Persistent poverty and informal credit*

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Abstract

This paper explores the consequences of nonlinear wealth dynamics for the formation of bilateral credit arrangements to help manage idiosyncratic risk. Using original data on expected wealth dynamics, social networks and informal loans among southern Ethiopian pastoralist households, we find that the threshold at which expected wealth dynamics bifurcate serves as a focal point at which lending is concentrated. Informal lending responds to recipients' losses but only so long as the recipients are not "too poor". Our results suggest that when shocks can have long term effects, loans are best understood as providing a safety net rather than a scale-neutral insurance mechanism. Furthermore, the persistently poor are excluded from social networks that are necessary to obtain loans given in response to shocks.

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1 Introduction

Risk is a central feature of life in rural areas of developing countries and therefore has appropriately attracted much attention in the development economics literature. The focus of much of this literature has been on how households smooth consumption in the face of idiosyncratic variation in income, either by analyzing how specific instruments contribute to that objective,[1] or by asking how well the full set of available instruments performs in stabilizing consumption.[2] The consumption smoothing literature uniformly starts, however, from the key assumption that shocks have only transitory consequences, in other words that the income generation process is stationary. Coate and Ravallion (1993, p.4), for example, 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.

This assumption seems to be contradicted by the empirical evidence, which suggests substantial persistence of poverty in low–income countries; the effects of shocks are often felt for many years.[3] That assumption also seems at odds with a large literature that emphasizes how uninsured risk can reinforce poverty, either because negative shocks have a disproportionately detrimental impact on poor people's investments(Jacoby and Skoufias, 1997, Dasgupta, 1997, Alderman, Hoddinott, and Kinsey, 2006, Carter et al., 2007), or because poorer individuals choose safer investment portfolios that prove, on average, less profitable (Rosenzweig and Binswanger, 1993, Morduch, 1995, Dercon, 1996). Curiously, the link from persistent poverty back to risk management options other than self–insurance remains underdeveloped in the literature. This paper aims to contribute to filling that void.

Theoretical models in which poverty is an attractor in the dynamic system suggest two key conditions under which short-term shocks might have longer-term consequences (Azariadis and Stachurski, 2005, Carter and Bar-

[1] Most commonly, credit, savings or insurance. See Alderman and Paxson (1994), Besley (1995) or Lim and Townsend (1998) for useful reviews.

[2] Deaton (1992) and Townsend (1994) are key contributions in a large literature that tests for the presence of full insurance or risk pooling in developing countries.

[3] See Baulch and Hoddinott (2000) and Barrett, Carter, and Little (2006) for recent reviews.

rett, 2006). First, if a nonconvexity in some technology generates a critical threshold at which expected wealth dynamics bifurcate, the mapping from current to future wealth will exhibit multiple attractors and poverty may persist if one of these attractors lies below the poverty line. Second, if some market imperfection (e.g., in the credit market) prevents those initially below the threshold from jumping to a basin of attraction around an expected higher welfare level, then persistent poverty can result from either meager initial endowments or an adverse shock that drives one beneath the threshold and into the basin of attraction whose expected path dynamics converge towards the low-level attractor. Conversely, in such an economy, small transfers can have large welfare impacts if they succeed in moving a recipient onto a path of accumulation towards an expected higher welfare level.

What seems not to have been recognized so far in the literature is that the first condition above – the existence of a threshold at which wealth dynamics bifurcate – might induce the market imperfection that is the second condition for risk to lead to persistent poverty. In this paper we empirically explore this possibility, by looking at the choices underlying informal credit markets that might facilitate escape from poverty.

The extensive literature on equilibrium credit rationing focuses largely on how adverse selection and moral hazard may cause the poor to be disproportionately rationed out of credit markets. The poor are not creditworthy because, having too little to lose, it may be prohibitively costly for a lender to punish them in case of default (Banerjee and Newman, 1993). An assumption underlying this result is that repayment does not depend on the realized returns of the project in which the borrower invests (Banerjee, 2001). If that is not the case, either because informal loans bundle credit and insurance (Udry, 1994) or because loans bundle an element of equity, as in the context we study below, then the presence of a bifurcation in expected wealth dynamics may turn the threshold (or its neighborhood) into a focal point for loans, since this is the point at which the expected gains to the borrower are greatest. In this context, those who are not "too poor" – the economy's "middle class" – become preferred borrowers, while both poorer individuals and the very rich may be excluded from such credit arrangements.

The remainder of the paper proceeds as follows. Section 2 introduces the population we study, Boran pastoralists in southern Ethiopia, drawing partially on previous work that has documented bifurcated wealth dynamics in this system and explained their apparent sources. In this paper, we take the existence of such dynamics as given in order to focus on their implications upon informal lending relationships. In section 3 we study the determinants of the willingness to extend informal credit among Boran pastoralists. We find that this decision is better explained by the expected gains due to the transfer than by the recipient's expected capacity to repay the loan. This result is robust to a series of additional covariates for correlation in asset returns between borrower and lender, and for the ex ante credit network of the lender. These findings imply a "middle class bias" in informal lending that favors those in the neighborhood of the threshold at which wealth dynamics bifurcate. The poorest are excluded because of their proximity to the low-wealth level attractor and the richest members are rationed out due to diminishing returns to wealth. In section 4 we then study patterns of social acquaintance (hereafter, social networks) and find that wealth plays a role in explaining who is known within a community. Being destitute (i.e., having no wealth in cattle) has a strong, negative impact on the probability of being known within the community and, given that informal credit networks are nested within social networks, social invisibility further reinforces the exclusionary process associated with credit rationing. Finally, section 5 discusses the policy implications of our findings.

2 Nonlinear expected wealth dynamics and credit networks: evidence from southern Ethiopia

Nonlinear expected wealth dynamics consistent with stylized poverty trap models were analyzed by Lybbert et al. (2004) among a poor population in southern Ethiopia, the Boran pastoralists. Using herd history data for 55 households over a 17 year period, they show that expected herd dynamics follow a S-shaped curve with two attractors (at approximately 1 and 35–40 cattle), separated by a threshold (at 12–16 cattle), consistent with stylized poverty traps models. [4] Drawing on prior ethnographic research and extensive direct field observation (Desta, 1999), 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.[5] Those with smaller herds are forced to stay near their base camps, where spatial concentration of herds quickly leads to localized rangeland degradation and thereby to a collapse of herd size towards the low-level stable attractor. Meanwhile, those households with bigger herds can migrate in search of the many distant areas with adequate water and pasture, enabling them to sustain far larger herds, free of the constraints imposed by localized range degradation.

