Ethnicity and Reciprocity: A Model of Credit Transactions in Ghana

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Abstract

This paper studies kinship band networks as capital market institutions. It explores two of the channels through which membership in a community where individuals are genealogically linked, such as a kinship group, can affect their access to informal credit. The first is that incentives to default are lower for community members who can expect retaliation to fall on their offspring as well as on themselves (*social enforcement*). The second is that lenders prefer to lend to those members from whom they can expect reciprocation in the form of future loans for themselves or for their children (*reciprocity*). These two effects are incorporated in a theoretical framework with overlapping generations and tested using household-level data from Ghana.

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Ahwe-wo-da-bi ba na wahwe no.

One shows benevolence to the child of his benefactor.

(Twi proverb, Ghana)

1 Introduction

Nonmarket institutions have been the object of growing attention in recent years for their potential in coping with problems of imperfect information and limited enforcement in environments where the formal legal system is not sufficient. An early example of such institutions is the Maghribi traders' coalition studied by Greif (1993), which enabled medieval traders to overcome the commitment problem inherent in agency relations. Credit markets in low-income countries are another example of the difficulty of enforcing binding agreements. Economic theory has shown that institutional arrangements like group lending programs, rotating savings and credit associations, and credit cooperatives can overcome some of the incentive problems that arise in individual transactions.[1] All these arrangements involve a relatively small number of participants, and people join voluntarily with the purpose of gaining access to credit.

There are other institutions people are born into —the family, the village or neighborhood, the religious or ethnic group, and many others— whose role for alleviating information and enforcement problems is often substantial, though generally not the primary reason for their existence. Among others, Besley and Coate (1995) refer to the social sanctions imposed by members of close-knit communities on borrowers who default as 'social collateral', and show that this form of collateral can improve repayment rates; Udry (1990) documents the key role of village authorities or senior family members in enforcing informal credit contracts in northern Nigeria. [2]

This paper studies kinship band networks in developing countries as capital market institutions. More generally, it analyzes the implications for informal credit of membership in a particular type of community: a group whose members are *dynastically linked* in a way that is observable by everybody, so that the actions of parents can fall upon their children for good or for bad. A common example of this type of community in developing countries are *kinship groups*, i.e. groups of unilineal families sharing common cultural traditions, ethnic identity, and often ancestors. As discussed in the next section, these groups are a pervasive reality in most African countries and serve a variety of economic as well as social functions, including that of providing informal credit to their members. The diffuse presence of these groups in developing areas motivates this

[1]See, among the others, Stiglitz (1990), Varian (1990), Ghatak (1997) on group lending; Besley, Coate and Loury (1993) on ROSCAS; Banerjee, Besley and Guinnane (1993) on credit cooperatives.

[2]Arnott and Stiglitz (1991) show that the reciprocal provision of insurance among families and friends can alleviate moral hazard problems when the participants can observe each other's efforts.

analysis, although the main results carry through in developed economies as well, as long as similar 'dynastic' organizations exist.

The explicit consideration of the dynastic structure of the group in a repayment game played by overlapping generations of players yields two main theoretical results, one regarding borrowers' incentives to repay and the other regarding lenders' incentives to supply credit selectively. The first result is that *social enforcement* can effectively prevent default not only when the punishment is targeted to the defector, but also when it falls on his or her children, as long as the defector is dependent on those children for support in old age. Without assuming altruism in the utility function, the model predicts that borrowers will want to maintain a good reputation for their children so that the latter can get credit and support them in the future. The kin becomes thus 'social collateral' in the sense of Besley and Coate (1995). This enhances the scope for cooperation even when the interaction between any single lender and any single borrower is limited to a finite number of periods.[3]

Secondly, the dynastic structure of the community gives stability to individual expectations on future members and allows current members to expect reciprocation for their actions not only from the direct beneficiaries but also from their offspring. This extends the scope for *reciprocity* in credit transactions beyond the concept of 'bilateral reciprocity' used in models of informal insurance (Coate and Ravallion 1993; Thomas and Worrall 1994). In particular, lenders who privilege the children of past creditors in the allocation of loans can expect future lenders to do the same with *their* children, so that a 'social norm' of reciprocity among creditors is implicitly established. Without any element of adverse selection or moral hazard, the model yields a sharp prediction on *who* will obtain a loan when credit is rationed: all other characteristics being equal, children of past lenders will be privileged in the allocation of loans.

Empirical evidence consistent with the main implications of the model is then provided using household level data from Ghana for the years 1987-88 and 1988-89. The main results of the empirical analysis are the following. *Ceteris paribus*, people who have children are less likely to default on their loans, consistently with the interpretation of the kin as 'social collateral'. After controlling for household characteristics and for the years of residence as a proxy for the availability of information on the household, I find that people born into the local community are more likely to borrow from their kinsmen while migrants rely relatively more on moneylenders and banks. This is consistent with the hypothesis that both social enforcement and the scope for reciprocity are greater among members of the local kinship group. In particular, two pieces of evidence seem to indicate that reciprocity plays an important role in informal credit transactions for the

[3] For general characterizations of cooperative equilibria in repeated games played by overlapping generations of finitely-lived players see Kandori (1992a,b) and Smith (1992). In these models no genealogical link exists among the players, so no individual is held accountable for the actions of his or her predecessor. As a consequence, the punishment for deviating has to target the defector directly and the possibility for cooperation depends on the length of the overlapping period.

sample considered. The first is that 95 percent of the loans from local kinsmen carry zero interest rates; the second is that, *ceteris paribus*, the ability to borrow from kinsmen is higher for those households who contributed resources to the kinship group in the past, in the form of remittances or loans to others.

The remainder of the paper is organized as follows. Section 2 briefly introduces the notion of kinship groups and their economic functions as they emerge from the anthropological literature and from related studies in economics. Section 3 develops the theoretical framework and the testable implications of the model. Section 4 describes the data and illustrates the main trends in the patterns of lending and borrowing among the surveyed households. In section 5 the various predictions of the model are tested through multivariate analysis. Finally, section 6 contains some concluding observations.

2 Kinship groups, reciprocity and enforcement

The notion of kinship is rather complex and much debated upon in the anthropological literature (for references, see Harris 1990). For the purposes of this analysis, kinship groups will be defined as an intermediate level of social organization between clans and tribes. While a *clan* is a unilineal group of relatives living in one locality, a *kinship group* is formed by various clans and comprises "socially recognized relationships based on supposed as well as actual genealogical ties" (Winick 1956: 302). When they are not true genealogical connections, the social ties that bind together members of the same kinship group are "modelled on the 'natural' relations of genealogical parenthood" (Keesing 1975: 13). On the other hand, a kinship group is smaller than a *tribe*, which consists of "a number of kinship groups bound together by a common language and common rules of social organization" (Goodall 1987).

Thanks to their intermediate size, large enough to constitute an adequate risk pool but not so much to hinder the monitoring and enforcement of members' obligations, kinship groups can perform a number of economic functions. One of the most important functions is that of providing *informal insurance* to the members of the group, often in the form of sharing non-storable production surplus (Scott 1976, Posner 1980) or in the form of consumption credit. As noted by Fafchamps (1992), solidarity mechanisms emerge naturally in societies with high idiosyncratic risk, and kinship is one of the main networks through which mutual insurance operates. Bates (1990) reports evidence from several studies that in many parts of East and Central Africa varying degrees of kinship ties reflect different needs to cope with risk. Two key features allow these informal insurance mechanisms to work: reciprocity and enforcement.

The reason why people share their crops or livestock with others is that they expect the recipients to do the same in the future. Even though the exact time and extent of the 'repayment' may not be known at the date of the first transaction —*'generalized' reciprocity*, in the anthropological terminology— the same act of giving creates an obligation to reciprocate. When risk is shared through consumption loans, the principle of reciprocity applies in a similar way. Theoretical models of informal insurance, such as Coate and Ravallion (1993) and Thomas and Worrall (1994), find that optimal constrained insurance arrangements embody reciprocity among two parties engaged in the scheme. At the empirical level, Platteau and Abraham (1987) document the prevalence of interest-free loans among fishermen in South India and observe that any recipient of such loans implicitly commits to lend to past creditors in the future, even after the original loans have been repaid. Among members of a kinship group the scope for reciprocity is even larger, in that reciprocation can be carried out not only by the original beneficiary but also by his or her offspring and can be directed to the original benefactor as well as to his or her offspring. In Ghana, for example, it is common that when young people receive support from older relatives (for example financing their studies), they reciprocate by helping their younger relatives once they start earning money, rather than by repaying the person who gave them the money in the first place.[4]

The second requirement for the viability of informal insurance mechanisms is that they must be *enforceable* despite the absence of legally binding agreements. For this reason theoretical models of informal insurance impose the constraint that contracts be 'self-enforcing' in the sense that the expected loss from reneging —exclusion from future transactions— is greater than the expected gain (Kimball 1988, Coate and Ravallion 1993). As a complement to self-enforcing contracts, some authors have looked at social sanctions against defectors as a direct utility loss entering the incentive compatibility constraint (Fafchamps 1994, Thomas and Worrall 1994, Besley and Coate 1995). There is evidence that members of particular ethnic groups have been able to enforce contracts by establishing information-sharing networks and by sanctioning any defector with exclusion from future trade (Greif 1993, Fafchamps 1996). In addition to being close-knit communities where information circulates freely and members are highly interdependent, kinship groups have an additional feature that increases their ability to enforce transactions within the group. Kinsmen in traditional societies tend to obey the principle of collective responsibility, whereby members of the same clan are held collectively responsible for each other's action (Posner 1980). Social stigma or retaliation from the injured parties can thus fall on the defectors as well as on other members of their clan, increasing the cost of breaching the contract.[5]

This paper focuses on the nature of reciprocity and enforcement mechanisms in kinship groups and suggests a possible way in which they may affect members' behavior on the credit market.[6]

[4] Personal communication from Gracia Clark.

[5] Applying the same principle to inter-ethnic conflict, Fearon and Laitin (1996) have recently analyzed cooperation among different ethnic groups as a rational response to the threat of across the board retaliation.

[6] The theoretical framework will abstract from problems of adverse selection and moral hazard, as well as from an explicit modeling of the insurance function of informal loans and transfers in village economies. These issues are well understood in the theoretical literature and there does not seem to be much specific to dynastic groups that would justify addressing them again in this paper. Where

3 The model

The main feature distinguishing a kinship group from a generic group, namely its dynastic structure, can be captured through an overlapping generations framework. This section shows how social enforcement in the form of children punishing their parents or lenders denying credit to the children of defaulters can induce cooperation under standard conditions on the discount rate. Pareto efficient matching rules to associate each lender with a borrower when there is credit rationing are then analyzed. An equilibrium in which the matching rule prescribes reciprocity among lenders is shown to be the best Pareto efficient equilibrium for lenders. Finally, the equilibrium interest rate on 'reciprocal' loans is proved to be lower than that on 'market' loans.

3.1 Basic setup

Consider an economy in which n individuals are born in each period: a fraction α of them is born with an endowment $\overline{e}$, and the remaining fraction $(1-\alpha)$ with an endowment $\underline{e}$, where $\overline{e} > \underline{e}$. Let αn be an integer number. I indicate with $\overline{E}$ the set of type-$\overline{e}$ individuals and with $\underline{E}$ the set of type-$\underline{e}$ individuals.

People live for two periods. In the first period they are 'young': they undertake a productive activity generating a deterministic surplus g over the input costs and they have children (for simplicity, let each individual have one child). I assume that the good produced is non-storable, so people cannot save and transfer resources from the first period to the second.[7] In the second period people are old and cannot produce, so each old individual relies on a young one to finance his or her consumption through a transfer b. Throughout the model, the subscript t will denote a generation born at time t. I will indicate with N_t the set of all individuals born in period t, which is equal to $\overline{E}_t \cup \underline{E}_t$.

The *kinship group* in this model is constituted by the set $\{N_t\}_{t=1,2,..\infty}$, namely by all generations of individuals belonging to the local community. For each current member i_t of the group, one can identify ancestors i_{t-1}, i_{t-2},... and descendents i_{t+1}, i_{t+2},..., etc.

