
Loss * Expected wealth			**21.868**		-7.995
			(8.554)		(13.058)
			[11.013]		[18.675]
Loss * expected gains				**1.555**	**1.849**
				(0.462)	(0.652)
				[0.547]	[0.898]
Observations	484	484	484	484	484

Note: The values within parenthesis are robust standard errors and the values within brackets are bootstrapped standard errors, obtained using 200 replicates. All the covariates present in Table 5, column 4 (except those expressing herd's position with respect to the different equilibria and their interactions) were included in the regression but are not reported. Values in **Bold** are statistically significant at the 5% significance level or lower when considering bootstrapped standard errors.

Table 8: Logit estimates of Gift-giving patterns: Additional explanations

	(1)	(2)
Match has no cattle	0.347	2.130
	[0.906]	[0.417]
Match's herd size	-0.029	-0.013
	[0.480]	[0.730]
E1	0.775	0.814
	[0.767]	[0.739]
E2	0.482	0.568
	[0.837]	[0.800]
E3	0.743	0.919
	[0.704]	[0.622]
Loss * match has no cattle	0.500	-1.143
	[0.734]	[0.221]
Loss * E1	0.379	0.498
	[0.625]	[0.547]
Loss * E2	**2.100**	**1.663**
	[0.000]	[0.001]
Negative correlation	-0.273	
	[0.736]	
Positive correlation	0.886	
	[0.222]	
Number of brothers		-0.077
		[0.761]
Number of brothers squared		0.020
		[0.515]
Observations	436	452
Number of respondents	107.000	104.000
Log pseudolikelihood	-182.705	-190.751
Pseudo R-squared	0.265	0.274
Adjusted count R-squared	0.339	0.364

Note: robust p-values within brackets. Values in **Bold** are significant at the 5%level of significance or smaller. All the covariates present in Table 5, column 4 were included in the regression but are not reported.

Table 9: Logit Estimates of Social Acquaintance Networks

	Know	Robust p-values	QAP corrected p-values
no cattle since 2000	**-1.106**	0.025	0.070
E1 since 2000	-0.145	0.736	0.392
E2 since 2000	-0.127	0.639	0.379
E3 since 2000	-0.581	0.558	0.485
E4 since 2000	-1.297	0.287	0.284
cattle loss since 2000	0.203	0.466	0.356
More cattle	**-0.014**	0.009	0.096
less cattle	***0.040***	0.001	0.043
Distance	-0.007	0.323	0.201
Same clan	***0.743***	0.015	0.033
Male, male	0.684	0.081	0.118
Male, female	0.177	0.671	0.359
female, male	0.618	0.084	0.121
Older	***-0.026***	0.013	0.005
Younger	-0.000	0.971	0.515
more land	0.143	0.215	0.193
less land	***0.482***	0.001	0.013
bigger family	0.042	0.499	0.264
smaller family	-0.097	0.088	0.111
Observations			745
Number of respondents			85
Log pseudolikelihood			-256.124
Pseudo R-squared			0.229
Adjusted count R-squared			0.041

Note: Values in **Bold** are statistically significant at the 5% level of significance or lower. Values in ***Bold italics*** remain statistically significant at the 5% level of significance or lower for p-values obtained through QAP. Village dummies and a constant were included in the estimation but are not reported here. Being from Qorate predicts being known perfectly – the variable was dropped and 300 observations were not used.