These authors present two other findings that are important for this paper. First, they show that asset risk is predominantly idiosyncratic. This creates conditions conducive to the implementation of welfare-improving insurance or lending contracts among pastoralist households. Nevertheless, inter-household gifts and loans of cattle are conspicuously limited, as in other societies in semi-arid Africa (Lentz and Barrett, 2004, McPeak, 2004, Kazianga and Udry, 2006, McPeak, 2006). A central purpose of this paper is to understand whether such paucity of prospectively welfare-improving informal transactions might be a direct consequence of the expected wealth dynamics faced by these pastoralists. Does the existence of a threshold at which expected wealth dynamics bifurcate reinforce the credit market failures that help underpin persistent poverty, by limiting lenders' willingness

[4] A remark on terminology: with shocks, there are no "traps" in the strict mathematical sense, as the poor will always have a non-zero probability of escaping poverty. We focus on "poverty persistence" for that reason, and use "poverty traps" when referring to previous work that uses this expression. The distinction is not essential: for example, Azariadis and Stachurski (2005) define "poverty traps" as any mechanism that makes poverty persist.

[5] During migration only part of the household moves, mainly young men, who are physically strong enough to undertake arduous, long treks to move herds between distant water points and to protect them against (human and animal) predators. Hence the need for a sufficiently large herd that can be split and still feed both the migrant herders and the remaining (largely child, aged, infirm and female) members of the household who are left at the base camp.

to extend credit?

In order to answer that question we collected new data on expected wealth dynamics and on prospective bilateral credit relations in the same communities (but not the same individuals) studied by Lybbert et al. (2004). Although the collection of subjective expectations data as part of household surveys is becoming widespread, both in developed (Manski, 2004, Hurd, 2009) and developing countries (Delavande, Gine, and McKenzie, 2009) it is worth explaining briefly how these data were obtained, as they underpin our two key explanatory variables: borrowers' expected gains from a loan and their capacity to repay. We do that in the next section, after which we then discuss the data on credit links (section 2.2).

2.1 Expected wealth dynamics

Our data come from a survey of 119 randomly selected Boran pastoralist households in four communities of southern Ethiopia. As part of the Pastoral Risk Management (PARIMA) project, these households have been interviewed since the beginning of 2000, allowing us to have access to varied information about their background and recent history.[6] In addition to this information, in 2004 we elicited subjective expectations of herd dynamics, in order to explore whether the wealth dynamics previously identified were perceived/expected by the pastoralists themselves. Those data form the core of this section.

We started by randomly selecting four hypothetical initial herd sizes for each respondent, one from each of the intervals defined by the equilibria identified by Lybbert et al. (2004). [7] Respondents were then asked about their expectations for rainfall the coming year (choosing between good, normal or bad), including the rainy season that had already started .[8] Because

[6]These data were collected every three months, March 2000-June 2002, and then annually for several years each September-October starting in 2003, covering both the rainy and the dry seasons. Barrett et al. (2004) describe the location, survey methods and available variables.

[7]The herd size intervals are [1,5), [5, 15), [15, 40) and [40, 60] cattle equivalents.

[8]Published rainfall forecasts, such as those disseminated by the regional Drought Monitoring Centre and government and nongovernmental organization extension officers, use

the information about rainfall was asked well into the rainy season, these are not uninformed priors that could possibly reflect differences in the degree of optimism of the respondents; rather they reflect real weather conditions. [9]

After thus framing the problem,[10] we asked each respondent to define the maximum and the minimum herd size they would expect to have one year later if they themselves started the year with the randomly assigned initial herd size. These bounds provide a natural anchor for the next step, in which we asked respondents to distribute, on a board, 20 stones among herd sizes between the minimum and the maximum previously elicited, thereby describing their subjective herd size distribution one year ahead conditional on the randomly assigned initial herd size. The elicitation of the probability distribution function is an appropriate technique under these circumstances (Morgan and Henrion, 1990) and allows us to compute conditional distributions and their moments.

In order to simulate pastoralists' long run expectations of herd dynamics, we need data on the expected behavior under more extreme conditions, namely severe drought and very good years. To obtain such information, we used a second questionnaire similar to the one described above except that we defined rainfall conditions in advance.[11] This instrument was fielded in only one of the four sites. These data allow us to estimate the parametric relation between initial and expected herd sizes (hereafter, herd_0 and herd_1, respectively). Conditional on each of the four rainfall scenarios (drought, poor rainfall, normal/good rainfall, very good rainfall), we estimate this relation with a respondent fixed effect specification, taking advantage of

precisely this sort of trinomial rainfall forecast, so it is familiar to respondents (Luseno et al., 2003, Lybbert et al., 2006).

[9]The spatial distribution of the answers further supports this interpretation: in one site – Dida Hara – 90% of the respondents expected a bad year, while in other – Negelle – 90% of the households expected a good year.

[10]Respondents were asked to assume a cattle herd of standard composition for the region, in terms of age and sex of the animals. Finally, each respondent was also asked if s/he had ever managed a herd approximately equal in size to the initial value provided as the random seed.

[11]In particular, we asked respondents to consider herd evolution "as if" in 1999, the last major drought, or "as if" in a very good year, which we asked them to define based on their own experience.

having repeated observations, r, across different herd size intervals on each individual. We thus estimate

$$h_{1\ ir} = f(h_{0\ ir}) + \alpha_i + \epsilon_{ir} \tag{1}$$

where $f(h_{0\ ir})$ is a polynomial function of initial herd size and α_i represents the fixed effect.[12] Table 1 presents the estimates.

Table 1: Estimates of Expected Herd Dynamics Conditional on Rainfall

Variable	**Very Good**	**Good**	**Bad**	**Very bad**
$herd_0$	1.293	1.477	0.528	0.246
	[0.000]	[0.019]	[0.224]	[0.246]
$herd_0^2$			0.026	0.009
			[0.010]	[0.010]
$herd_0^3$			-0.00039	-.00017
			[0.0001]	[0.0001]
constant	0.897	0.179	0.513	-0.575
	[0.448]	[0.416]	[1.185]	[1.083]
N	61	96	192	61
R^2	0.986	0.994	0.792	0.589

Combined with historical information on rainfall (in practice, monthly rainfall data for the 4 sites over the period 1991-2001),[13] these estimates

[12] Besides the assumptions on the functional form of f(•), we also assumed that $\epsilon_{ir} \sim N(0,\sigma^2)$. Other specifications, that replace the fixed effect with other regressors that could affect subjective expectations, such as gender, age, experience and migrant status, were considered, but none of those variables proved statistically significant, so we omit these results, which are available upon request. We omit higher order polynomial terms in the very good and good/normal year specifications because they added nothing given the good fit already achieved with a simple linear specification with fixed effects. Note that because h_0 was randomly assigned we do not need to worry about the fact that, otherwise, this would be a dynamic panel. In any case, additional specifications that omit the fixed effect estimate lead to similar conclusions.