I assume that the productive activity has a fixed cost that exceeds $\underline{e}$, say $\underline{e}+l$, so that in every period the poorly endowed individuals need to borrow from the rich ones to undertake production. For simplicity, the amount the former need to borrow and the interest rate are fixed at l and r, respectively. The assumption on the interest rate will be relaxed later. To make the problem interesting, I also make the following assumptions:

Assumption 1: $\alpha < 1/2$
Assumption 2: $2l \leq (\overline{e}-\underline{e}) < 3l$
Assumption 3: $\overline{e} < 2(\underline{e}+l)$

relevant, these elements will be accounted for in the empirical analysis.

[7] This assumption is meant to represent a more general situation in which the goods produced are difficult to store (e.g., food crops) and the money that can be gained by selling them can hardly be converted into savings (e.g., there are no banks for deposits and keeping it at home would be unsafe).

Assumption 4: $\underline{e} + g \geq rl + b$; $\underline{e} < b$

Assumptions 1 and 2 imply that each rich individual can lend at most to one other person and there will be credit rationing in equilibrium. Assumption 3 guarantees that the endowment of a rich individual (large enough to lend l to someone else) is not sufficient to undertake two projects himself. Finally, assumption 4 says that the income of a type $\underline{e}$ who obtains a loan, $\underline{e} + l + g$, is enough to both repay the loan inclusive of the interest and to transfer b to her parent, while the mere endowment $\underline{e}$ is not enough to support the parent.

All agents share the same preferences represented by the instantaneous utility function $u(\cdot)$, where $u'(\cdot) > 0$ and $u''(\cdot) \leq 0$, and they discount future utilities with a factor $\delta \leq 1$. No altruism is assumed.

The temporal structure of the model is as follows. In the first period of their lives, people receive their initial endowments from nature and they decide whether to lend (or borrow) l and who to lend to (borrow from). Without loss of generality, suppose that each borrower can apply for at most one loan at a time; if more than one borrower goes to the same lender, those who get rejected can go to another lender, and so on. Those individuals who have the necessary resources in the first period produce g (otherwise they stay with the initial endowment), they decide whether to transfer b to the old, they choose between repayment and default if they are borrowers (partial default is ruled out), and they consume the residual income. At the end of the first period each individual has a child who starts going through an analogous sequence of events. In the second and last period of their lives people are old and consume b if the young decide to support them, zero otherwise.[8] The temporal sequence of events for lenders and borrowers is summarized below.

Lender :	$\overline{e}$	lend	g	transfer	get repaid	consume	child	b
Borrower :	$\underline{e}$	borrow	g	transfer	repay	consume	child	b

3.1.1 Strategies

People live for two periods, but their strategic behavior is confined to the first period of their lives. In fact in period two they cannot make any choice but accept the next

[8]This simple structure abstracts from an obvious feature of real life, namely the fact that a parent can affect the likelihood of her child being a lender or a borrower by leaving bequests or transferring income to the child while she is alive. Bequests are ruled out in this model by the non-storability of the good, while inter-vivos transfers (or more simply the possibility that the parent be the lender for her own child) are assumed away by requiring that all income is consumed before the child is born. While these assumptions would not be necessary in a model in which people's income is subject to shocks throughout their lives rather than only at their birth, here they serve the purpose of conveying the idea that parents' help may not be enough throughout a child's life and that even the child of a rich parent may need loans from third parties at some point in time.

generation's decision to transfer or not. Let L (NL) indicate the action 'lend' ('not lend'), R (NR) indicate 'repay' ('not repay'), and T (NT) indicate 'transfer' ('not transfer'). Denoting with A_i individual i's action space, we have

$A_i = \{(L,T), (L,NT), (NL,T), (NL,NT)\}$ for any $i \in \overline{E}$

$A_i = \{(R,T), (R,NT), (NR,T), (NR,NT)\}$ for any $i \in \underline{E}$.

If the 'history' h_{t-1} denotes all players' actions up to period $t-1$ (included), and H_{t-1} is the set of all possible histories h_{t-1}, a pure strategy for player $i \in I_t$ will be a function $s_i(h_{t-1}) : H_{t-1} \rightarrow A_i$.

One further element that should be part of people's action space is the choice of *who* to lend to (or borrow from) and who to transfer to. This will be treated in the form of a matching between young lenders and borrowers, and between young and old individuals. Players will then be allowed to choose a matching rule.

3.1.2 Matching rules

A matching μ is a disjoint set of triples (i_t, j_t, k_{t-1}) in $\overline{E}_t \times \underline{E}_t \times N_{t-1}$, and represents the association of a young lender i_t with a young borrower j_t and an old individual k_{t-1} whom i_t has to support. An analogous definition can be given from the borrower's point of view. Let $\mu_1(i_t) = j_t$ indicate the young who is matched with player i_t, and $\mu_2(i_t) = k_{t-1}$ indicate the old who is matched with player i_t.

In principle any random individual from generation $t-1$ could be matched with someone from generation t. However, if we realistically assume that information on individuals' history of transfers is available at a lower cost to members of the same family, any efficient matching rule should have $\mu_2(i_t) = i_{t-1}$. In other words, information costs will be minimized if every young individual is matched with his or her own *parent* for the purpose of transferring b. In what follows I will therefore restrict my attention to rules satisfying this condition, and focus on the matching between lenders and borrowers.

3.1.3 Equilibrium concept

In the absence of legal enforcement methods, the stage game between a young lender, a young borrower and the old individual matched with each of them has only one Nash equilibrium: $s_i = (NL,\ NT)$ for $i \in \overline{E}$, $s_j = (NT,\ NR)$ for $j \in \underline{E}$. The borrower in fact has no incentive to repay given that the loan is taken once and for all and there is no collateral put up against it. Anticipating this, the lender will refuse to lend in the first place. Furthermore, no young individual has an incentive to transfer any income to the parent, since the parent cannot give any monetary reward in exchange.

The infinitely repeated version of this game, where two-period-lived players successively play the stage game, has instead a multiplicity of subgame perfect equilibria. I am interested in *cooperative* equilibria, i.e. equilibria in which all borrowers repay their loans and all young individuals support their parents. Following Abreu (1988), I will describe strategy profiles as rules specifying an initial path and punishments for any deviation from the initial path. I will use the following criteria to select the equilibria on which to concentrate.

First of all, the equilibrium must be *stationary*. Every generation faces the same problem of the previous generations, so that for a given history, any strategy that is optimal for an individual i_t must be optimal for an individual j_{t+1} of the same type.

Secondly, equilibrium strategies must be *minimal*, where by 'minimal' I mean that the punishment to player i_t for deviating from the equilibrium path does not extend beyond period $t+1$. This requirement is motivated by the following lemma.

Lemma 1 *Any outcome that can be achieved by extending the punishment for i_t's deviation to periods $t+k$, $t = 1, 2, ..., \infty$, $k > 1$, can be achieved by punishing in period $t+1$ only.*

Proof. All proofs are in Appendix A.

Contrary to models where the more severe the punishment, the more cooperation can be supported, the overlapping generation structure of this model is such that any punishment that extends beyond the next generation will lead to a loss of social surplus without improving the possibilities for cooperation.[9]

3.2 Social enforcement

In this section I show how the dynastic structure of the model can be used to support cooperation. Given that the emphasis is here on enforcement, I will momentarily abstract from the strategic choice of the matching rule and concentrate on equilibria where lenders randomize among potential borrowers in every period, so that all type-$\underline{e}$ individuals have the same probability $\alpha/(1-\alpha)$ of obtaining a loan. This kind of matching rule is referred to as one of 'uniform random matching'.

Definition 1 *A* ***uniform random matching*** *rule is one in which*

$$Prob\{\mu_1(i_t) = j_t\} = \alpha/(1-\alpha), \text{ for some } i_t \in \overline{E}_t \text{ , } \forall j_t \in \underline{E}_t, \forall t$$

and the matching in each stage is independent.

The key to enforcing cooperation is to design punishments that will make a unilateral deviation from the equilibrium path unprofitable for any single player after any history.

[9] In particular, Lemma 1 rules out 'unrelenting' strategies like "each young borrower plays (R, T) as long as every other young borrower has done so in the past; if somebody deviates, everybody from then on will play (NR, NT). Each young lender plays (L, T) as long as all borrowers have repaid in the past, and (NL, NT) otherwise". Unrelenting strategies like these have the strong limitation of not being Pareto efficient in a dynamic sense. (See Bernheim and Ray (1989) for 'Pareto-perfection' in finitely repeated games and Farrell and Maskin (1989) for 'renegotiation-proofness' in infinitely repeated games).

There are two main ways in which such punishments can be designed in this context, one 'direct' and one 'indirect'.

The *direct* punishment code requires that if a player deviates at time t, her child will refuse to transfer b in the following period. According to this scheme the child is responsible for punishing the parent not only when she has not transferred b to her own parent, but also when she has failed to repay or give a loan. The following proposition provides the conditions under which cooperation can be enforced through this punishment code.

Proposition 1 *For values of δ satisfying*

$$\delta \geq \frac{u(\underline{e}+l+g)-u(\underline{e}+g-rl-b)}{2\alpha[u(b)-u(0)]} \tag{1}$$

the following strategies constitute a subgame perfect equilibrium under uniform random matching:

$s_i = (L, T)$ for all $i \in \overline{E}$;

$s_j = (T, R)$ for all $j \in \underline{E}$ such that $j = \mu_1(i)$ for some $i \in \overline{E}$;

$s_j = (NT, NR)$ for all $j \in \underline{E}$ such that j is unmatched.

Punishment: if k_t deviates from s_k $(k = i, j)$, k_{t+1} will play NT instead of T in s_k.

If k_{t+1} fails to carry out the above punishment, he is subject to the same punishment code.

Proposition 1 says that, provided players are patient enough, the threat of punishing defectors by denying them support in old age is sufficient to enforce an equilibrium in which: (i) all type-$\overline{e}$ players lend to someone and transfer b to their parents; (ii) all type-$\underline{e}$ players who receive a loan repay and transfer b to their parents; (iii) all type-$\underline{e}$ players who do not receive a loan do not transfer (and obviously do not repay). It should be noticed that according to the above strategies no innocent player is held responsible for someone else's deviation, so unilateral deviations do not cause a general breakdown of cooperation.

A second, *indirect* punishment code requires that children only police deviations of their parents from the intergenerational social security scheme, and that sanctions for defections on the credit side are carried out in the credit market itself. In particular, I consider a simple punishment code: the child of a borrower who defaulted or of a type-$\overline{e}$ player who did not lend in period t is denied a loan in $t + 1$. Although there is no direct punishment to the parent for deviating, the above code constitutes an indirect penalty because, unless born rich, the child will not have enough resources to transfer b to the parent in $t + 1$. The following proposition gives the conditions under which this mechanism is sufficient to enforce cooperation.

Proposition 2 *For values of δ satisfying*

$$\delta \geq Max\left\{\frac{u(\underline{e}+l+g)-u(\underline{e}+g-rl-b)}{2\alpha[u(b)-u(0)]}, \frac{u(\underline{e}+l+g-b)-u(\underline{e}+g-rl-b)}{\alpha[u(b)-u(0)]}\right\} \tag{2}$$

the following strategies constitute a subgame perfect equilibrium under uniform random matching:

$s_i = (L, T)$ *for all* $i \in \overline{E}$;

$s_j = (T, R)$ *for all* $j \in \underline{E}$ *such that* $j = \mu_1(i)$ *for some* $i \in \overline{E}$;

$s_j = (NT, NR)$ *for all* $j \in \underline{E}$ *such that* j *is unmatched.*

Punishment: if i_t (j_t) *plays* NL (NR), i_{t+1} (j_{t+1}) *will be unmatched if they are* $\underline{e}$*-types. If* i_t (j_t) *plays* NT, i_{t+1} (j_{t+1}) *will play* NT.

Anyone who fails to carry out the above punishment will be subject to it.[10]

The first threshold value in (2) guarantees that unilateral deviations from the social security scheme are unprofitable; the second refers instead to deviations on the credit market. Notice that if the latter value is higher than the former, the indirect punishment scheme will require more patient players than the direct one to sustain cooperation. Intuitively, this happens because under the indirect scheme parents who defaulted on the credit market face a positive probability of being unpunished (their children will in fact still transfer b to them if they are born rich). As a consequence, their discount factor has to be relatively high for cooperation to be incentive-compatible. Compared to the direct mechanism, the scheme in proposition 2 has another limitation: out of equilibrium the punishment falls not only on the defector but also on her offspring (although for one generation only). On the other hand, the indirect scheme has a relatively attractive feature, in that it formalizes the notion that reputation in the credit market is passed from one generation to the other —a notion that is often emphasized in the empirical evidence on informal credit markets.[11]

Both the direct and the indirect punishment codes exploit the fact that the link between parents and children constitutes a form of *social collateral* on the credit market. They can therefore be thought of as *social enforcement* schemes. For simplicity, in what follows I will present results for the 'direct' scheme in proposition 1. Any result applies to the 'indirect' scheme in proposition 2, provided the threshold value for the discount factor is adjusted accordingly.

[10] As long as in any period the number of type-$\underline{e}$ players born from defectors is less than $(1-2\alpha)N$, lenders will have an incentive to carry out the punishment because they can find enough 'unspotted' borrowers to lend to. For those histories out of the equilibrium path in which the above number is greater than $(1-2\alpha)N$, a simple way to give lenders the incentive to punish and prevent them from lending 'in secret' is to specify that whoever receives a loan 'in secret' is not held accountable for repaying it. In this case anyone who borrowed from a defector would have the right not to repay a loan if he got one, so no lender would want to lend 'in secret'. Alternatively, the punishment to a lender who fails to punish could be that her children will be denied a loan. In this case, δ exceeding the second value in (2) is sufficient (although not necessary) to make punishing incentive-compatible for lenders.

[11] While allowing for a negative reputation effect on the credit market, this model does not hold children responsible for *repaying* their parents' debts. The latter phenomenon is documented for some developing countries, but incorporating it into the model would not add any insights to its conclusions.

3.3 Pareto efficient matching rules

The next step after analyzing the enforcement role of intergenerational links is to endogenize the choice of the matching rule. This section analyzes the effect of different matching rules on individuals' utilities and describes the set of (constrained) Pareto efficient rules under which cooperation can be sustained.

Every matching rule μ induces a probability p that a type-$\underline{e}$ individual will get a loan in equilibrium. All potential borrowers are *ex ante* equal, except for the fact that they may be born from a type-$\underline{e}$ or from a type-$\overline{e}$ parent. Matching rules can therefore discriminate among players according to the 'type' of their parent, so p can differ for children of lenders and of borrowers.[12] Furthermore, a rule should specify who is matched with whom for every possible realization of types, i.e. when all αn children of today's lenders are born with endowment $\overline{e}$, when only $\alpha n - 1$ of them are, etc.

Definition 2 *Let $\underline{p}$ ($\overline{p}$) denote the probability that a type-$\underline{e}$ individual born from a type-$\underline{e}$ (type-$\overline{e}$) obtains a loan. Let $\underline{p}|k$ ($\overline{p}|k$) denote the probability that a type-$\underline{e}$ born from a type-$\underline{e}$ (type-$\overline{e}$) obtains a loan, conditional on k children of previous period lenders being type-$\overline{e}$.*

If we indicate by $\pi(k)$ the probability that number k children of previous period lenders are born type-$\overline{e}$, we can write $\overline{p} = \sum_{k=0}^{\alpha n-1} \pi(k)(\overline{p}|k)$ and $\underline{p} = \sum_{k=0}^{\alpha n} \pi(k)(\underline{p}|k)$. Substituting the expression for $\pi(k)$ from combinatorial calculus we get:[13]

$$\overline{p} = \sum_{k=0}^{\alpha n-1} \frac{\binom{\alpha n-1}{k}\binom{n-\alpha n}{\alpha n-k}}{\binom{n-1}{\alpha n}} (\overline{p}|k) \tag{3}$$

$$\underline{p} = \sum_{k=0}^{\alpha n} \frac{\binom{\alpha n}{k}\binom{n-\alpha n-1}{\alpha n-k}}{\binom{n-1}{\alpha n}} (\underline{p}|k)\,. \tag{4}$$

Pareto efficient matching rules must induce probabilities $\underline{p}$ and $\overline{p}$ that maximize the expected lifetime utility of one type of individual, subject to the constraint of assuring the other type a given utility level, to the constraint that cooperation is incentive-compatible for both types, and to feasibility constraints on the number of available loans.[14] Letting

[12] I will only consider matching rules that treat individuals *within a given category* in the same way, i.e. all children of type-$\overline{e}$ parents face the same probability of getting a loan, and the same for the children of type-$\underline{e}$ parents.

[13] See Appendix A for the derivation of expressions (3) and (4).

[14] The analysis in this section follows a *positive* approach postulating that the rules of the game are chosen in each period by the generations who are alive and who know if they were born with a high or a low endowment. A different approach would be to ask the question: "what matching rule would be agreed upon by people before they knew their type (i.e. before they were born)?". The answer to this question is what is called a 'command optimum' and amounts to choosing the expected utility of the representative type as the social welfare function.

$\overline{U}_{\underline{e}}$ denote the minimum utility that type-$\underline{e}$ individuals must be guaranteed, the problem is to maximize with respect to $\overline{p}|k$ ($k = 0, 1, ..., \alpha n - 1$) and $\underline{p}|k$ ($k = 0, 1, ..., \alpha n$) the following function:

$$U_{\overline{e}}(\overline{p}) \equiv u(\overline{e} + g + rl - b) + \delta \left[\alpha u(b) + (1-\alpha)\left(\overline{p}u(b) + (1-\overline{p})u(0)\right)\right] \tag{5}$$

subject to:

$$U_{\underline{e}}(\underline{p}) \equiv u(\underline{e} + g - rl - b) + \delta \left[\alpha u(b) + (1-\alpha)\left(\underline{p}u(b) + (1-\underline{p})u(0)\right)\right] \geq \overline{U}_{\underline{e}} \tag{6}$$

$$u(\underline{e} + g - rl - b) + \delta \left[\alpha u(b) + (1-\alpha)\left(\underline{p}u(b) + (1-\underline{p})u(0)\right)\right] \geq u(\underline{e} + l + g) + \delta u(0) \tag{7}$$

$$u(\overline{e} + g + rl - b) + \delta \left[\alpha u(b) + (1-\alpha)\left(\overline{p}u(b) + (1-\overline{p})u(0)\right)\right] \geq u(\overline{e} + g + rl) + \delta u(0) \tag{8}$$

$$(\alpha n - k)(\overline{p}|k) + [(1-2\alpha)n + k](\underline{p}|k) = \alpha n, \quad k = 0, 1, ...\alpha n \tag{9}$$

where $\overline{p}$ and $\underline{p}$ are given by (3) and (4), respectively.

The objective function is the expected lifetime utility of a type-$\overline{e}$ individual. The first constraint requires that the utility of the other type exceeds a given threshold. Conditions (7) and (8) are the incentive compatibility constraints for types $\underline{e}$ and $\overline{e}$, respectively. Finally, the set of equations in (9) represent feasibility constraints: they require that, for any realization k of rich children born from lenders, the probabilities of getting a loan of the poor children of types $\underline{e}$ and $\overline{e}$, multiplied by their respective number, sum up to the total number of loans available, αn.

The (constrained) Pareto frontier is obtained by tracing the solutions to the above problem for all possible nonnegative values of $\overline{U}_{\underline{e}}$. The following proposition describes its features.

Proposition 3 [15] *The Pareto frontier is a line with slope $-(1-\alpha)/\alpha$ whose endpoints are the combinations $(U_{\overline{e}}(\overline{p}), U_{\underline{e}}(\underline{p}))$ obtained by substituting in (3) and (4) the following values:*

Best equilibrium for type-$\overline{e}$ players:

$\overline{p}|k = 1, \quad \underline{p}|k = \frac{k}{(1-2\alpha)n+k}, \ \forall k.$

Best equilibrium for type-$\underline{e}$ players:

$\overline{p}|k = Max\left\{0, \frac{(3\alpha-1)n-k}{\alpha n-k}\right\}, \quad \underline{p}|k = Min\left\{\frac{\alpha n}{(1-2\alpha)n+k}, 1\right\}, \forall k.$

[15] Proposition 3 holds for $\delta \geq Max\left\{\frac{u(\underline{e}+l+g)-u(\underline{e}+g-rl-b)}{(\alpha+\underline{p}-\alpha\underline{p})[u(b)-u(0)]}, \frac{u(\overline{e}+g+rl)-u(\overline{e}+g+rl-b)}{(\alpha+\overline{p}-\alpha\overline{p})[u(b)-u(0)]}\right\}$, where $\underline{p} = \sum_{k=0}^{\alpha n} \frac{\binom{\alpha n}{k}\binom{n-\alpha n-1}{\alpha n-k}}{\binom{n-1}{\alpha n}} \frac{k}{(1-2\alpha)n+k}$ and $\underline{p} = \sum_{k=0}^{\alpha n} \frac{\binom{\alpha n-1}{k}\binom{n-\alpha n}{\alpha n-k}}{\binom{n-1}{\alpha n}} Max\left\{0, \frac{(3\alpha-1)n-k}{\alpha n-k}\right\}$.

[Insert figure 1 here]

The Pareto frontier is depicted in figure 1. Point R corresponds to the equilibrium of proposition 1 in which $\overline{p}|k = \underline{p}|k = \alpha/(1-\alpha)$ due to the uniform random matching rule. Points above R are obtained by giving the children of types $\overline{e}$ probabilities $\overline{p}|k$ higher than $\alpha/(1-\alpha)$ for $k = \alpha n - 1$, then for $k = \alpha n - 1$ and $k = \alpha n - 2$, etc. up to the point $(U_{\underline{e}}^{min}, U_{\overline{e}}^{max})$ where all type-$\underline{e}$ children of types $\overline{e}$ are *guaranteed* a loan with probability one, whatever their number is. Children of type-$\underline{e}$ players are in this case allocated only the *residual* loans. Similarly, points below R are obtained by giving the children of type-$\underline{e}$ parents probabilities $\underline{p}|k$ higher than $\alpha/(1-\alpha)$ up to the point $(U_{\underline{e}}^{max}, U_{\overline{e}}^{min})$ where all type-$\underline{e}$ children of types $\underline{e}$ have absolute priority on the allocation of loans for all values of k. Their probability of getting a loan may or may not be one, however, depending on the relative size of k and $(3\alpha - 1)n$: there are in fact $n - 2\alpha n + k$ 'poor' children of type-$\underline{e}$ individuals and a total of αN loans available. When the existing loans are not enough to satisfy all borrowers born from types $\underline{e}$, the probability of getting a loan for children of lenders is zero, as indicated in proposition 3.

3.4 Reciprocity among lenders

From a normative point of view, the choice of a point on the Pareto frontier depends on the particular social welfare function adopted. From a positive point of view, however, there are reasons to believe that the best equilibrium for types $\overline{e}$ will be selected, or the next closest point compatible with incentive constraints if the discount rate is not high enough. Given the relative scarcity of lenders compared to borrowers ($\alpha < 1/2$), the former will generally have more power in the choice of the matching rule, i.e. they will be able to choose *whom* they want to lend to. By choosing whom they lend to, lenders will determine the probabilities $\overline{p}|k$ and $\underline{p}|k$, hence their own expected utilities.

Once this possibility is taken into account, it will be suboptimal for lenders to *randomize* among potential borrowers and pick point R on the Pareto frontier (figure 1). If they did, their children would face a probability $1 - 2\alpha$ of needing a loan and not getting it, in which case a lender would be left with the unpleasant outcome of starvation in old age despite the abundance of resources in the first period of her life. Contrast this situation with the following strategy for lenders:

> "Screen all loan applicants: if any of them is the child of a type-$\overline{e}$, give the loan to him or her; if more than one applicant satisfies this requirement, randomize among these and disregard the others; if all the type-$\underline{e}$ children of lenders have obtained a loan, randomize among other borrowers."

If all lenders play this strategy, they can be virtually sure that their children will have the resources necessary to undertake production and support them, i.e. that $\overline{p}|k = 1$,

$\forall k$. This corresponds to the best equilibrium for types $\overline{e}$ in proposition 3, i.e. to point $(U_{\underline{e}}^{min}, U_{\overline{e}}^{max})$ on the Pareto frontier in figure 1.