[13] Average rainfall was 490 mm/year, with a standard deviation of 152 mm/year. Given the skewness and the kurtosis of this distribution, we cannot reject the null hypothesis that rainfall follows a normal distribution. The minimum annual rainfall over the period was registered in 1999 (259 mm) and the maximum in 1997 (765 mm). The probability of such events is 0.064 and 0.035. Given these results, we assumed, for simulation purposes, a symmetric distribution, with a probability of extreme events (drought and very good year) equal to 0.10.

enable us to simulate the empirical distribution of herd size up to ten years ahead, a temporal horizon used previously in analysis of this system (Lybbert et al., 2004). Figure 1 presents the basic structure of the simulation procedure we used and figure 2 presents the mean (dashed line) and its 95% confidence interval (dotted lines) of 10-year ahead herd size for 500 replicates of this simulation with initial herd sizes between 1 and 60.

t-1	t	t+1
predict $herd_t$ ($herd_0$ given)	→ rainfall draw ↓ call h_{t+1}=f(h_t | rainfall) ↓ predict h_{t+1} →	repeat as in t

Figure 1: Scheme of simulation procedure

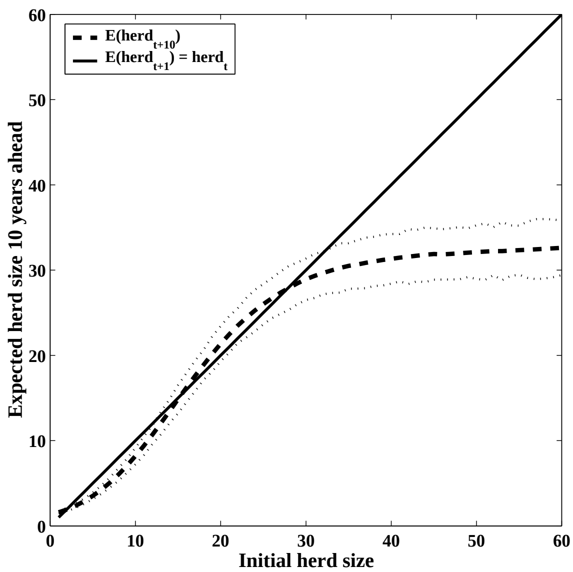

Figure 2: Expected wealth dynamics

These results clearly suggest that the wealth dynamics revealed in the historical data are in fact understood by pastoralists, as evidenced by the existence of multiple attractors and their location in the wealth space, which closely match those estimated based on actual herd history data (Lybbert et al., 2004). In section 3.1 we use these data to generate the key variables in our analysis: expected gains from a loan and expected capacity to repay a loan.

2.2 Credit networks

In order to understand the decision to extend credit to potential borrowers we randomly matched each respondent with five other respondents from the sample and asked two types of questions. The first question identified (real) social networks through the question "Do you know (the match)?" The other question inquired about the possibility of transferring cattle as a loan if the match asked for it.[14] This latter question provides information on potential credit networks and is the subject of study in the next section. Our approach to data collection offers one major advantage relative to previous studies of informal transfers. Because we know the characteristics of both lender and borrower, we can avoid concerns of biased estimates due to lack of knowledge about one end of this bilateral relation (Rosenzweig, 1988, Cox and Rank, 1992, Ackerberg and Botticini, 2002).

There are, however, two prospective problems with this approach. First, by studying links between individuals rather than the transfers themselves, we could err due to excessive discretization. However, this does not seem to be 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 (80%) were of 1 or 2 cattle. [15] For that reason, and with only a slight abuse of language, we use the terms "credit network" and "loans" interchangeably in what follows.

[14] We also asked about the possibility of transferring cattle as gifts. The pattern of answers is virtually identical; loans and gifts seem empirically indistinguishable in this sample. In only 13 (2.3%) of 561 matches did the decision differ between loans and gifts. We therefore concentrate solely on transfers deemed "loans" in what follows.

[15] 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 animal, 8 (or 7%) were of 2 cattle and the remaining less than 2% were more than 2 cattle.

Second, one might reasonably wonder how well potential credit networks elicited in this manner reflect the decision process underlying the formation of real credit networks. In a separate paper (Santos and Barrett, 2007) we show that the inferred determinants of insurance networks derived from the approach used in this paper closely match those obtained from analysis of real insurance relations among the same population. [16] The appeal of using randomly matched respondents thus seems to outweigh the prospective pitfalls of using discrete data on hypothetical transfers.

3 Nonlinear expected wealth dynamics and credit networks

The basic pattern of answers to the credit link questions is described in Table 2. Three key facts emerge clearly.

Table 2: Knowing and lending: a sequential process

Lend / Know	No	Yes	Total
No	67	2	69
Yes	367	144	511
Total	434	146	580

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: 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 loan: in only 2/69 cases did a respondent indicate that they would be willing to lend livestock to someone they did not know. The sequential structure of these

[16] This is not an entirely surprising result. An extensive literature on stated choice methods suggests that when properly contextualized, elicitation of hypothetical behaviors can provide an accurate view of actual behaviors (Arrow et al., 1993). The benefits of using experimental data in the study of social capital (a concept closely related to that of social networks) is emphasized by Durlauf and Fafchamps (2005).

answers has consequences for our econometric strategy. In particular, we must estimate the determinants of credit networks only on the subsample of those who know their matches (Maddala, 1983). This also raises the question of who is excluded from social networks, which we explore in section 4. Third, 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 lend an animal to the match. The acquaintance between lender and borrower seems therefore to be necessary but insufficient for obtaining credit.

3.1 Understanding informal credit rationing

The intuition behind the analysis of respondents' willingness to extend a cattle loan to a random match from the sample is that respondents evaluate the expected benefits and costs of each potential link/loan, answering "yes" if their evaluation of the benefits exceeds the costs. Two key considerations enter this calculus: the possibility that the borrower may not repay the loan and the value of the compensation provided for parting with an animal.

The first, default risk consideration is heavily emphasized in the literature that explores the relation between wealth and exclusion from contracts,[17] usually finding a positive monotonic relation between a borrower's wealth and creditworthiness. If informal credit were strictly a debt instrument, this might be the end of the story and willingness to extend credit should be a monotonically increasing function of the prospective borrower's ex ante wealth, and thus capacity to repay.

In our setting, however, as in many other developing country settings, loans often come bundled with insurance (Udry, 1994) or, in this case, an element of equity investment. Among the Boran, informal lending traditions of the type we asked our respondents about [18] hold that the loan of a cow[19] entitles the lender not only to the original animal (the conventional

[17] See Banerjee (2001) for a comprehensive analysis.