I refer to the above matching rule as one of *reciprocity among lenders* because by lending to the child of an old lender, a type-$\overline{e}$ individual creates an obligation for somebody else to reciprocate in the future and grant preferential treatment to her child in the assignment of loans. In other words, a matching rule with reciprocity among lenders guarantees that at any time t all type-$\underline{e}$ children of time $t-1$ lenders will be matched with some lender with certainty, as stated in the following definition.

Definition 3 *A* ***matching with reciprocity among lenders*** *is one in which*

$$Prob\{\mu_1(j_t) = i_t\} = 1 \text{ for some } i_t \in \overline{E}_t,\ \forall j_t \in \underline{E}_t | j_{t-1} \in \overline{E}_{t-1},\ \forall t.$$

This rule has two interesting features. The first is that it goes beyond the notion of 'bilateral' reciprocity, according to which the same person who receives something today is expected to give something back to the original partner in the future. In this model any young lender at a given time has an interest in reciprocating a loan given *to somebody else* in the past, because in this way she enters a pool of creditors who help each other by helping each other's children.

The second feature is that even if the distribution of endowments is randomly picked at the beginning of each period and bequests are not allowed, initial inequalities tend to persist for one generation because, due to reciprocity, credit market imperfections act differentially on the children of rich and poor people. Although the children of lenders cannot choose to be lenders themselves unless nature decides so, they are at least guaranteed loans and hence a positive income stream.

3.5 Endogenous interest rates: the 'price' of reciprocity

One strong assumption in the above analysis was that both the loan size l and the interest rate r were exogenously fixed. This is extremely unlikely, especially in a setting in which there is excess demand for credit and lenders have some monopoly power. In this section I retain the assumption of a fixed loan size l, but I allow lenders to choose the interest rate r as well as the matching rule. Although there is no purpose in using the interest rate to screen potential borrowers given that all $\underline{e}$-individuals are identical, this extension has some relevant implications.

Let us start from the benchmark case of uniform random matching and consider the choice of r in isolation. In this case lenders will set r so as to maximize their expected utility (5) subject to the borrowers' incentive compatibility constraint (7), with $\overline{p} = \underline{p} = \frac{\alpha}{1-\alpha}$. This constraint will be binding in equilibrium, so the optimal interest rate under uniform random matching, r_u, must solve:

$$u(\underline{e} + g - r_u l - b) = u(\underline{e} + l + g) - 2\alpha\delta[u(b) - u(0)] \tag{10}$$

When both the matching rule and the interest rates can be chosen, lenders face a trade-off. On the one hand, by choosing a rule that increases $\overline{p}$ compared to the random matching case they can obtain a higher expected utility. On the other hand, the resulting decrease in $\underline{p}$ may induce a violation of the incentive compatibility constraint, hence require a reduction of the interest rate and therefore of the lenders' expected utility. The following proposition describes the solution to this constrained optimization problem.

Proposition 4 [16] *When r is endogenous, the best subgame perfect equilibrium for type-$\overline{e}$ players is one in which*

$$\overline{p}^* = 1, \quad \underline{p}^* = \sum_{k=0}^{\alpha n} \frac{\binom{\alpha n}{k}\binom{n-\alpha n-1}{\alpha n-k}}{\binom{n-1}{\alpha n}} \frac{k}{(1-2\alpha)n+k} \tag{11}$$

and the optimal interest rate, r^*, solves:

$$u(\underline{e}+g-r^*l-b) = u(\underline{e}+l+g) - \delta(\alpha+\underline{p}^*-\alpha\underline{p}^*)[u(b)-u(0)] \tag{12}$$

Corollary 1 $r^* < r_u$

Proposition 4 says that lenders will choose a system of matching with reciprocity and increase the interest rate up to the point where borrowers are indifferent between cooperating and defaulting. In other words, the possibility of increasing current profits by charging higher interest rates does not make 'reciprocal arrangements' less attractive for lenders. On the contrary, the equilibrium of proposition 4 is a corner solution in that $\overline{p}$ is set equal to 1 and r is only used as a 'secondary' channel to increase the value of the objective function. Intuitively, this is due to the fact that any increase in $\overline{p}$ induces a proportional decrease in $\underline{p}$ (specifically, $\Delta\underline{p} = -\frac{1-\alpha}{\alpha}\Delta\overline{p}$), while due to the concavity of $u(\cdot)$ every marginal increase in r will widen the gap between $u^{'}(\overline{e}+g+rl-b)$ and $u^{'}(\underline{e}+g-rl-b)$ and lower the left hand side of the incentive compatibility constraint more than proportionately.

Finally, the corollary to proposition 4 says that, *ceteris paribus*, the equilibrium interest rate under reciprocity will be lower than that under uniform random matching. This is essentially due to the fact that in a system of matching with reciprocity among lenders, borrowers have less to gain from repaying their loans because there is a higher chance that their children will not get a loan. In order to satisfy the incentive compatibility constraint lenders must therefore make the decision to repay less costly in the present, i.e. set a lower r. Loosely speaking, the interest forgone by the lenders can be thought of as the 'price' of reciprocity, i.e. the monetary return that lenders are willing to give up in order to be assured that their children will be able to borrow if they need to.

[16] Proposition 4 holds for $\delta \geq \frac{u(\underline{e}+l+g)-u(\underline{e}+g-rl-b)}{(\alpha+\underline{p}^*-\alpha\underline{p}^*)[u(b)-u(0)]}$, where $\underline{p}^*$ is given by (11).

3.6 Interpretation and extensions

Two features of the above model make it a model of transactions among kinsmen as opposed to anonymous individuals. The first is that the analysis requires that borrowers' and lenders' actions are publicly observable: this confines its validity to a closed-knit community in which everybody can have access to *information* on the other members. The second is that the model relies on *genealogical ties*, in the sense that the reciprocity mechanism (and the social enforcement scheme described in proposition 2) can only work if parents' actions can fall upon their children, for good or for bad. Notice that there are other possible models within which reciprocal arrangements can be supported, e.g. with sanctions unrelated to credit transactions (a generalization of interlinked contracts, so to speak), or also through self-enforcing schemes within an individual's life. This paper has focused on the intergenerational aspect of reciprocity in the theoretical framework, and will in part deal with the other potential aspects in the empirical section.

One issue that has not been addressed in the above model is that of transactions among lenders and borrowers who do not belong to the same kinship group. This can be easily addressed by assuming that in addition to the kinship group $\{N_t\}_{t=1,2,..\infty}$ there is a set $\{M_t\}_{t=1,2,..\infty}$ of individuals who do not belong to the local community (think of them as 'migrants'), but who have the same typology and the same production possibilities. In particular, let the proportion of type-$\overline{e}$ individuals among migrants be the same as among local kinsmen, i.e. $\alpha < 1/2$. It seems reasonable to assume that information flows more freely within a given group —at least within $\{N_t\}$— than between groups. For example, suppose that any individual belonging to N_t has to pay a cost c to know the 'family history' and repayment records of someone belonging to M_t, and that members of M_t have to pay a cost d to obtain the analogous information on anyone else (including other individuals in M_t). In this case, any efficient matching rule that supports cooperation and minimizes information costs should be such that $\mu_1(i_t) \in N_t(M_t)$ for $i_t \in N_t(M_t)$, i.e. every lender should be matched with a borrower from the same group. Furthermore, *ceteris paribus* the scope for reciprocal arrangements is greater among kinsmen (members of $\{N_t\}$) than among migrants, because it is relatively more costly for the latter to find out who is born from whom and who previous period lenders lent to.[17]

A limitation of the model which is not corrected by the above extension is that the *size* of the kinship group in every period, n_t, is exogenous. The optimal size of the kinship groups could be derived endogenously by modelling monitoring and information costs with more accuracy, but this goes beyond the scope of the present analysis.

A second limiting feature of the model is its two-period structure, which constrains all action to take place among generations, in the sense that any future cost or benefit that parents may have from their behavior on the credit market, they have indirectly through

[17] Alternatively, the cost of lending to migrants could be modelled by introducing a positive probability that they will move somewhere else in the future (hence not repay or not reciprocate past loans). This would increase the value of the discount rate required to lend to migrants and substantially lead to the conclusion that players will prefer to transact *within* groups rather than between groups.

their children. In real life individuals live many periods before they become dependent on their offspring: they are therefore concerned about their *own* loss of reputation if they do not repay a loan, as well as with the reciprocation they can get *for themselves* if they grant a loan to someone at concessional terms. Extending the intuition of the two-period model to a multi-period setting, one can expect the same sort of effects to apply in the early stages of an individual's life as among generations.

A possible extension for the multi-period version of the model could be to model uncertainty in income streams as a stochastic process, and to derive optimal insurance arrangements along the lines of Coate and Ravallion (1993) or Thomas and Worrall (1994). The paper has followed a different approach in an attempt to keep things simple and to focus on the intergenerational structure of kinship.

Finally, if one introduced different types of borrowers and let the size of the loan, as well as the interest rate, to be determined in equilibrium, an intertemporal pattern similar to that described by Ghosh and Ray (1996) could be expected to arise for borrowers on whom limited information is available.

3.7 Empirical implications

The model presented in this section has several empirical implications. Some of the implications of the two-period version can be investigated directly using the available data:

(*i*) *intergenerational links and enforcement*: borrowers who have children should be less likely to default on their loans, *ceteris paribus*, because in addition to their own reputation they destroy the reputation of the children on whom they will depend in the future;

(*ii*) *reciprocity and sources of credit*: children whose parents do not belong to the local community (e.g. migrants) should have less access to reciprocal loans for two reasons. First, members of the local kinship groups have no past loans to reciprocate, since the parents of individuals who have migrated from another area by definition were not lending to local individuals in the past. Second, migrants' own kinsmen have no incentive to lend to them because it is less likely that their children will get reciprocation from somebody who is far away. We therefore expect migrants to borrow relatively more from institutional lenders or professional moneylenders and less from kinsmen;[18]

(*iii*) *reciprocity and loan conditions*: other things being equal, interest rates should be lower on 'reciprocal' loans than on 'market' loans (see the corollary to proposition 4).

The above implications relate to the effects of genealogical ties or kin membership on repayment or on potential sources and conditions of credit. One may also want to

[18] The prediction that migrants will be offered less credit, at given interest rates, would also be yielded by a purely informational model in which it is harder for informal lenders to assess strangers' creditworthiness. In the empirical analysis I will try to discriminate between this and the reciprocity hypothesis.

test the *effectiveness* of the reciprocity mechanism, namely whether children of people who have given loans to others in the past do indeed get easier access to credit in the present. Testing this prediction directly would require panel data to span a generation's time, something that is currently unavailable for most developing countries. The only variant of this prediction that can be tested with the existing short panels is closer to the multi-period version of the model and is the following:

(*iv*) *past contributions and current access to credit*: if reciprocity is effective, individuals who have lent to others in past years should have access to more credit in the present, *ceteris paribus*. This effect should be observed for loans from kinsmen but not from institutional sources, and should apply to local kinsmen but not to migrants (see point (*ii*)).

4 The data: a descriptive analysis

The above predictions will be tested using household-level data from the Ghana Living Standard Surveys (GLSS) of 1987/88 and 1988/89. The GLSS contains information on loans contracted by household members during the year, on loans, remittances or other transfers from household members to non-household members, on ethnicity and migration status of the respondent, and on other individual and household characteristics.

The sample of households interviewed in both rounds of the survey consists of 1,215 households, of which 578 live in rural areas, 268 in semi-urban (between 1,500 and 5,000 inhabitants), and 369 in urban areas (more than 5,000 inhabitants). The data was collected in clusters of 16 or 32 households. The numerous tribal groups and corresponding languages listed in the survey have been aggregated into four major categories: Akan (50 percent of the sampled households), Ewe (16 percent), Ga-Adangbe (8 percent), and Northern (26 percent). Akans are therefore the dominant ethnicity; Gas and Adangbe live mainly in the region of the capital, Ewes in the Eastern and Volta region, and the remaining tribes (in part muslim) in the North.

Credit transactions are relatively common among the sampled households. Of the 1,215 households interviewed, 32.5 percent borrowed in the first year, 34.3 in the second, and 18.2 in both; similarly, 29.5 percent lent in the first year, 34.8 in the second, and 16.2 in both years. Approximately half of these households (14.2 percent in the first year and 17.4 percent in the second) were participating on both sides of the market, suggesting a possible use of loans for inter-household transfers. Indeed, when asked what the main reason for borrowing was, only 12.4 and 14.5 percent of the loans were described as related to farm or to business and trade, respectively, 1.6 percent to education, and 71.5 percent to 'other' purposes, among which are consumption and transfers to friends or relatives.[19]

A first step towards assessing the role of kinship groups in credit transactions is to

[19] These figures, as well as all the figures in tables 1 and 2, refer to the second year of the survey.

examine who the partners in these transactions are. As is usually the case in surveys on credit activity, the respondents did not reveal the *identity* of their lenders, but only the broad category to which the lender belonged. Due to this intrinsic limitation of the data it will be impossible to test the model by directly matching lenders and borrowers belonging to the same kinship group. The closest approximation is to consider relatives and private individuals who have a positive probability of being members of the same kinship group as the borrower.

[Insert Table 1 here]

As reported in table 1, the main **sources** of credit for surveyed households are private individuals not professionally involved in the lending business. The two categories of 'relative' and 'private' (non-moneylender) together account for about 83 percent of the total number of loans, banks and cooperatives together for 4.5 percent, while professional moneylenders for only 3 percent. When these numbers are weighted by the amount of each loan, the joint contribution of banks and cooperatives increases to 20 percent while that of moneylenders remains around 3 percent. The most notable fact from table 1 is that, although the size of individual loans from relatives and private individuals is below the sample average of 11,476 Ghanaian Cedis, these two sources jointly cover more than 65 percent of the total amount of loans. This confirms the general finding from most studies of informal credit in Africa, that the vast majority of the transactions occur between relatives, friends and neighbors (see e.g., Shipton 1992, Aryeetey and Udry 1995). In particular, *the prevalence of relatives and other private sources of credit is consistent with the hypothesis that most loans may come from lenders who belong to the same kinship group as the borrower.* Whether this is a plausible interpretation will be explored in the econometric section.

[Insert Table 2 here]

A brief analysis of the **conditions** attached to loans depending on their source can give further insights. Column one of table 2 clearly shows that the profit motive is not at the heart of the decision to supply credit from relatives or other private individuals: when asked whether the loan carried an interest, the respondents answered "yes" only for 4.5 percent of the loans given by relatives and 4 percent of those given by other privates, while the corresponding figures for moneylenders and banks were, respectively, 52 and 90.9 percent.

In order to account for the possibility that these unusually low figures were due to misperception on behalf of the respondents, I constructed a broader measure using a different section of the questionnaire. Respondents were asked how much the original loan was and how much they should have paid, were the loan to be repaid at the date of the interview. There were instances in which the same individual who had answered "no" to the interest rate question reported that a larger amount than that originally borrowed should be repaid: the 'adjusted' data appears in the second column of table 2. Even after the adjustment, the percentage of loans bearing a positive interest rate remains below 5.5 for relatives and private individuals, suggesting that some other form of compensation must be expected from the lender, consistently with our reciprocity story.[20]

Column 3 of table 2 reports the average annual interest rate on loans from the different sources, conditional on the interest rate being non-zero and weighted by the amount of each loan.[21] It is surprising that the interest rates from relatives and privates are now substantially higher than those from bank, cooperatives and even moneylenders. It should be observed, however, that these are annualized figures, and that the duration of the loans is much shorter for the first two sources than for the others: 18 percent of the loans from relatives and privates are one-month loans, and cumulatively 45 and 48 percent of the loans from these two sources, respectively, are four months or less. On the other hand, banks tend to give one-year loans (32.2 percent of their loans) and professional moneylenders three-months loans (17.4 percent of their loans).

A common practice in African rural settings is to bring a gift together with the repayment of an informal loan, which could partially substitute for the absence or low level of the interest rates explicitly set. However, when asked whether "additional goods or services should be provided together with the repayment", most respondents answered "no". Column 4 of table 2 shows that less than 2 percent of the loans from relatives or other private individuals had this feature. This also seems to limit the scope for an analysis of *interlinking* with this data (Bardhan and Rudra 1978), although it does not imply that interlinking does not occur: money received as part of an interlinked transaction might not be reported as a 'loan' in the first place.

Finally, the last two columns of table 2 explore the guarantees of repayment incorporated in the various loans. In only 7.3 and 12.7 percent of the cases were households who borrowed from relatives or other private individuals required to make regular payments, as compared to 48 percent for loans from moneylenders and 37 percent for bank loans. Moreover, the pledge of collateral against default does not seem to be used by lenders in this sample: only banks make a significant use of collateral clauses, which are practically non-existent on other loans. Again, the absence of standard enforcement mechanisms leaves room for an enforcement role of kinship groups.

Overall, both the low or zero interest rates and the absence of formal guarantees on loans from relatives and private individuals are consistent with our story of reciprocity

[20] The figures for bank loans and loans from private moneylenders seem quite low too. It cannot be excluded that misreporting or measurement error are responsible for part of the unusually low values. However, there are at least two relevant considerations to be made. First, in some cases collateral on these loans was provided in the form of land which was to be held by the creditor until the loan would be repaid, yielding substantial returns. Second, in a study of informal finance in Ghana using different data Aryeetey (1994) reports that it is common among Ghanaian moneylenders to see the interest rate as determined not only by market forces but also by tradition, or by the 'need' of the borrower.

[21] Although it is not specified in the questionnaire, the figures should be considered *nominal* interest rates. The annual inflation rate in the second year of the survey was 24.4 percent. (Source: CPI figures from the GLSS documentation.)

and enforcement within kinship groups.

5 Econometric analysis

This section relies on multivariate analysis to examine the main predictions of the model regarding enforcement and reciprocity. Ideally, one would want to follow the behavior of members of the same kin over various generations, to test directly the intergenerational mechanisms outlined by the model. Unfortunately, data of this type is unavailable for virtually every developing country, as well as for many industrialized countries. The approach followed here therefore will be to gather a number of pieces of evidence consistent with the model, and to document why indeed we may view them as indirect confirmation of the theoretical analysis.

In what follows, the 'social enforcement' role of the kin is assessed directly by testing that default rates are lower for borrowers who have children. As for reciprocity, two strategies are followed. The first is to test that the *potential* for reciprocal transactions affects the sources from which people can borrow and the terms of the loan. In particular, I test if migrants borrow less from their kinsmen and if they are more likely to pay an interest on their loans. The second approach followed is to test if reciprocity is *effective*, namely if past contributions in the form of loans or remittances are associated with higher access to credit from kinsmen in the present. Definitions and summary statistics for all variables used in the regressions are reported in appendix B.

5.1 Default and family structure

A first implication of the theoretical framework was that, *ceteris paribus*, borrowers who have children should be less likely to default on their loans. Table 3 reports probit estimates of the probability of defaulting for those households that had borrowed in the first year of the survey.

[Insert Table 3 here]

The dependent variable is equal to one if the household has defaulted on some loan and zero otherwise. The explanatory variables include household controls such as the age, education, urban and migration status of the head, plus two measures of resource availability: household labor income and the value of the crops lost during the year due to unexpected shocks.[22] In addition, two variables are included to capture the enforcement role of kinship groups.

The first is a dummy taking the value 1 if the head of the household has children, and zero otherwise. Consistently with the prediction of the theory, this variable has a negative coefficient, and it is significant at the 1 percent level. Borrowers who have

[22] The sex of the household head was dropped from the explanatory variables because there were no female-headed households among the defaulters.

children may indeed be discouraged from defaulting by the stigma that would fall on their offspring or by the fear of direct sanctions from their children.[23] An alternative interpretation of this result is that having children may proxy more generally for greater availability of resources. Notice first of all that household income is included among the regressors, which partially alleviates the above concern. Of course, to the extent that some unobservable component of permanent income which is not picked up by *current* income is correlated with having children, the problem remains. Something can be said in favor of the interpretation put forward here, however. If one looks at the means of variables which would be expected to be correlated with permanent income for households with and without children, they are basically never statistically different: the tests for age, sex, education, wealth, and ability to sell land have p-values that range from .36 to .87.

The second proxy for 'social enforcement' is a dummy equal to one if the head of the household can autonomously decide to sell land. According to traditional Akan beliefs, land is sacred and belongs to an individual as well as to the ancestors and descendants. Therefore, it can temporarily be given away but cannot be alienated or sold on the market. When asked whether they were free to sell their land, only 13 percent of the surveyed households answered affirmatively: the rest was either unable to or had to ask for permission from other family members and/or village elders. In his work on property rights in Ghana, Besley (1995) finds that the evolution of land property rights from communal systems to individual rights is associated to a weakening of customary authority. The rationale for using the variable "Can sell land" as a proxy for enforcement is that those who are subject to the authority of senior kinship members in matters of land are probably more vulnerable to social sanctions in case of default. As can be seen from table 3, borrowers who are free to dispose of their land are also more likely to default, and this association is statistically significant at the 1 percent level.

5.2 Migration status and loan sources

A second prediction of the model was that, *ceteris paribus*, migrants would have relatively less access to credit from kinsmen than local borrowers. The distinction between migrants and non-migrants is helpful in that the former are by definition not born into the locally dominant kinship group while the latter have a positive probability of belonging to it.[24] Table 4 reports multinomial logit estimates of the probability to borrow from different sources for households who borrowed in the second year of the survey.

[23] Notice that the coefficient on the *number* of children is instead positive: nothing in the theory says that the expected cost of default should be higher the more children one has; on the contrary, it is more likely that at least one of these children will not need loans and will be able to support the parent even if the latter has defaulted. After controlling for income, the only other effect that this variable may capture is the extent of 'dependency' of household members on a given set of resources.

[24] See Collier and Garg (1995) for a similar assessment of kin membership in the context of labor markets.

The sources listed are relatives, private non-moneylenders, professional moneylenders and banks; cooperatives and residual lenders are kept as the reference category. The key result to look for in table 4 is that the migration status of the head will be a significant determinant of the type of lender to which the household has access.

[Insert Table 4 here]

Before interpreting the results a *caveat* is in order. An obvious difference between migrants and non-migrants is that local lenders are less likely to have interacted with the former, and that information on their creditworthiness may be harder to obtain for some categories of lenders than for others. In order to control for this effect, which has a lot to do with *information* and little with reciprocity, the number of years the household head has lived in the current place is introduced among the regressors. The longer this time, the more likely it is that even a migrant becomes known to local lenders, hence that the purely 'informational discrimination' is swept away.[25] Provided the years of residence effectively control for information effects, the residual explanatory power left for the migrant dummy should be attributable to the kinship channel.

As can be seen from table 4, after controlling for information and other household characteristics, migrants are less likely to borrow from relatives and private non-moneylenders than from other sources, and this association is statistically significant at the 1 percent level. This fact is consistent with the theory presented in this paper and suggests that the distinction between migrants and non-migrants can be crucial when assessing the scope for reciprocal loans.

Notice also that female-headed households rely on loans from relatives and other private individuals and are basically unable to borrow from professional moneylenders, suggesting that the availability of intra-kin loans may have important implications for poverty and income distribution.

5.3 Migration status and interest rates

Another prediction of the model was that interest rates would be lower on 'reciprocal' loans than on 'market' loans. We have already seen in table 2 that almost 95 percent of the loans from relative and private non-moneylenders (i.e., potential kinsmen) carry no interest at all, as opposed to loans from professional lenders. A sharper prediction can be derived drawing on the results of the previous section. If migrants are less likely to receive reciprocal loans, and if interest rates are lower on reciprocal loans than on market loans, *ceteris paribus* one should observe higher interest rates on loans contracted by migrants. Furthermore, this discrepancy should not be observed on loans from 'institutional' sources, on which the reciprocal motive is absent.

[25] Notice that, consistently with the empirical evidence for most developing countries, professional moneylenders place a substantial weight on information about their borrowers. According to the estimates in table 4, *ceteris paribus*, the shorter the time somebody has lived in a place, the less likely this person is to borrow from local moneylenders.