[18] We asked about *dabarre* loans, interpreted in the literature as risk-sharing arrangements. We did not ask about other, shorter-term, loans that are mainly intended to provide food (milk) to the recipient household – in Boran, *amesa*.

[19] Even money to be used to buy animals, which is becoming less rare.

loan component) but also to its female offspring, with male calves kept by the borrower. [20] This introduces a second channel through which a borrower's wealth may matter: the borrower's expected herd growth affects the expected returns to the lender, reflecting an equity component to informal livestock loans in this setting[21].

Clearly, these motives are non-exclusive. We can conceive of an individual Boran pastoralist (indexed by i) making lending decisions as if maximizing the net expected returns (ER) on a loan of one cattle to another herder (indexed by j):

$$\mathrm{ER_{ij}} = \sigma \mathrm{EG_j} \times \mathrm{r(EW_j)} - 1 \tag{2}$$

Here, $\mathrm{EG_j}$ stands for j's Expected Gains from a loan, σ stands for the lender's share in the gains from the loan, which is set by social convention, and $\mathrm{r(EW_j)}$ is the repayment function, that depends on expected wealth ($\mathrm{EW_j}$). In the empirical application, we define the Expected Gains from lending as

$$\mathrm{EG_j} \equiv (\mathrm{EW_j} |\, \mathrm{l_{ij}} = 1) - (\mathrm{EW_j} |\, \mathrm{l_{ij}} = 0) \tag{3}$$

where $\mathrm{l_{ij}}$ is an indicator variable that takes the value of 1 if a loan is extended, and approximate the repayment function by the probability that future herd size ten years hence, post transfer of one animal, will be larger than a specified value given actual herd size – that is, the probability that the recipient of a loan will be "wealthy enough" to repay it. Clearly, both $\mathrm{EG_j}$ and $\mathrm{r(EW_j)}$ are functions of $\mathrm{EW_j}$, a variable created using the simulation procedure briefly described in section 2.1. The results from that exercise, when "wealthy enough" is understood as having a herd bigger than 30 animals, [22] are presented in figure 3, with $\mathrm{r(EW_j)}$ the dot-dashed line (read

[20] Keeping the male calves does not allow herd growth, per se. However, moving one's herd size towards the threshold at which wealth dynamics bifurcate allows the recipient to benefit from increasing returns to wealth, by allowing them to undertake seasonal migration that, as argued above, is not feasible for households owning smaller herds.

[21] Recent work (for example, Berhanu, 2009) suggests that such recalls can be quite frequent, confirming our own impressions from the field.

[22] This herd size has the advantage that it can be interpreted as close to the lower bound estimate of the attractor associated with higher levels of welfare. Other herd sizes (10, 15, 20, 25, 35) lead to similar conclusions.

against the lefthand vertical axis) and EG_j the dotted line (read against the righthand vertical axis).

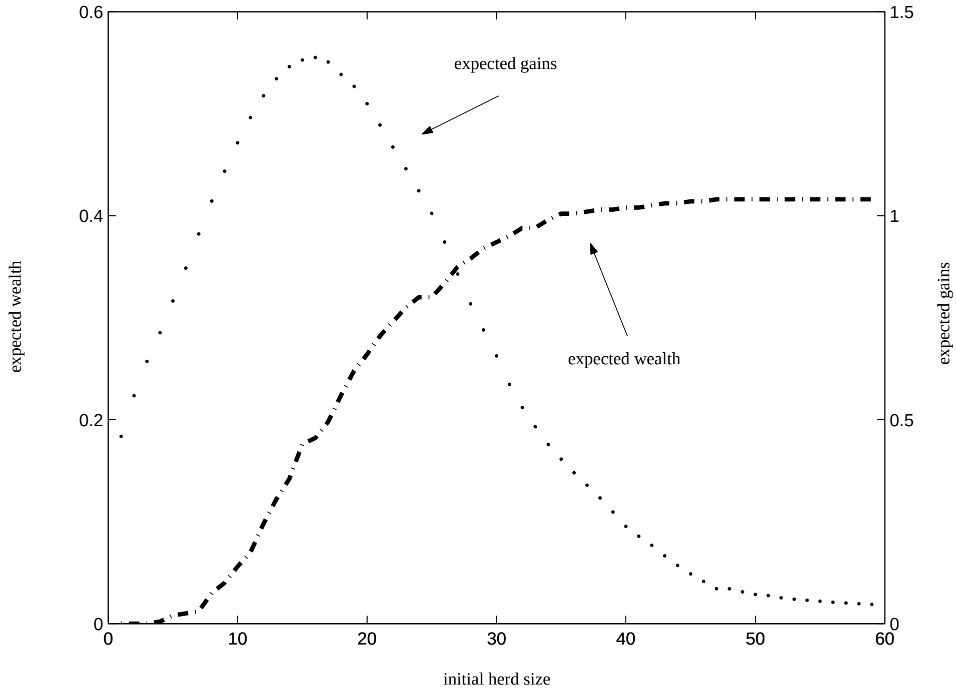

Figure 3: Expected consequences of a loan of 1 cattle

Two features merit particular attention. First, the probability that a recipient's herd size will reach the high-level asset attractor (more than 30 cattle) is S-shaped, with values less than 1% below 7 head and reaching a plateau in the 35-45% range beginning roughly at 22 head. Second, the only asset range over which expected gains exceed the 1 cattle initially transferred is the interval of 7-22 cattle – that is the neighborhood of the threshold at which expected wealth dynamics bifurcate. [23]

[23] The use of EW_j as a proxy for capacity to repay a loan is only valid under the assumption that there is a linear relation between expected wealth and repayment. Our knowledge of this system suggests otherwise: for example, it is impossible to ask someone that only has 1 cattle – a herd size that coincides with the attractor associated with those who start to the left of the threshold – to repay loans, given the ceremonial role played by cattle (namely in burial ceremonies) and its importance in defining the Boran identity.

Given these results, the empirical relevance of the different variables has important implications for our understanding of informal bilateral credit relations and for related policy interventions. If only matches' capacity to repay ($\mathrm{r(EW_j)}$) drives credit access, it would signal that the wealth threshold *per se* is not important. In this case, we would expect the wealthiest herders to be the primary beneficiaries of these loans.

If, on the other hand, expected gains ($\mathrm{EG_j}$) guide the allocation of loans, this might induce a "middle class bias" that favors those nearer the threshold at which wealth dynamics bifurcate. This can be seen by noting that, given the small size of these cattle loans, expected growth ex post of the loan is low or even negative for those in the vicinity of the low or high level attractor. On the other hand, and in expectation, the expected wealth dynamics enable those below and "sufficiently close" to the threshold to recover onto an expected growth path leading to the higher level wealth attractor.[24]

In the empirical part of this paper we focus on these two considerations in the context of informal credit as de facto insurance, a role recognized in the literature (Alderman and Paxson, 1994, Besley, 1995). In our analysis we pay attention to this possibility by taking into account the effect of past shocks in the decision to extend credit, captured through the interaction between past losses and our variables of interest.