This prediction is tested by estimating a probit model in which the dependent variable is equal to one if at least half of the loans contracted by the household (in value) carry a positive interest rate, and zero otherwise.[26] The explanatory variables include household controls and a dummy for the migration status of the head. The model is estimated separately for loans from relatives and private non-moneylenders and loans from banks, cooperatives and professional moneylenders. Our theory predicts that the migration dummy should have a positive coefficient, and that it should be significant in the former but not in the latter group of loans. Table 5 reports the estimates.

[Insert Table 5 here]

Notice that this prediction is also consistent with a model in which there is imperfect information and the interest rate on loans to migrants incorporates a premium for the lack of information on their creditworthiness. As in the previous regression, I try to separate the reciprocal motive from the informational one by controlling for the years of residence in the local community.

Table 5 shows that for loans from potential kinsmen, being a migrant increases the probability of having to make interest payments by 4 percentage points on the margin (although the size of the coefficient is quite small, it is statistically significant at conventional levels). As predicted by the theory, migration status has no significant effect on loans from non-kin, suggesting that the reason migrants are more likely to pay interests on the loans from relatives and private non-moneylenders may not lie in some intrinsic characteristic of migrants themselves but in the lack of 'reciprocal connections' with the kinship group.

5.4 Reciprocation of past loans

The last step is to test the *effectiveness* of reciprocity by asking whether individuals who have lent to others in the past have access to more credit in the present. This is done by estimating the reduced form of a system of demand and supply of loans, which takes the following form:

$$L_i = \alpha + \beta X_i + \gamma_1 E_i + \gamma_2 R_i + \gamma_3 M_i + \delta_1 (E_i M_i) + \delta_2 (R_i M_i) + \epsilon_i \tag{13}$$

where the subscript i refers to the household; L_i is the amount borrowed in equilibrium; X_i is a vector of household controls; E_i is a vector of proxies for the enforceability of the loan; R_i is a vector of past 'reciprocal contributions' made by the household; M_i is a

[26] Given that most loans in the sample do not carry any interest, the appropriate question to ask is not whether the value of the interest rate is higher for migrants, but whether the *probability* that a loan carries a positive interest rate is significantly higher when the borrower is a migrant. Notice also that the size of the loan does not appear among the explanatory variables because what is being estimated is an equilibrium relationship, i.e. the reduced form of a system of demand and supply of credit that has been solved out for the quantity of credit.

dummy equal to 1 if the household head is a migrant, and it is subsequently interacted with enforcement and reciprocity variables; ϵ_i is the error term; finally, α is a vector if constants (cluster fixed effects are included); β, γ's and δ's are vectors of coefficients.[27]

The dependent variable takes a value of zero for those households that did not borrow during the survey year, and a positive value for those that contracted one or more loans. Therefore, in assessing the impact of a change in an explanatory variable on the dependent variable, one is actually considering two effects: the impact on the probability that the household will borrow a positive amount, and the impact on the entity of the sum borrowed. Tobit estimates will be reported as a synthetic way to combine the two effects in a single parameter.[28]

The theoretical model developed in this paper yields the following predictions on the sign of the coefficients: $\gamma_1 > 0$, $\gamma_2 > 0$ —social enforcement and reciprocity increase people's access to credit—, and $\delta_1 < 0$, $\delta_2 < 0$ —social enforcement and reciprocity work for members of the local kinship group but not for migrants. Table 6 reports coefficient estimates for the variables of interest separately for rural and urban households.[29]

[Insert Table 6 here]

The first test on the effectiveness of *social enforcement* regards past default. According to the model, households who have defaulted on past loans should receive less credit from their kinsmen in the present, and this should hold for local borrowers more than for outsiders (who are less susceptible to social punishment). The results in table 6 are consistent with this prediction. In the urban sample, local households who defaulted in the previous year get less credit in the current year (the coefficient on "Default_1" is negative and significant at the 1 percent level), while migrants do not seem to be affected by past credit history (the sum of the coefficient on "Defaulted_1" and on the following interaction term is not statistically different from zero). As for the rural sample, the same default variable could not be used due to the absence of defaulters among migrants (the interaction term would have dropped out of the regression). Past credit history is therefore proxied by a dummy for households that contracted and repaid a loan in the previous year. The sign on this variable is positive, as expected, but its coefficient is not statistically significant. This should not be surprising given that past repayment is a less precise measure of creditworthiness than past default: some households are in fact recorded as 'not having repaid' simply because the terms of their loans have not expired,

[27] Together with household controls, X includes production shocks and the income of the borrower. Given the unavailability of information on the lender's income, the estimates are going to be affected by omitted variable bias. All variables (including the dependent variable) refer to the second year of the survey, except for some lagged variables labeled with the suffix '_1' for which data from the first year are used.

[28] Simple probit estimates have been obtained as well —although they are not reported in the tables for expositional convenience— and they lead to the same qualitative conclusions.

[29] The regression is controlled for a number of variables, including cluster dummies, that are listed in the footnote to the table. The full regression output is available from the author upon request.

but they are not 'defaulters' and therefore do not get less credit.

A second variable used to assess the enforcement role of kinship groups is the amount of money lost by household members in the previous year, for example gambling. To the extent that this signals 'irresponsible' behavior, it can be thought to have a negative effect on the perceived creditworthiness of the household, hence on the amount it can borrow. Table 6 shows that local households who lost money in the past have less access to credit from kinsmen in the present, while migrants do not (the sum of the coefficient on the loss variable and on the interaction is not statistically different from zero). The results are stronger for the urban than for the rural sample, but in both cases they are consistent with the model.

The effectiveness of *reciprocity* among kinsmen is tested by asking whether local households who have contributed resources to the community in the past have more access to credit in the present, and if this effect holds for migrants too. The first type of contribution considered is past loans. The variable 'Lent to others_1' in table 6 measures the amount of money lent by household members to non-household members in the previous year.[30] For the rural sample, its coefficient is positive and significant at the 1 percent level for local households but not for migrants (the sum of the coefficient on 'Lent to others_1' and on the interacted term is not statistically different from zero). This seems to support the hypothesis that households belonging to the local network who have given loans in the past get reciprocated in the present, exactly as predicted by our model.

For the urban sample the coefficients on this variable and on the interaction term have the expected signs, but they are not significant at conventional levels. One possible explanation is that different forms of contributions take the place of what in the model is past loans. In particular, the bulk of transfers from households living in urban and semi-urban areas take the form of *remittances*. It can be hypothesized that for these households it is past remittances, in addition to past loans to others, that are reciprocated in the present in the form of credit from kinsmen. In order to test this hypothesis, the amount of remittances sent by the household to the relatives of the head ('lineage') or to the relatives of the head's spouse ('in-laws') is included among the regressors at the bottom of table 6. While the former have a positive effect on access to credit for urban local households, the latter have a negative effect, both coefficients being significant at the 1 percent level. As expected, the effect of past remittances for migrant households is not significantly different from zero. Also, neither variable turns out to be significant for rural households, which is not surprising given that the latter do not generally send remittances. The opposite signs on the coefficients for the urban regression can be interpreted by observing that in matrilineal kinship systems (e.g., the Akans of Ghana) the authority over children and the control over their labor belong to the family of the

[30] To have a rigorous test of our hypothesis, only loans to kinsmen should be included. However, no information is available on the recipients of these loans, so the total amount lent to private individuals outside the household must be taken as a proxy of the amount lent to members of one's kinship group.

mother. Expected reciprocation by these children to the different branches of the family will therefore be asymmetric.[31]

None of the reciprocity variables had significant explanatory power in a similar regression (not reported) where the dependent variable was the amount borrowed from banks, cooperatives or moneylenders, consistently with the theory. It seems therefore that we can conclude that reciprocity does play a role in determining people's access to credit from their kinsmen, although not uniquely through the lending channel and not indiscriminately regardless of the genealogical ties of the recipient.

Overall, the results from table 6 do not allow to reject the hypothesis that *social enforcement and reciprocity are important for determining people's access to credit when the lenders are relatives or private non-moneylenders*. Furthermore, the comparison between urban and rural areas suggests that kinship networks are at least as effective in the former as in the latter, challenging the common view that cities are anonymous places where the market prevails over social forces and that the only place for traditional social ties to play an economic role is the countryside. On the contrary, one classic reading of the nature of African towns argues that one of their distinguishing features is the proliferation of associations aimed at constituting networks and providing informal social security, and that a common feature of these associations is that they are based upon traditional social groupings like the clan, the village group or the tribe (Hodgkin 1956).[32]

6 Conclusions

This paper has suggested two complementary ways in which membership in a dynastically-linked community like a kinship or ethnic group can shape individual incentives in credit transactions. First, it makes default more costly for the members in that the punishment, in the form of exclusion from future credit or other social sanctions, will fall on the defaulter's offspring as well as on himself (herself), thus reducing the support that a defaulter can expect from the kin in the future. This channel has been referred to as 'social enforcement'. Second, the kinship group provides a pool of potential future

[31] Preliminary findings using the same data set suggest that matrilineal households in Ghana tend to send significantly less remittances to the 'in-laws' (relatives of the husband) in the first place. Furthermore, when these households do send remittances to the 'in-laws', they do not seem to get reciprocal transfers in the following year.

[32] The empirical results in this section are subject to one major qualification. The theoretical model emphasized the supply side of the credit market, giving clear-cut predictions for the effects of kin membership on the availability of credit. This theory does not bear similarly sharp implications for the *demand* of credit by members of the group. In other words, it could be argued that members of local kinship groups borrow more in equilibrium not because they are offered more credit but because they demand more. Given that the above empirical results obtain after controlling for income, wealth, various household characteristics and fixed effects at the village level, I believe that this objection should not invalidate the general findings.

lenders whose willingness to lend will depend on the past behavior of the borrower, and particularly on whether the borrower has lent or transferred money to a member of the community in the past. By lending to a member of the same kinship group an individual can create an obligation for reciprocation on behalf of other kinsmen, as well as of the recipient, in the form of future loans. This has been called the 'reciprocity' channel.

The empirical relevance of these effects has been documented using household-level data from Ghana. The results seem to suggest that both social enforcement and reciprocity play a role in determining access to credit from relatives and private non-moneylenders for local households, while they do not influence loans from banks, cooperatives and professional moneylenders. Furthermore, the means of 'reciprocal exchange' vary with the environment: while for rural households it is loans given to others that prove to give the highest payoff in terms of future access to credit, for urban households it is remittances to the relatives of the head.

Incorporating kinship and ethnicity in the traditional analysis of informal credit and insurance seems important for a number of reasons. First of all, their empirical relevance: family ties and kinship groups play a major role in economic transactions in most developing countries. Second, from a modelling point of view the explicit consideration of the genealogical links among the players can enrich the strategy space compared to games with anonymous players. In particular, this can increase the scope for cooperation in some cases in which the finite horizon of the game or the limited enforceability of contracts make mutually beneficial agreements difficult to sustain. Finally, community links in credit transactions have important welfare implications. If formal credit is available only to those who are able to pay high interest rates or to offer collateral, credit from one's own kinship group can have positive distributive effects for the landless and the poorest, alleviating the liquidity constraints faced by these segments of the population.

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Appendix A - Proofs

A.1 Proof of lemma 1

Any strategy to induce cooperation must condition i_t's action on j_{t-1}'s choice to deviate or conform to the equilibrium, for some $i_t \in N_t$ and $j_{t-1} \in N_{t-1}$. If it were not so, in the first period of her life j_{t-1} would know that her utility in old age will not depend on her own actions, so j_{t-1} would deviate. Conditioning on j_{t-k}'s ($k > 1$) choice to deviate or not, in addition to j_{t-1}'s, would not improve anyone's incentives. It would not affect j_{t-k}'s incentives because by stationarity j_{t-k+1}'s action is already conditional on j_{t-k}'s choice; nor would it affect i_t's incentives, which only depend on period t and $t+1$ outcomes. $\square$

A.2 Proof of proposition 1

By the principle of optimality of dynamic programming, in all the proofs that follow it suffices to check that no player can gain by unilaterally deviating from the equilibrium strategy profile in a single stage.

The expected lifetime utility of a type-$\overline{e}$ player from conforming to the equilibrium is $u(\overline{e}+g+rl-b)+\delta[2\alpha u(b)+(1-2\alpha)u(0)]$. The most profitable deviation —to (L, NT)— would yield instead $u(\overline{e}+g+rl)+\delta u(0)$. Therefore a type-$\overline{e}$ player will have no incentive to deviate unilaterally if

$$\delta \geq \frac{u(\overline{e}+g+rl)-u(\overline{e}+g-rl-b)}{2\alpha[u(b)-u(0)]} \equiv \delta_{\overline{e}}.$$

For type-$\underline{e}$ players the expected lifetime utility from conforming is $u(\underline{e}+g-rl-b)+\delta[2\alpha u(b)+(1-2\alpha)u(0)]$. The most profitable deviation —to (NT, NR)— would yield instead $u(\underline{e}+l+g)+\delta u(0)$. Therefore a type-$\underline{e}$ player will have no incentive to deviate unilaterally if

$$\delta \geq \frac{u(\underline{e}+l+g)-u(\underline{e}+g-rl-b)}{2\alpha[u(b)-u(0)]} \equiv \delta_{\underline{e}}.$$

Given assumption 2 and $u''(\cdot) \leq 0$, we have $\delta_{\underline{e}} > \delta_{\overline{e}}$ so condition (1) in proposition 1 is sufficient to ensure that the cooperative equilibrium is subgame perfect for both types of players. □

A.3 Proof of proposition 2

The condition for type-$\overline{e}$ players is the same as in proposition 1. For type-$\underline{e}$ players the expected lifetime utilities from conforming or from deviating to (NT, NR) are also the same. However, deviating to (T, NR) now yields $u(\underline{e}+l+g-b)+\delta[\alpha u(b)+(1-\alpha)u(0)]$. Therefore a type-$\underline{e}$ player will have no incentive to deviate unilaterally to (T, NR) if

$$\delta \geq \frac{u(\underline{e}+l+g-b)-u(\underline{e}+g-rl-b)}{\alpha[u(b)-u(0)]}.$$

□

A.4 Derivation of expressions (3) and (4)

As defined in the text, $\overline{p}$ ($\underline{p}$) is the summation over i of two components: $\pi(k)$ and $\overline{p}|k$ ($\underline{p}|k$). I explain here how the expression for $\pi(k)$ in (3) and (4) is derived. For simplicity, let us start from expression (4).

It will be recalled that $\underline{p}$ represents the probability that the child of a type-$\underline{e}$ parent obtains a loan *conditional on being type-$\underline{e}$* himself. Therefore, in calculating this probability one must proceed as if the uncertainty regarding one of the future children of current players had been resolved (he will be type-$\underline{e}$), and the αn lucky winners of endowments $\overline{e}$ will be extracted from an urn containing the remaining $n-1$ children. Of these $n-1$ children, αn are born from a type-$\overline{e}$ parent, and $n-\alpha n-1$ from a type-$\underline{e}$ parent. The probability that k children of current type-$\overline{e}$ parents will be type-$\overline{e}$ themselves, $\pi(k)$, is the ratio between the number of ways in which it can happen that k of the αn extracted winners are children of current type-$\overline{e}$ parents, and the total number of ways in which the αn winners can be extracted from a pool of $n-1$ children.

The latter number —the denominator of $\pi(k)$— is $\binom{n-1}{\alpha n}$. The numerator of $\pi(k)$ is the product of two factors: first, the number of ways in which k type-$\overline{e}$ children can be extracted from the pool of αn children of current type-$\overline{e}$ parents, which is $\binom{\alpha n}{k}$; second, the number of ways in which $\alpha n-k$ type-$\overline{e}$ children can be extracted from the pool of $n-\alpha n-1$ children of current type-$\underline{e}$ parents, which is $\binom{n-\alpha n-1}{\alpha n-k}$. This gives the formula reported in (4).

The procedure for calculating $\overline{p}$ is the same, except that there are $\alpha n-1$ children of current type-$\overline{e}$ parents among whom k winners can be extracted, and $n-\alpha n$ children of type-$\underline{e}$ parents among whom $\alpha n-k$ winners can be extracted.

A.5 Proof of proposition 3

Intuitively, we are considering only equilibria in which the total amount of resources gets invested. The "size of the pie" is therefore fixed and the question is how much of it each type of agent will get. The Pareto frontier is thus linear with a slope equal to the relative proportion of the two types. A more thorough proof is the following.

Assume for the moment that the discount rate δ is such that incentive constraints (7) and (8) are satisfied for any matching rule we are going to consider.[33] We can start by finding the endpoints of the Pareto frontier.

The best matching rule for type-$\overline{e}$ players is one that *guarantees* their children a loan independently of the number of type-$\underline{e}$ children born next period from current type-$\overline{e}$ parents, i.e. $\overline{p}|k = 1$, $\forall k$. We then use the set of constraints in (9) to derive the corresponding feasible $\underline{p}|k$ for each k. For example, when 1 child of current type-$\overline{e}$ players is $\overline{e}$ himself ($k = 1$), all other $\alpha n - 1$ children of type-$\overline{e}$ parents will be guaranteed a loan, and there will only be one loan available for the $n - \alpha n - (\alpha n - 1)$ type-$\underline{e}$ children of current type-$\underline{e}$ players. It is easy to see that this rule yields $\underline{p}|k = \frac{k}{(1-2\alpha)n+k}$, $k = 0, 1, ...\alpha n$, as stated in proposition 3. The best point for type-$\overline{e}$ players on the Pareto frontier is found by substituting these values for $\overline{p}|k$ and $\underline{p}|k$ in (5) and (6).

The best matching rule for type-$\underline{e}$ players can not *guarantee* their children a loan, because in any period there may be more type-$\underline{e}$ players who are born from type-$\underline{e}$ parents (up to $n - \alpha n$) than available loans (αn). The best that can be done is to give priority to children of type-$\underline{e}$ individuals in the assignment of loans, so that when k of the type-$\overline{e}$ children are born from type-$\overline{e}$ parents, $\underline{p}|k$ will be αn divided by $(n - \alpha n + k) - \alpha n$. If this number is greater than 1, $\underline{p}|k$ will be 1 and the remaining loans will be allocated randomly among the $\alpha n - k$ children of lenders who need a loan. This gives $\underline{p}|k = Min\left\{\frac{\alpha n}{(1-2\alpha)n+k}, 1\right\}$ and, through the feasibility constraints in (9), $\overline{p}|k = Max\left\{0, \frac{(3\alpha-1)n-k}{\alpha n-k}\right\}$. The best point for type-$\underline{e}$ players on the Pareto frontier is found by substituting these values for $\overline{p}|k$ and $\underline{p}|k$ in (5) and (6).

It remains to be shown that the Pareto frontier is linear and that its slope is $-\frac{1-\alpha}{\alpha}$. Notice from (5) and (6) that $U_{\overline{e}}$ and $U_{\underline{e}}$ are linear functions of $\overline{p}$ and $\underline{p}$, respectively, and that the coefficient on $\overline{p}$ or $\underline{p}$ is the same for both functions, namely $\delta(1-\alpha)[u(b) - u(0)]$. Therefore $\Delta U_{\overline{e}}/\Delta U_{\underline{e}}$ will be constant if and only if $\Delta\overline{p}/\Delta\underline{p}$ is.

Consider moving from the equilibrium with uniform random matching to a point more favorable to type-$\overline{e}$ players by giving their children probability one of getting the loan when there are $\alpha n - k$ of them who are born poor. In this case

[33] This amounts to saying that players are so patient that even if their children had a zero probability of receiving a loan in the future (worst case scenario), the parents would still want to conform to the equilibrium in order to get the transfer b in the case that the children are born with a high endowment. As we shall see, this is a sufficient but not necessary condition for the analysis that follows.

$$\Delta\overline{p} = \frac{\binom{\alpha n-1}{k}\binom{n-\alpha n}{\alpha n-k}}{\binom{n-1}{\alpha n}}\left(1-\frac{\alpha}{1-\alpha}\right) > 0.$$

The corresponding change in $\underline{p}$ is

$$\Delta\underline{p} = \frac{\binom{\alpha n}{k}\binom{n-\alpha n-1}{\alpha n-k}}{\binom{n-1}{\alpha n}}\left(\frac{k}{n-2\alpha n+k}-\frac{\alpha}{1-\alpha}\right) < 0.$$

By simplifying the binomials we get that the ratio $\Delta\overline{p}/\Delta\underline{p}$ is independent of k and is equal to $-\frac{1-\alpha}{\alpha}$.

Consider now a movement in the opposite direction by giving the children of type-$\underline{e}$ players priority in the allocation of loans when there are k children of type-$\overline{e}$ players who are born 'rich'. In this case

$$\Delta\overline{p} = \frac{\binom{\alpha n-1}{k}\binom{n-\alpha n}{\alpha n-k}}{\binom{N-1}{\alpha N}}\left(Max\left\{0,\frac{(3\alpha-1)n-k}{\alpha n-k}\right\}-\frac{\alpha}{1-\alpha}\right) < 0$$

$$\Delta\underline{p} = \frac{\binom{\alpha n}{k}\binom{n-\alpha n-1}{\alpha n-k}}{\binom{n-1}{\alpha n}}\left(Min\left\{\frac{\alpha n}{(1-2\alpha)n+k},1\right\}-\frac{\alpha}{1-\alpha}\right) > 0.$$

Again, by simplifying the binomials we get that the ratio $\Delta\overline{p}/\Delta\underline{p}$ is equal to $-\frac{1-\alpha}{\alpha}$ independently of the particular k chosen.

Finally, the threshold values for δ in the note to proposition 3 are derived by imposing that the cooperative equilibrium strategies are incentive compatible for types $\underline{e}$ and $\overline{e}$, respectively, in the worst equilibria for each type. These values are therefore sufficient for all points on the Pareto frontier to be sustainable as subgame perfect equilibria. □

A.6 Proof of Proposition 4

The problem is to maximize (5) with respect to $r \geq 0$, to $\overline{p}|k$ and $\underline{p}|k$, $(k = 0, ..., \alpha n)$, subject to constraints (7) and (9). Setting up the Kuhn-Tucker conditions and simplifying the factorials one obtains that an interior solution would require the ratio of $u'(\overline{e}+g+rl-b)$ to $u'(\underline{e}+g-rl-b)$ to equal $(1-\alpha)/\alpha$, which is inconsistent with the hypotheses that $u(\cdot)$ is concave and $\alpha < 1/2$.

Totally differentiating (5) and (7) and plotting the lender's indifference curves and the borrower's incentive constraint on a graph with r on the horizontal axis and $\overline{p}$ on the vertical axis, one finds that for $r \geq 0$ the slope of the constraint is uniformly higher (in absolute value) than that of the indifference curve. The maximum utility can therefore be achieved by setting $\overline{p}$ equal to 1.

The corollary follows from comparing conditions (10) and (12) and observing that $\underline{p}^* < \frac{\alpha}{1-\alpha}$. □

Appendix B - The data

B.1 Variable definitions

All variable names followed by '_1' refer to the first year of the survey, as opposed to the second.

Age: age of the household head.

Age6_15: ratio of household members aged 6 to 15.

Borrow: dummy = 1 if household borrowed a positive amount.

Can sell land: dummy = 1 if household head can sell land without asking permission from non-household members.

Children: dummy = 1 if household head has children.

Clusters: dummy variables identifying different clusters. Each cluster contains 16 or 32 households.

Crop loss: value of the crops lost by the household during the year due to insects, rodents, fire or rotting (Ghanaian Cedis).

Culture: dummy = 1 if household head speaks language of the locally dominant ethnicity.

Default: dummy equal to 1 if at the date of the interview household had outstanding loans whose terms had already expired and which had not been repaid yet.

Education: highest grade of education attained by household head.

Female head: dummy = 1 if household head is a woman.

Hedge: dummy = 1 if household had a loss on some but not all the crops it was cultivating.

Income: annual labor income of the household (Ghanaian Cedis).

Index_loan: categorical variable for loan source: 1 = professional moneylender; 2 = relative; 3 = private non-moneylender; 4 = private or government bank; 6 = cooperatives and others.

Int_rate: dummy = 1 if household has to pay interest on at least half of the loans contracted (in value).

Kin_loans: amount borrowed by household members from relatives or private non-moneylenders (Ghanaian Cedis).

Language dummies: three different dummies = 1 if household head speaks Ewe, Ga-Adangbe, Northern languages (Akan used as omitted category).