Given what is written above, it is important to notice that the possibility of lending in response to borrowers' shocks and expected gains (more than

[24]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 to the threshold. One needs to recognize, however, that this limitation is purely an artifact of the two person, dyadic model we employ. Anecdotal evidence from a survey of life histories collected during fieldwork suggests that coordinated transfers are commonly sought and obtained, raising the potential for transfers to perform such a role over a wider herd size range although, unfortunately, not so wide as to catch the very poor or the destitute: the maximum size of a transfer such as this was 5 cattle. This is further corroborated by anthropological work among the Boran (Dahl, 1979, Bassi, 1990) on the functioning of *busa gonofa*, an 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 cannot be pursued here but that, together with our evidence, seem to reinforce the existence of a minimal herd size for viable pastoralism.

borrowers' shocks and expected capacity to repay) would suggest that, in this context, informal lending might be best understood as a safety net – a mechanism that prevents participants from falling into persistent poverty – rather than as a mutual insurance mechanism activated whenever the potential borrower suffers a loss, irrespective of his/her wealth after the shock. This has policy implications in terms of how to target transfers, and we explore these in section 5.

The closest study, empirically, to our analysis is McPeak (2006). He explores different motives for livestock transfers in a northern Kenyan environment quite similar to ours and finds that transfers are targeted to wealthier pastoralists. He interprets this as reflecting differential capacity to reciprocate the original transfer, essentially our $r(EW_j)$ function. More surprisingly, he finds support for an interpretation of asset transfers as a form of "precautionary savings" as transfers do not seem to be triggered by recent wealth shocks. We differ from this study in that we analyze the formation of credit networks through which such transfers occur and can condition our analysis on expected gains thanks to our analysis of the wealth dynamics. Omission of this term from McPeak (2006) could explain the difference in our results.

Hoff (1997) analyzes the relation between insurance arrangements, the erosion of investment incentives and the persistence of poverty, and predicts matches along wealth levels. Individuals with high 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 (i.e., 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 the empirical section we test this implication of Hoff's model as well, since we use data from both sides of the credit contract and thus can control for lender's wealth.

Given that informal transfers can insure only against idiosyncratic shocks, asset covariance between potential insurance partners should matter to contracting choices, as the 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 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 equilibrium contracting. Genicot and Ray (2003) likewise suggest that insurance groups may be bounded because risk-sharing arrangements need to be robust to defection by sub–groups. [25] Although these authors do not explicitly model wealth as a source of friction that might prevent credit links from forming, they offer complementary explanations for the behavior that we observe. In our empirical work, we therefore control also for covariates that may reflect differences in the degree of enforcement of such contracts or of monitoring of the other agent's activity and, less perfectly, for the degree of alternative credit ex ante of the link formation decision.

3.2 Econometric model

We study respondents' willingness to lend or not to lend using a model that nests the different explanations/motives for asset transfers under the reduced form

$$\mathrm{Prob}(\mathrm{l_{ij}} = 1) = \Lambda(\mathrm{EG_j}, \mathrm{r}(\mathrm{EW_j}), \mathrm{L_j}, \mathrm{W_i}, \mathrm{X_{ij}}) \tag{4}$$

where $\mathrm{l_{ij}} = 1$ denotes that a link is formed between i (the respondent) and j (the match), $\mathrm{EG_j}$ is the match's expected gains from the loan of 1 animal, $\mathrm{r}(\mathrm{EW_j})$ is the probability of being wealthy enough for loans to be recalled

[25] Unlike Genicot and Ray (2003), we address network formation rather than group formation. Groups differ from networks because the latter lack common boundaries. 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).

after the same transfer, L_j indicates whether the match lost cattle in the recent past (in practice, the period 2000/03 for which we have data), W_i is the respondent's wealth and the X_{ij} vector captures a range of covariates describing the distance, in both physical and socio-economic space, between i and j. Finally, Λ is the logit cumulative distribution function and we assume that:

$$E(\varepsilon_{ij}, \varepsilon_{ih}) \neq 0 \text{ if } j \neq h \tag{5}$$

$$E(\varepsilon_{ih}, \varepsilon_{jh}) \neq 0 \text{ if } i \neq j \tag{6}$$

where ε_{ij} is the error term of the regression. Two issues need to be addressed before we present our estimates: (1) the way we express the distance between respondent and match (the vector X_{ij}), and (2) how to make accurate inferences as to the statistical significance of our estimates given that unobserved heterogeneity across individuals is likely important for the network formation decision (as in 6).

The elements of the X_{ij} vector – clan membership, gender, age, land holdings, and household size – are expressed not as the Euclidean distance between the pair but rather using a measure of distance that allows for ordinal differences in the relative position of the respondent and match to play a role in explaining the respondent's decision. To be more concrete, consider the case of a categorical variable such as gender. If the match and respondent share the same gender we can either control for a dummy variable "same gender" - implicitly imposing that the effect of a female–female match is the same as that of a male–male one – or we can consider the set of all possible matches (female–female, female–male, male–female and male–male) and incorporate a dummy variable for each specific combination. *Mutatis mutandis*, the same reasoning applies to continuous variables. [26] 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 (as in Akerlof (1997)) that, implicitly, imposes symmetry in the effect of these variables upon the dyad formation decision.

[26] With a different formalization, the same idea is captured in Fafchamps and Gubert (2007).

Our assumptions about the error term (expressions 5 and 6) formalize the possibility of correlation across matches' unobservables, that is, that the error term is also dyadic. [27] Most of the studies that account for this possibility do so by correcting the covariance matrix using the estimator suggested by Conley (1999) and further developed, in this literature, by Fafchamps and Gubert (2007). We follow a different strategy, using a nonparametric permutation test known as Quadratic Assignment Procedure (QAP) (Hubert and Schultz, 1976, Krackhardt, 1988, 1987) to obtain correct p–values that allow us to test the hypothesis that $\beta_{\mathrm{x}} = 0$, where β_{x} is any of our estimates of interest. [28] 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. The repetition of this exercise (in our case, 200 times) allows us to construct the empirical distribution of the parameter of interest and compute the p–values of each estimate (Good, 2005). Contrary to most of the previous studies, we find that accounting for the possibility of correlation across matches' unobservables does matter for inference. For that reason, we present the QAP–corrected p–values only.

[27] An alternative way of modeling the error term is to assume that the personal network is a complex attribute of the individual and that relations are nested within individuals (Valente, 2005). This assumption implies a logit model estimated by clustering the observations on the identity of the respondent, that is, that $\mathrm{E}(\varepsilon_{\mathrm{ih}}, \varepsilon_{\mathrm{jh}}) \neq 0$ if $\mathrm{i} \neq \mathrm{j}$. The record of whether such simplification matters is mixed. Fafchamps and Gubert (2007), Udry and Conley (2005) and Santos and Barrett (2008) find no significant differences from estimates that do not account for correlation across matches' unobservables. Other studies, for example Arcand and Fafchamps (2007), find that allowing for correlation across matches' unobservables does matter to inference.

[28] Each of our respondents is matched with five other individuals. With such a small number of matches, it does not seem credible that the assumptions for the asymptotic properties of an estimator such as the one introduced by Conley (1999) would hold. In an earlier version of their analysis, Fafchamps and Gubert (2007) used QAP to derive correct p–values. As they mention, inference was similar to using the correction that they ultimately report.

3.3 Estimation results

Table 3 presents descriptive statistics of the regressors used in our estimation.

Table 3: Variable definitions and descriptive statistics

Variable	Definition	Mean (SD)
r(EW_j) (Repayment Function)	Percent probability that the match will have a herd bigger than 30 cattle, 10 years after receiving a loan of one cattle, given current (2003) herd size	9.62 (12.29)
EG_j (Expected Gains)	Difference in match's expected herd size, 10 years after receiving a loan of one cattle, given current herd size	0.973 (0.383)
Respondent's wealth	Respondent's herd size in 2003	11.31 (13.45)
L_j (Loss)	Dummy variable, equal to 1 if the match lost cattle in the period between September 2000 and September 2003	0.219 (0.414)
Physical distance	Absolute value of the distance between respondent and match, in kilometers	44.65 (61.89)
Same clan	Dummy variable, equal to 1 if both respondent and match belong to the same clan	0.23 (0.42)
Both male	Dummy variable, equal to 1 if both respondent and match are male	0.42 (0.50)
Male, female	Dummy variable, equal to 1 if respondent is male and the match is female	0.25 (0.43)
Female, male	Dummy variable, equal to 1 if the respondent is female and the match is male	0.19 (0.40)
Older	Absolute value of the age difference between respondent and match if the respondent is older than the match, 0 otherwise	7.40 (11.97)

Continued on next page...

... table 3 continued

Variable	Definition	Mean (SD)
Younger	Absolute value of the age difference between respondent and match if the respondent is younger than the match, 0 otherwise	7.91 (12.44)
More land	Absolute value of the difference in land cropped be– tween the respondent and match if the respondent cultivates more land than the match, 0 otherwise	0.34 (1.04)
Less land	Absolute value of the difference in land cropped be– tween the respondent and match if the respondent has less land than the match, 0 otherwise	0.37 (1.28)
Bigger family	Absolute value of the difference in family size (in persons) between the respondent and the match if the respondent has a bigger family than the match, 0 otherwise	1.27 (2.04)
Smaller family	Absolute value of the difference in family size (in persons) between the respondent and the match if the respondent has a smaller family than the match, 0 otherwise	1.60 (2.37)
Positive correlation	Absolute value of the correlation in herd size since 2000, between the respondent and the match, if the correlation is positive, 0 otherwise	0.26 (0.29)
Negative correlation	Absolute value of the correlation in herd size since 2000, between the respondent and the match, if the correlation is negative, 0 otherwise	0.12 (0.21)
Number of brothers	Number of brothers of the respondent	3.04 (2.08)
No cattle since 2000	Dummy variable, equal to 1 if the match has no cattle since 2000	0.04 (0.20)
Poor since 2000	Dummy variable, equal to 1 if the match manages	0.05

Continued on next page...

... table 3 continued

Variable	Definition	Mean (SD)
	a herd size that is smaller than 5 cattle (but strictly positive) since 2000	(0.21)
Not poor but below threshold, since 2000	Dummy variable, equal to 1 if the match has a herd of intermediate size but below the threshold (i.e., between 5 and 14 cattle) since 2000	0.22 (0.41)
Above thresh–old, not wealthy, since 2000	Dummy variable, equal to 1 if the match has a herd of intermediate size but above the threshold (i.e., between 15 and 39 cattle) since 2000	0.01 (0.09)
Wealthy since 2000	Dummy variable, equal to 1 if the match manages a herd that is larger than 40 cattle since 2000	0.01 (0.11)

Table 4 then reports the results of estimating equation 4, where the dependent variable is the answer to the question "Would you lend cattle to (the match) if asked for it?". [29] Before we discuss the effects of our core covariates of interest – the respondent's expected capacity to repay the loan and expected gains from a loan of one cattle – let us first note a few results with respect to the X variables, defining relational characteristics between i and j. These results reflect possible frictions and associated costs of establishing a credit relation, analogous to the effect of physical distance in driving localized insurance (Murgai et al., 2002). Clearly, when interpreting these results, we must assume that when respondents know their match they also know their characteristics (clan, gender, age and so on).

The propensity to lend cattle is strongly and positively influenced by belonging to the same clan, which may reflect closer affinity or, simply, the interest in keeping one's "strength in numbers" when competing with

[29] In most east African pastoralist societies, cattle loans can serve different purposes, most notably restocking or supply of milk to the household through the short term loan of milking animals. This is also true among the Boran, where such transfers are known respectively as dabare and amesa. We specifically asked about dabarre transfers.

Table 4: Logit estimates of willingness to give loans

Variable	Coefficient	QAP p-value
L_j=0 × r(EW_j)	0.027	0.000
L_j=0 × EG_j	0.092	0.400
L_j=1 × r(EW_j)	-0.112	0.025
L_j=1 × EG_j	1.936	0.040
Respondent's wealth	0.014	0.180
Physical distance	-0.001	0.650
Same clan	2.320	0.000
Both male	0.819	0.050
Respondent is male, match is female	0.959	0.035
Respondent is female, match is male	0.344	0.180
Respondent is older than match	0.014	0.000
Respondent is younger than match	0.009	0.095
Respondent has more land than match	-0.120	0.390
Respondent has less land than match	-0.172	0.260
Respondent has a bigger family than match	-0.136	0.130
Respondent has a smaller family than match	-0.161	0.095
Pseudo–R^2	0.274	

Note: Village–specific dummies and a constant were included in the estimation but are not reported. L_j=0: Match did not loose wealth in the period 2000/03. L_j=1: Match lost wealth in the period 2000/03. r(EW_j): Match's repayment function. EG_j: Match's expected gains from a loan.

individuals from other clans for the control of natural resources (especially water in this setting). Variables that measure social distance in terms of gender are clearly asymmetric. Men are more willing to lend cattle (either to women or to other men) than are women[30] . Respondents are slightly, but statistically significantly, more willing to lend cattle to matches who are older than themselves. Differences in household size decrease the probability of a

[30]This may simply reflect the fact that women are not, traditionally, herd managers in their own right - rather they manage herds on behalf of an older son, given the death of the husband. However, one should notice that, when the lender is a man, the propensity to lend cattle to women is not much smaller than to men, possibly signalling the *de facto* recognition that women can manage herds. We thank an anonymous referee for reminding us of that fact.

loan, signaling a propensity to establish links with those in a similar stage of the life cycle. Physical proximity has no statistically significant effect on credit access patterns in these data, as is perhaps unsurprising among a population that has mobility at the center of its livelihood. Finally, the suggestion that wealthier givers would be less interested in entering into such contracts (Hoff, 1997) does not seem to find support in these data as the probability of extending an informal loan is modestly increasing in respondent's wealth (although our estimates are not statistically significant at the usual levels of significance).

We now turn to the core hypotheses of interest: the relation between credit access and the match's wealth and shocks, holding the respondents' wealth constant. [31] The first point to notice is that having suffered losses in the recent past (that is, the period 2000/03, for which we have data) seems to be critically important in defining who is creditworthy[32].

In the case of those herders who suffered no losses in the recent past, only capacity to repay the loan seems to be important. This is not true in the case of herders who suffered losses. Both one's capacity to repay the loan and expected gains are statistically significant in explaining this decision (with p–values of 0.025 and 0.040) but, more interestingly, seem to have opposite effects on the propensity to be given a loan: an increased repayment capacity (that can be interpreted to reflect one's capacity to stand on one's own after

[31] 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 perhaps more straightforward, as we could take the closest herd size - 1 cattle - as a guide, and assume, for example, that

$$\Pr(\text{herd size 10 years ahead} \geq 30 \mid \text{match has no cattle, loan of 1 cattle}) = \Pr(\text{herd size10 years ahead} \geq 30 \mid \text{match has 1 cattle}) = 0$$

The downside of such choice is that we would not be able to clearly interpret our estimates, as they could just as well be reflecting this additional assumption. For that reason, we exclude from the estimation those observations for which the match has no cattle.

[32] Note that we do not discriminate the cause of such losses, and as such this variable simply represents a decrease in wealth.

a shock) decreases the propensity of receiving a loan while expected gains has a positive effect on the probability of receiving such a loan.

The second point to notice is that the identification of the net effect of borrower's wealth on the probability of being given credit requires us to take into account the combined effect of the two variables of interest – expected wealth and expected gains. This combined effect is graphed in Figure 4 for the "average link" (that is, one characterized by the average value of all other variables), taking into consideration the differences between those who suffered a loss and those who did not.

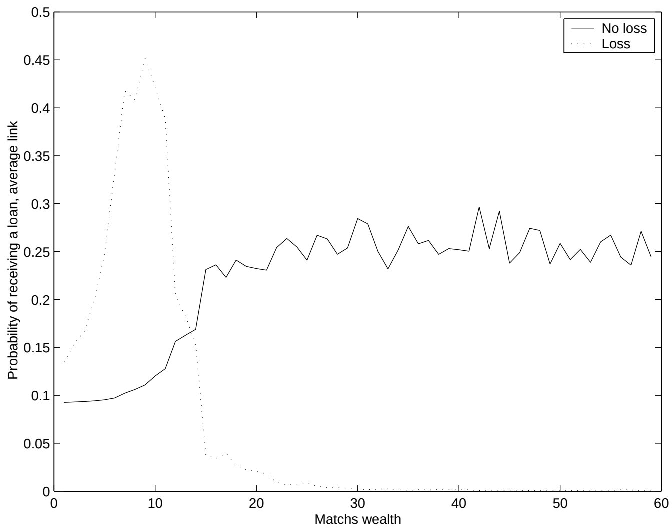

Figure 4: Probability of being willing to establish a credit link: the effect of match's wealth

Credit seems to respond to losses only for those herders who, having cattle, are not "too poor", that is, those with wealth in the neighborhood of 7-10 animals, while those with wealth above 15 animals receive no loans in response to shocks. Recall that the threshold in this economy is in the neighborhood of 12–16 animals. This suggests that credit, in practice, insures that recipients will be wealthy enough to remain mobile herders, rather than insuring all losses, regardless of the beneficiaries' wealth. Given our earlier discussion, this appears a direct consequence of how gains from informal credit are shared, creating an incentive for lenders to be willing to extend credit to prospective borrowers in the neighborhood of the threshold at which wealth dynamics bifurcate. The social convention behind informal lending in this setting seems to have evolved to provide a safety net against collapse into the poverty equilibrium, but not an insurance mechanism.

Those herders who did not suffer losses in the recent past seem to be evaluated under different criteria: expected capacity to repay seems to matter most. Here again a wealth level of 15 animals seems to play a role: above this value, the probability of receiving credit does not seem to change much, signaling that all herders above the accumulation threshold seem to be seen as equally desirable/viable, but those with smaller herd sizes are significantly less likely to receive a loan if they have not suffered a loss.

Note that the expected probability of being willing to extend credit never exceeds 0.5. In other words, under no conditions is the "average link" expected to correspond to an informal lending relationship between the two individuals. Of course, the average link is an abstraction, but alternatives that add more detail (by considering what happens when both parties in this contract are from the same clan, for example) will only shift the probability of establishing a link up or down, without really changing the fundamental message of our results: informal lending is directed chiefly toward those expected to gain the most from the loan and, because it tips them into the more desirable basin of attraction, configures a safety net and not an insurance mechanism.

3.4 Alternative explanations of exclusion from credit contract

Finally, we check whether our central results are robust to the inclusion of additional explanatory variables suggested by the alternative models identified earlier. We have already addressed in Table 4 the concerns of Hoff (1997) and Murgai et al. (2002). In Table 5 we include the correlation between herd sizes of our respondents and their random matches in the nine quarterly survey rounds for which we have data. As with the other variables, we allow for the possibility of different effects upon the propensity to transfer cattle as a loan depending on whether this correlation is positive or negative.

Table 5: Logit estimates of willingness to give loans: the effect of correlation in wealth dynamics

Variable	Coefficient	QAP p-value
L_j=0 × r(EW_j)	0.021	0.000
L_j=0 × EG_j	-0.264	0.375
L_j=1 × r(EW_j)	-0.153	0.035
L_j=1 × EG_j	2.038	0.070
Respondent's wealth	0.029	0.255
Negative correlation in wealth	1.481	0.185
Positive correlation in wealth	0.042	0.040
Pseudo–R^2	0.289	

Note: Other covariates presented in table 4 were used in the estimation but are not presented here.

The inclusion of these variables does not change our results in any important way. Informal lending appears concentrated around the threshold in response to asset shocks, serving as a safety net against the expected collapse into poverty. Somewhat unexpected is the fact that past positive correlation in wealth increases the probability of giving a loan to the respondent – perhaps reflecting more similar livelihoods and the possibility of closer monitoring of the potential beneficiaries of a loan.

This is likewise true when we include the respondent's number of brothers and its square as a proxy for the size of the ex ante credit network (Table 6): just as before, we find that expected gains from a transfer post-shock appear to drive informal lending.

Table 6: Logit estimates of willingness to give loans: the effect of ex ante credit networks

Variable	Coefficient	QAP p-value
L_j=0 × r(EW_j)	0.019	0.000
L_j=0 × EG_j	-0.233	0.340
L_j=1 × r(EW_j)	-0.180	0.030
L_j=1 × EG_j	2.100	0.030
Respondent's wealth	0.014	0.240
Number of brothers	-0.183	0.485
Number of brothers squared	0.031	0.365
Pseudo–R^2	0.292	

Note: Other covariates presented in table 4 were used in the estimation but are not presented here.

4 Nonlinear wealth dynamics and social exclusion

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 multiple attractors arise in this setting because of asset shocks, then protection against such shocks is critical to maintaining a viable livelihood. Yet if the asset poor cannot get transfers their ability to climb out of poverty may be negligible. The results reported in the preceding section may even understate this effect because they are based only on credit decisions relating to the subsample of random matches with whom respondents were already acquainted. Given that social acquaintance seems to precede the establishment of a credit network, as shown in table 2, this section explores the possibility of wealth–dependent "social invisibility", which could reinforce the credit rationing mechanism identified in the previous section.

We use the same logit estimation approach from equation 4 to examine patterns of social acquaintance among the individuals in our sample, now using the "know" variable from table 2 as the dependent variable. Because this variable is certainly the result of past processes, we incorporate the effect of past dynamics (in practice, variables that characterize herd size transitions between 2000 and 2003, also described in table 3) and not the variables that we previously interpreted as a measure of future repayment capacity or expected gains from a loan. The results are presented in table 7.

Table 7: Logit estimates of social acquaintance networks

Variable	Coefficient	QAP p-value
Match is destitute (i.e. has no cattle) since 2000	-1.106	0.070
Match has less than 5 cattle since 2000	-0.145	0.391
Match has between 5 and 14 cattle since 2000	-0.127	0.379
Match has between 15 and 39 cattle since 2000	-0.581	0.485
Match has more than 39 cattle since 2000	-1.297	0.284
Match lost cattle since 2000	0.203	0.356
Respondent has more cattle than match	-0.014	0.096
Respondent has less cattle than match	0.040	0.043
Distance	-0.007	0.201
Same clan	0.743	0.033
Both male	0.684	0.118
Respondent is male, match is female	0.177	0.359
Respondent is female, match is male	0.618	0.121
Respondent is older than match	-0.026	0.005
Respondent is younger than match	-0.000	0.515
Respondent has more land than match	0.143	0.193
Respondent has less land than match	0.482	0.013
Respondent has a bigger family than match	0.042	0.264
Respondent has a smaller family than match	-0.097	0.111
Pseudo–R^2	0.2264	

Note: Village–specific 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. The comparison category is "Match gained cattle since 2000".

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 and being older have a negative impact, a clear demonstration of the asymmetric effects of wealth and status on the structure of social networks. 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, and statistically significant coefficient estimate. A herd size consistently at the low–level equilibrium appears associated with greater likelihood of social invisibility that, recall from Table 2, seems to prevent one from entering into dyadic informal credit relationships. Informal credit arrangements cannot function for the poorest members of a society if they are not part of the social networks from which credit networks are drawn. [33]

The nature of the channels through which this process operates are not entirely clear, although the anthropological literature on the Boran offers some suggestions. Dahl (1979), for example, mentions that participation in the social and political life of the Boran is hardly compatible with the daily management of the herd: wealthy herders, who usually occupy these traditional (and highly visible) offices, quite often delegate these tasks to someone else. Lybbert et al. (2004) hypothesize that the wealth dynamics that they describe 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 those who remain as herders.

Regardless of the precise causal mechanisms by which the greater 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, Illife (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

[33] Vanderpluye-Orgle and Barrett (2009) find very similar patterns of exclusion from informal social insurance among "socially invisible" persons in Ghana.

such a person is not to be trusted". Closer to our study site, a Somali proverb states that "Prolonged sickness and persistent poverty cause people to hate you" (World Bank, 2000, p.16).

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 not 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 precisely estimated. There are two possible explanations for this. First, knowing one's match may be a less "rational" process than is choosing a loan recipient, leading to a greater role for unobserved heterogeneity for both respondent and match. Second, even if we use all the relevant variables to eliminate two–way unobserved heterogeneity, we only observe them for a relatively short period and there can be no presumption that the process from destitution to social invisibility takes effect immediately. For example, moving 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.

5 Conclusions and policy implications

This paper presented a simple conceptual discussion of the implications of bifurcated expected wealth dynamics for patterns of informal credit and, using data from a population among which poverty traps have been previously identified, found support for the hypothesis that informal credit arrangements conform to this model. Livestock loans among these herders appear to function largely as safety nets, triggered by herd losses so long as those losses leave the prospective transfer recipient not "too poor" so that the expected gains to the borrower – and thus to the lender – from the loan are relatively high, as compared to loans to poorer or richer prospective borrowers.

This effect of credit rationing that leaves out poorer members of the community is compounded by the fact that the poorest are less socially visible than their somewhat wealthier neighbors. Because being known is, in this context, a necessary condition for receiving transfers, the greater social invisibility of the destitute compounds their rational exclusion from informal transactions effected through social networks, leaving them vulnerable to shocks and largely without credit networks to fall back on in times of need.

The focal role played by the wealth threshold in this economy have profound implications for public policies to address problems of persistent poverty and asset loss in a setting characterized by multiple attractors. Because informal loans can have, literally, life or death consequences in contexts such as the rangelands of southern Ethiopia, one must be cautious about deriving strong conclusions about optimal redistributive policies simply from our econometric results (Cohen-Cole, Durlauf, and Rondina, 2005). Our results nonetheless speak to the 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 in dire poverty. In this context, worries about the crowding out effect of public interventions well targeted to the poorest seem misplaced, because the poorer members are left uninsured with distressingly high probability. In fact, our 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 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 gain from loans.

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