Lent to others: amount lent by household to non-household members during the year (Ghanaian Cedis).

Lost money: amount of money lost by household members (e.g. gambling) during the year.

Matrilineal: dummy = 1 if household head is a woman and the husband is living in the household.

Migrant: dummy = 1 if household head was born in place different from current residence.

Number of children: number of children of household head.

Remittances to in-laws: amount of remittances sent by household to relatives of household head's spouse during the year (Ghanaian Cedis).

Remittances to lineage: amount of remittances sent by household to relatives of household head during the year (Ghanaian Cedis).

Repaid: dummy = 1 if household contracted and repaid a loan during the year.

Semi-urban: dummy = 1 if household lives in a semi-urban area (i.e., between 1,500 and 5,000 inhabitants).

Size of HH: number of household members.

Urban: dummy = 1 if household lives in a semi-urban or urban area (i.e., above 1,500 inhabitants).

Years resident: number of years household head has been living in current place of residence.

B.2 Summary statistics

Variable	Urban		Rural		All	
	Mean	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*
Age	44.20	14.47	46.37	16.04	45.24	15.28
Age6_15	.22	.21	.24	.20	.23	.21
Borrow_1	.35	.47	.31	.46	.33	.47
Can sell land	.09	.29	.18	.39	.13	.34
Children	.89	.31	.86	.34	.88	.33
Crop loss	3009.4	11540.4	7137.6	20455.9	5001.6	16579.2
Crop loss_1	5149.3	28863.7	8437.4	18788.5	6736.1	24569.1
Culture	.69	.46	.81	.39	.74	.44
Default_1	.005	.07	.008	.09	.007	.08
Education	6.52	6.53	3.70	4.92	5.16	5.98
Female head	.34	.47	.21	.41	.28	.45
Hedge	.31	.46	.51	.50	.41	.49
Income	191861.0	256108.6	153698.5	293984.3	173277.2	275749
Income_1	160490.4	235850.8	97104.8	154974.2	129652.7	203024.7
Index_loans	3.20	1.16	3.05	.94	3.09	1.06
Int_rate	.05	.22	.06	.23	.05	.23
Kin_loans	6567.8	28516.0	3632.2	12383.4	5129.0	22179.4
Lang. Ewe	.14	.35	.18	.38	.16	.36
Lang. Ga-Adangbe	.10	.30	.06	.24	.08	.28
Lang. Northern	.21	.41	.31	.46	.26	.44
Lent to others_1	5360.1	16527.9	3339.0	11734.0	4384.7	14444.4
Lost money_1	2955.4	26774.4	1071.4	4481.9	2024.4	19421.1
Matrilineal	.15	.36	.09	.29	.12	.33
Migrant	.52	.50	.48	.50	.50	.50
No. of children	3.84	2.94	4.05	3.30	3.94	3.12
Remitt. in-laws_1	3025.9	13246.5	1617.6	6885.6	2346.3	10680.6
Remitt. lineage_1	5978.5	14293.9	4649.1	13431.4	5337.0	13894.5
Repaid_1	.21	.40	.18	.38	.19	.39
Semi-urban	.43	.49	—	—	—	—
Size of HH	4.34	2.78	5.14	3.09	4.72	2.96
Urban	—	—	—	—	.52	.50
Years resident	14.73	11.76	15.03	12.64	14.88	12.19

Variable	**Urban**		**Rural**		**All**	
	Mean	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*
Borrow_1 * Migrant	.19	.39	.20	.40	.195	.40
Default_1 * Migrant	.003	.06	0	0	.002	.04
Lost_1 * Migrant	2122.7	26593.3	660.9	3895.9	1421.0	15698.5
Lent_1 * Migrant	3048.8	12272.3	2419.6	11078.5	2745.2	11710.8
Rem. lineage_1 * Migrant	3865.7	11670.8	3370.0	12621.7	3626.5	12136.4
Rem. in-laws_1 * Migrant	1167.0	6679.3	1190.5	6410.8	2745.2	11710.8
Rem. lineage_1 * Matrilineal	845.6	7065.2	624.8	5545.4	739.0	6375.5
Rem. in-laws_1 * Matrilineal	81.18	928.1	27.0	553.2	55.0	770.4
Repaid_1 * Migrant	.12	.32	.10	.30	.11	.31

Annex - Tables

Table 1: Source and amount of individual loans

Loan source	*% number of loans*	*% value of loans*	*Mean*	*Standard Deviation*
Relatives	13.3	11.5	9,937	29,621
Private	69.7	54.4	8,956	20,996
Moneylender	3.0	3.0	11,520	11,895
Bank	4.0	18.4	52,826	72,565
Coop	0.5	1.5	35,000	23,804
Other	9.3	11.1	13,662	22,421
All sources	100.0	100.0	11,476	27,500

Source: author's calculations on GLSS data.

Table 2: Terms of loans by source (% of total number of loans)

Loan source	*% with interest*	*% with interest (adj.)*	*average interest rate*	*% with add. goods or services*	*% with regular payments*	*% with collateral*
Relative	4.5	5.4	68.1	1.8	7.3	0.9
Private	4.0	5.2	54.5	1.7	12.7	0.7
Moneylender	52.0	52.0	27.8	4.0	48.0	0.0
Bank	90.9	93.9	20.1	3.0	37.5	18.2
Coop	50.0	50.0	7.1	0.0	0.0	0.0
Other	15.6	19.5	24.2	1.3	32.5	5.2
All sources	10.3	11.7	29.0	1.8	16.2	1.8

Source: author's calculations on GLSS data.

Table 3: Probit estimates of default

Dependent variable: probability of default (Default_1)

	Estimated Coefficient	*Marginal Coefficient*[a]
Age	-.010	-.00005
	(-1.484)	
Education	.054	.0003
	(1.303)	
Income	-.007	-.00004
	(-2.143)	
Crop loss	.0008	4.5e-06
	(0.195)	
Migrant	-.406	-.003
	(-1.107)	
Urban	.045	.0003
	(0.117)	
Children	-.995	-.015
	(-2.190)	
Number of children	.218	.001
	(3.422)	
Can sell land	.754	.011
	(2.428)	
Constant	-1.519	
	(-3.520)	
Log-likelihood	-27.35	
Log-likelihood (restr)[b]	-38.97	
LR test (p-value)	.006	
No. of obs.	388	

Note: t-statistics in parenthesis. Robust standard errors estimated using Huber's formula for clustered sampling. All variables refer to the first year. 'Income' and 'Crop loss' measured in thousands of Ghanaian Cedis. a) Marginal coefficients = $\varphi(\overline{X}\beta)\beta$, where $\overline{X}$ are means of the explanatory variables and $\varphi(\cdot)$ is the Standard Normal density. b) Restricted model: clusters only.

Table 4: Multinomial logit on loan source

Dependent variable: index variable for loan source (Index_loan)

Source:	*Relative*	*Private*	*Moneylender*	*Bank*
Age	.001	.009	-.025	.040
	(0.087)	(0.686)	(-0.972)	(1.915)
Education	-.010	-.074	-.152	.032
	(-3.623)	(-3.619)	(-3.161)	(0.942)
Female head	1.382	1.405	-31.31	.911
	(2.363)	(2.610)	(0.000)	(1.104)
Urban	-.383	-.234	.534	-1.127
	(-1.099)	(-0.795)	(0.964)	(-2.246)
Years resident	-.019	-.004	.061	-.010
	(-1.058)	(-0.284)	(2.259)	(-0.417)
Migrant	-1.047	-.858	-.223	-.332
	(-2.949)	(-2.820)	(-0.345)	(-0.683)
Constant	2.115	2.853	-.134	-1.938
	(2.874)	(4.655)	(-0.114)	(-1.945)
Log-likelihood	-703.45			
Log-L (restr.)^a	-757.50			
LR test (p-value)	.000			
No. of obs.	768			

Notes: t-statistics in parenthesis. The omitted category is loans from cooperatives and others. a) Restricted model: constant only.

Table 5: Probit estimates for the presence of interest rate

Dependent variable: probability of positive interest rate (Int_rate)

Source:	**Kin**		**Non-kin**	
	Estimated	*Marginal*[a]	*Estimated*	*Marginal*[a]
Age	.001	.0001	.011	.004
	(0.100)		(0.724)	
Education	.045	.005	.010	.004
	(2.035)		(0.477)	
Female head	-.501	-.049	-.060	-.024
	(-1.590)		(-0.135)	
Years resident	.008	.001	-.003	-.001
	(0.675)		-0.164	
Migrant	.339	.039	-.248	-.099
	(1.609)		(-0.747)	
Constant	-2.087		-.404	
	(-4.264)		(-0.601)	
Log-likelihood	-88.85		-51.09	
Log-L (restr)[b]	-96.36		-51.82	
LR test (p-value)	.010		.918	
No. of obs.	366		75	

Notes: t-statistics in parenthesis. Robust standard errors estimated using Huber's formula for clustered sampling. a) Marginal coefficients = $\varphi(\overline{X}\beta)\beta$, where $\overline{X}$ are means of the explanatory variables. b) Restricted model: constant only.

Table 6: Tobit estimates of loan amount

Dependent variable: amount borrowed from relatives and private non-moneylenders (Kin_loans)

	Rural		**Urban**	
	Estimated	*Marginal*[a]	*Estimated*	*Marginal*[a]
Migrant	-3315.9	-579.3	-1675.5	-406.08
	(-0.312)		(-0.130)	
Repaid_1	6006.9	1049.4		
	(1.029)			
Repaid_1*Migrant	7705.7	1346.2		
	(0.974)			
Default_1			-212665	-51536.6
			(-4.398)	
Default_1*Migrant			209130	50684.8
			(3.870)	
Lost money_1	-.804	-.140	-1.338	-.324
	(-1.473)		(-2.680)	
Lost_1*Migrant	1.719	.300	1.408	.341
	(1.428)		(2.804)	
Lent to others_1	1.122	.196	.249	.060
	(5.018)		(1.059)	
Lent_1*Migrant	-1.211	-.211	-.176	-.043
	(-4.626)		(-0.611)	
Remittances to lineage_1	-.182	-.032	.996	.241
	(-0.893)		(2.810)	
Rem. lineage_1*Migrant	.307	.054	-.745	-.180
	(1.408)		(-1.925)	
Remittances to in-laws_1	-.398	-.069	-.469	-.114
	(-1.041)		(-2.191)	
Rem. in-laws_1*Migrant	.172	.030	.262	.064
	(0.387)		(0.731)	
Log-likelihood	-2108.64		-2576.04	
Log-likelihood (restr)[b]	-2174.39		-2651.00	
LR test (p-value)	.000		.000	
No. of obs.	519		546	

Notes: t-statistics in parenthesis. Robust standard errors estimated using Huber's formula for clustered sampling. Controlled for: Age, Education, Education squared (rural only), Female head, Size of HH, Age6_15, Income, Income squared (rural only), Language dummies, Semi-urban (urban only), Crop loss, Hedge, Culture, Years resident, Borrow_1 (the last five variables also interacted with Migrant), Clusters. a) Marginal coefficients = $\Phi\left(\frac{\overline{X}\beta}{\sigma}\right)\beta$, where $\overline{X}$ are means of the explanatory variables. b) Restricted model: clusters only.

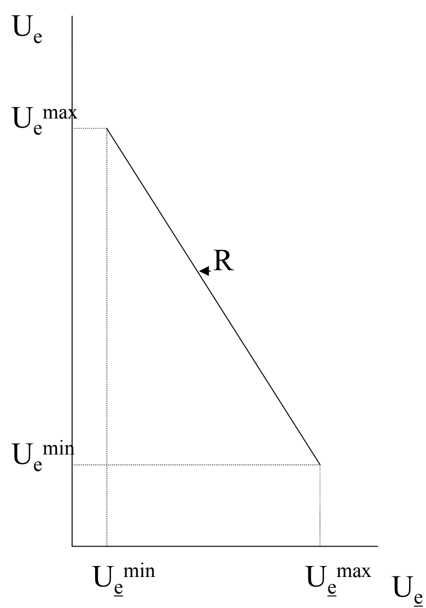
U_e
U_e^{max}
R
U_e^{min}
$U_{\underline{e}}^{min}$
$U_{\underline{e}}^{max}$
$U_{\underline{e}}$

Figure 1: