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Ethnicity and Networks in African Trade

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Abstract

This paper investigates the role of ethnicity and networks in domestic agricultural trade in Africa. Using a theoretical model of self-disciplining markets, we begin by demonstrating that statistical discrimination and networks can generate similar patterns of ethnic concentration. We then test these ideas using original survey data collected in Benin, Malawi, and Madagascar. We find no evidence that members of a particular sex or ethnic group are more easily trusted by suppliers and trust clients more easily. In contrast, network effects have a strong and systematic effect on trust and information sharing. Women accumulate working capital slower than men, including in Benin where women represent 80% of surveyed traders. This does not suggest the presence of discrimination. Agricultural trade appears open to all, irrespective of gender, ethnicity, or religion.

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1. Introduction

It has long been observed that business has something to do with ethnicity. This is particularly true in Africa. In manufacturing, for instance, members of non-indigenous communities dominate business in specific countries in spite of the fact that they represent only tiny minorities in the population at large (e.g. Marris 1971, Himbara 1994, Fafchamps 2002). Similar observations have been made by numerous authors regarding agricultural trade (e.g. Geertz, Geertz & Rosen 1979, Geertz 1963, Amselle 1977, Staatz 1979, Cohen 1969, Meillassoux 1971, Bauer 1954, Jones 1972). In this respect, Africa is reminiscent of ancient trade practices in other parts of the world (e.g. Braudel 1986, North 1990, Greif 1993, Greif 1994). Similar comments have been made about gender and the conspicuous absence of women entrepreneurs in many parts of Africa (Spring & McDade 1998).

There are many possible explanations for this state of affairs. This paper focuses on one – the functioning of markets – using original survey data on agricultural traders collected in Benin, Malawi, and Madagascar. African agricultural markets are such that nearly all contracts between traders cannot credibly be enforced by courts. One reason is that most transactions are too small to justify court action. Another is that most traders are poor and have no fixed assets to foreclose upon. As a result, traders must trust each other to conduct business (Fafchamps 1996).

For our purpose, trust can be defined as the belief that a commercial contract will not be breached in bad faith. Trust can originate in interpersonal relationship, as when two people learn to trust each other through repeated interaction (Fafchamps 2003*a*). Trust can also find its source in beliefs about differences between sexes, religions, or ethnic groups, as when people distrust others 'not like themselves'.

In this paper we investigate the extent to which religion, ethnicity, and gender affects the functioning of markets through their effect on trust. We seek to assess the relative importance of the two possible origins of trust. We therefore distinguish between two possible effects: a direct effect through prejudice and statistical discrimination; and an indirect effect via the formation of networks.

We also investigate the possible existence of location-invariant effects of religion, ethnicity, or gender that make members of a particular faith, ethnic group, or gender more or less trustworthy. The existence of such effects has been hypothesized in the literature under various guises. Since Max Weber, the

economic success of the West has often been attributed to protestant ethics. In the old literature on East Asia, for instance, Shintoism and Confucianism were seen as value systems antagonistic to development. Greif (1994) argues that in medieval Europe, certain communities of traders developed a 'culture' that was better able to foster trust. Other, less presentable ideas about the superiority of one group over others have yielded similar predictions about race and gender.

Such generalizations are suspect both on philosophical grounds and on the grounds that they are regularly disproved by counter-examples and subsequent historical events. One possible exception concerns gender. In nearly all human societies, parenting responsibilities fall primarily on the shoulder of women.[1] This is also true in Africa. In such a context, it is likely that men and women would differ systematically in the way in which they conduct business, particularly for women with children. We test for this possibility as well.

Results are mixed. In the case of domestic agricultural markets in the three countries studied, we find no strong evidence that ethnicity or religion matter. Gender, however, has systematic effects that are constant across location, irrespective of the gender make-up of the surrounding trader community. The direct effects of ethnicity and religion generally disappear once we control for network effects. Ethnicity does not appear to have a significant effect on network formation either. This suggests that whatever relationship is observed between success in trade and ethnicity is probably due to network effects, not to discrimination and prejudice in the conduct of everyday business.

The paper is organized as follows. We begin by developing a model of trade based on trust and repeated interaction. We show that statistical discrimination (our direct effect) and networks (our indirect effect, if network formation is influenced by ethnicity) generate similar predictions regarding trader behavior. We then present the data. We first focus on trust among traders. Trade credit is our yardstick for trust. We also examine whether traders share information about breach of contract by their respective clients.

The first empirical section tests the significance of religion, ethnicity, and gender dummies. Having found no consistent relationship, except for gender, we switch to a location-specific definition of ethnic or religious dominance. We find that members of the dominant ethnic or religious group expect to receive

[1] Whether this is the result of women's choice or it is imposed upon them by society is irrelevant for our analysis.

and give more credit. This effect, however, disappears once we control for number of business contacts. The last part of our empirical analysis focuses on start-up conditions and accumulation of network and working capital over time. Our objective is to test whether members of particular groups either are advantaged at start-up or grow faster.

2. A Model of Trust-Based Exchange

To formally illustrate how statistical discrimination and network effects influences trust, we begin by constructing a stylized market economy in which economic agents screen potential commercial partners, grant trade credit to clients, and pay suppliers. The model, which is inspired of the works of (e.g. Grossman & Van Huyck 1988, Milgrom, North & Weingast 1991, Greif 1993, Fafchamps 2003*b*), integrates screening and strategic default considerations. There is no external mechanism for the enforcement of contracts other than the discipline imposed by the market itself.[2]

Consider an economy composed of a large number of firms $2N$ living indefinitely and discounting the future with factor δ. Time is divided into rounds within which firms trade with each other. Since each transaction involves a buyer and a seller, each firm assumes two distinct roles, that of supplier and client. To keep things simple, we assume that each firm buys from one supplier and sells to one client at a time. With these assumptions, a particular trading round can be visualized as directed graph in which each firm, e.g., A, B, and C, is a node and each sales transaction is an arrow (Figure 1).

There are two types of firms, competent and incompetent. Their proportion in the economy is constant and common knowledge but firm type is private information. Competent firms gain from trade. Incompetent firms, in contrast, cannot make a profit by processing or reselling goods purchased from suppliers. They can, however, profit from cheating suppliers by taking goods on credit and failing to pay.[3] Many – though not all – African microenterprises satisfy this definition of incompetence: the inadequacy of their equipment and technical expertise and the fragility of their financial base make it difficult for them to complete large commercial transactions.

[2] As long as the external enforcement of contracts is imperfect, most of the qualitative results presented here carry through.

[3] In our model, it is irrelevant whether incompetent firms know their own type and thus are dishonest, or ignore their type and discover subsequently that they cannot repay. See Fafchamps (2003*b*) for a discussion.

Firms decide whether or not to grant trade credit to their client.[4] Those who do not receive credit must pay in cash. Payment in cash is risky (e.g., theft) and costly to administer. The use of trade credit among competent firms is thus efficient. Payoffs are normalized so that the profit of competent firms is 0 without trade credit. The main concerns of suppliers is to get clients to pay back the trade credit they received and thus to avoid granting trade credit to incompetent clients. To do so, suppliers spend resources screening potential customers. For the sake of brevity, we take c to be the cost of the optimally chosen screening method and we assume that it is sufficient to identify incompetent firms after one period.[5]

The game played between firms is depicted in extensive form on Figures 2, 3 and 4. Realized payoffs, which are the sum of instantaneous and continuation payoffs, are shown at the extreme right of each figure. The payoff to client C is shown on top, the payoff to supplier S below. The expected continuation payoff of a matched supplier is denoted V^S; that of an unmatched supplier is written V^N. The corresponding continuation payoffs for clients are written V^C and V^U. The value of continuation payoffs depend on the strategies pursued by firms, to be discussed below. Parameters α and β are the supplier's and client's net profit margins, respectively. In case of non-payment, a client's instantaneous payoff is $1 > \beta$: clients always have a short-term incentive to default. Suppliers make a profit of α in case of repayment; otherwise they make a loss of -1. Since the profit margin of the supplier can be increased and that of the client reduced by raising the sales price (or, equivalently, the interest rate on trade credit), α can be increased by lowering β, and vice-versa. The combined gains from trade $\alpha + \beta$ is denoted κ and assumed exogenously determined by market conditions. By negotiating over the price, supplier and client bargain over the share of $\kappa = \alpha + \beta$ that goes to each of them. We are not interested here in this bargaining process but rather on the constraints that incentive conditions put on the choice of α and β. To ensure that trade patterns change over time, we assume that, with probability $1 - \tau$, clients discover that gains from trade

[4] For simplicity, we assume that the purchasing and buying sides of each firm can be analyzed separately. In practice, a firm that does not receive trade credit from its supplier may not be able to offer it to its clients. This possibility is ignored here.

[5] The screening cost c depends on whether the reliability of the client can be assessed directly – e.g., by inspecting the client's business premises – or indirectly – e.g., by selling small amounts on credit and observing whether the client repays.For indirect screening to be effective, the supplier must grant an amount of credit that is sufficient to induce an incompetent firm to reveal its type: if too little credit is given, incompetent clients will repay only to cheat the supplier more later. For evidence on the screening methods used by African suppliers, see (e.g. Fafchamps, Pender & Robinson 1995, Fafchamps 2000). Indirect screening is the most commonly used.

with their current supplier permanently fall to 0 and that they need to change supplier (see Greif (1993) for a similar assumption).

Since trade is voluntary, supplier and client can both stop the relationship at the beginning of the trading period, in which case they both must seek a new commercial partner. Nature randomly pairs unmatched firms with each other so that, with probabilities μ and $1-\mu$, suppliers are matched with an incompetent or a competent client, respectively (Figure 3).[6] Suppliers do not observe the client's type. Neither do they know whether the client has ever failed to pay other suppliers.[7] Suppliers must decide whether to refuse to trade, to screen the new client at cost c, or to offer trade credit. Incompetent clients invariably cheat suppliers who offer credit from the start (lower branches in Figure 3).[8] It is never in a client's interest to refuse credit when offered. Unmatched clients must similarly seek a new supplier (Figure 4). With probabilities μ and $1-\mu$, nature matches them with an incompetent or competent supplier, respectively. Incompetent suppliers cannot provide trade credit. Clients then get an instantaneous payoff of 0 and search for another supplier in the next period.

If the economy lasts only one period – i.e., $\delta = 0$ – clients always refuse to pay. Anticipating this, suppliers do not offer trade credit. The economy resembles a one-sided Prisoner's Dilemma game: the unique sub-game perfect equilibrium is one in which all payments are made in cash and Pareto efficiency is not achieved. If agents live long enough, however, they may be able to deter opportunistic breach of contract by forming long-term relationships. To show this formally, we focus on a class of trust-based strategies in which suppliers and clients form business relationships that last until one party breaches its promise.[9] Clients pay suppliers to avoid having to search for another supplier who will grant them trade credit. The market disciplines itself in a way that is reminiscent of unemployment as a disciplining device in Shapiro & Stiglitz (1984) (see also Ghosh & Ray (1996)). Transitional dynamics are ignored and we

[6] The proportion of competent and incompetent firms among the unmatched depends not only on the proportion of incompetent firms in the economy but also on the number of competent firms that are unmatched. Here, we ignore transitional dynamics and treat μ as an exogenously determined constant. See Fafchamps (2003*b*) for a precise treatment.

[7] This assumption is lifted later.

[8] Since incompetent firms never behave strategically, their continuation payoff can be ignored from Figure 3.

[9] Formally, the strategies are as follows. Unmatched suppliers screen new clients. If the client is identified as incompetent, suppliers screen another firm in the subsequent period and continue to do so until a competent client is found. Once one is found, suppliers offer trade credit and the parties engage into a long term commercial relationship. As long as the client's gains from trade remain positive, the client pays and the relationship continues. When a client discovers that gains from trade have fallen to 0 and that the time has come to change supplier, default occurs and the relationship ends. The supplier then starts screening new clients, and the client starts being screened by new suppliers.

focus exclusively on the long term equilibrium of the economy.[10]

When all agents follow trust-based strategies, expected continuation payoffs to matched and unmatched suppliers are, respectively:

$$V^S = \tau(\alpha + \delta V^S) + (1-\tau)(-1 + \delta V^N) \quad (2.1)$$

$$V^N = \mu\delta V^N + (1-\mu)\delta V^S - c \quad (2.2)$$

The corresponding payoffs to matched and unmatched clients are:

$$V^C = \tau(\beta + \delta V^C) + (1-\tau)(1 + \delta V^U) \quad (2.3)$$

$$V^U = \mu\delta V^U + (1-\mu)\delta V^C \quad (2.4)$$

Since, by construction, incompetent firms always get screened away, their payoff is zero and can be ignored.

For trust-based strategies to be sub-game perfect, seven equilibrium conditions must be satisfied: it must be beneficial for matched supplier and client to continue a commercial relationship (EC1 and EC2); it must beneficial for a client to pay a supplier (EC3); it should not be in a client's interest to respect the contract once the relationship ends (EC4); it pays for unmatched clients and suppliers to screen and be screened by other firms (EC5 and EC6); and it does not pay to grant instant trade credit to all applicants (EC7). Formally, we need:

$$V^S \geq V^N \quad \text{(EC1)}$$

$$V^C \geq V^U \quad \text{(EC2)}$$

$$\beta + \delta V^C \geq 1 + \delta V^U \quad \text{(EC3)}$$

$$0 + \delta V^U \leq 1 + \delta V^U \quad \text{(EC4)}$$

[10] Dynamics are examined in detail in Fafchamps (2003*b*).

$$V^N \geq 0 \quad \text{(EC5)}$$

$$V^U \geq 0 \quad \text{(EC6)}$$

$$V^N \geq \mu(-1 + \delta V^N) + (1-\mu)(\alpha + \delta V^S) \quad \text{(EC7)}$$

Let us denote the client's trade margin that is just sufficient to ensure voluntary payment, denoted β^*, and the supplier's trade margin that is just sufficient to induce screening, denoted α^*. By manipulating equations (1) to (4) and (EC1)-(EC7), we obtain:

$$\alpha^* \equiv \frac{1-\tau}{\tau} + \frac{c(1-\delta\tau)}{\tau\delta(1-\mu)} \quad (2.5)$$

$$\beta^* \equiv \frac{1-\delta\mu}{1+\delta-\delta\mu} \quad (2.6)$$

This yields the following proposition:

Proposition 1. *(Proof in appendix).*

(1) If $\alpha^* \leq \frac{\mu-c}{1-\mu}$ and if the combined gain from trade κ is greater than $\alpha^* + \beta^*$, then there exist a division of the gains from trade $\{\alpha, \beta\}$ such that the provision of trade credit is self-enforcing by trust-based strategies.

(2) A self-enforcing division of gains from trade $\{\alpha, \beta\}$ must satisfy $\frac{\mu-c}{1-\mu} \geq \alpha \geq \alpha^*$ and $\beta \geq \beta^*$.

Proposition 1.2 shows that it is not in the interest of the supplier to raise the sale price beyond the point at which β falls below β^*: the client must make money from the transaction for repayment to be in his or her interest. This is true irrespective of the bargaining power of both parties: when the repayment constraint is binding, the selling price is entirely determined by β^*. The same holds on the supplier side: unless suppliers make a profit of at least α^*, they will refuse to screen clients for trade credit.

A immediate corollary of Proposition 1 is that β must be strictly positive: a trust-based equilibrium cannot exist if clients never gain anything from trade. This is in sharp contrast with the standard competitive equilibrium in which free entry guarantees that pure profits are 0. Here, clients collect a payment that can be interpreted as the return to their relationship – what Coleman (1988) calls 'social capital'. It is the fear of losing this return that guarantees repayment of trade credit. For most parameter

values, β^* is non-trivial. If $\delta = 0.9$ and $\mu = 0.5$, for instance, then $\beta^* = 0.38$: transactions with a client's margin lower than 38% are not self-enforceable.

It is easy to verify that α^* rises with μ: suppliers are more willing to screen if the proportion of incompetent firms among in the unmatched is low and thus the chances of finding a reliable client are high. In contrast, β^* decreases with μ: commercial contracts are easier to enforce if there are many incompetent firms. The reason is that the more incompetent suppliers there are, the longer it takes for an unmatched client to find a new reliable supplier. The presence of incompetent suppliers thus helps discipline clients.[11] Proposition 1 further shows that, even if the screening cost c is 0, there must be some incompetent firms in the economy for screening to be worthwhile. The more costly screening is, the more tempting it is for suppliers to take a chance and grant instant credit, and the larger μ must be for screening to be in suppliers' self-interest. In the absence of incompetent firms, it is individually optimal for suppliers to grant credit without screening; in this case, clients incur no punishment for breach of contract and the equilibrium unravels (see below).[12] Although α^* increases with μ, it is possible to show that, as long as c is small and μ is not too close to 1, $\alpha^* + \beta^*$ falls with μ. In general, therefore, the presence of incompetent firms makes it easier for a trust-based system of trade credit to be self-enforcing.

If $\kappa < \alpha^* + \beta^*$, there exists no allocation of the gains from trade among supplier and client that provides sufficient incentives for both the supplier to screen and the client to pay. It is then rational for suppliers to refuse trade credit to their clients. This is because a client could not convince a supplier to provide trade credit by offering a higher price because doing so would only reinforce the client's incentive

[11] Since $\lim_{\mu \to 0} \beta^* = \frac{1}{1-\delta}$, even in the absence of incompetent suppliers there exists a sufficiently high trade margin such that the repayment condition is satisfied. The reason is that, in a trust-based equilibrium, unmatched clients first get screened before receiving trade credit and thus lose at least one trade round. It is not, however, optimal for suppliers to wait before granting trade credit if there are no incompetent clients in the economy. Of course one could imagine a 'tit-for-tat' punishment strategy whereby cheaters must wait for one (or more) periods before being granted trade credit. For such punushment to be credible, however, suppliers would have to be punished for granting credit to cheaters. The informational requirements for such punishments to be implemented are daunting and there is little or no evidence that they occur in practice. Dun and Bradstreet, for instance, circulates information about bad payers but not about firms who deal with bad payers.

[12] In the case EC7 is violated but $\mu > 0$, a market equilibrium with instant trade credit may still be sustainable provided clients who fail to pay their supplier are not instantly matched with an another competent supplier. Provided that μ is large enough, and thus that the expected waiting time is long enough, this punishment may be sufficient to deter breach. Demonstrating that such an equilibrium exists is left as an exercise for the reader.

Other equilibria, such as reputational equilibria (e.g. Kandori 1992, Greif 1993, Milgrom, North & Weingast 1991) or contagious equilibria (e.g. Kandori 1992, Ellison 1994) may nevertheless be sustainable. Reputational equilibria require the sharing of information and the existence of meta-punishment; they are discussed in Fafchamps (2003*b*). Contagious equilibria are susceptible to external shocks (see, however, Ellison (1994)) and to the presence of incompetent firms; for that reason, they are not very plausible.

to default.[13] Circumstances that make both constraints $\alpha > \alpha^*$ and $\beta > \beta^*$ more binding – short horizon (low δ), high firm turnover (low τ), and high screening costs (high c)– are likely to result in the absence of trade credit. Markets then take the form of a 'flea market economy' in which all transactions are on a cash-and-carry basis and gains from trade are dissipated through inefficient business practices.

2.1. Statistical Discrimination in Trade Credit

We now investigate the conditions under which statistical discrimination arises. Economic agents typically differ in characteristics that are relevant for contractual performance (Arrow 1972): some entrepreneurs, for instance, are more competent and financially secure and thus better trade credit risk than others. Most individual characteristics are private information but some, like gender or ethnicity, are not. These observable traits typically have no effect on contractual performance but they may be correlated with underlying characteristics, such as size and financial security, that they help predict. It is then rational to treat agents with different observable traits differently, not because these observable traits indicate inherent inferiority, but because they are correlated with hidden characteristics of interest (Foster & Rosenzweig 1993).

A compounding feature of statistical discrimination is that it can be self-fulfilling. Coate & Loury (1993), for instance, study the allocation of black and white workers between demanding and non-demanding tasks (see also Milgrom & Oster (1987) and Borjas & Bronars (1989)). Using a theoretical model, they show that an equilibrium exists in which the belief that black workers are inferior is self-fulfilling: because blacks expect to be discriminated against by employers, they invest less in their own education and work ethics, which makes them less suitable for demanding tasks. Similar forces may be at work concerning trade credit.

To apply these ideas to trust-based markets, we now assume that the firm population is made of two separate ethnic groups, denoted A and B, with $A + B = 2N$. Firm ethnicity is publicly observable through the entrepreneur's language, name, attire, race, etc.[14] The proportion of A firms in the total population is denoted θ, and the proportion of incompetent firms among unmatched firms in each group

[13] Stiglitz & Weiss (1981) derive a similar result in a model of adverse selection.

[14] Identical results obtain if what differentiates firms is not ethnicity but gender, religion, etc, as long as it is externally observable.

is written μ_i, $i \in \{A, B\}$. For statistical discrimination to arise, ethnicity must help 'predict' competence. Without loss of generality, we assume that the proportion of incompetent firms in larger in group B than in group A, i.e., $\mu_B > \mu_A$.[15] This may be because entrepreneurs in group B are less educated, have less technical and commercial experience, or have a weaker financial base.

Several types of discriminatory equilibria can obtain when firms apply trust-based strategies: price discrimination, in which B clients are asked to pay more than A clients; discriminatory exclusion, in which B firms are denied any access to trade credit; and discriminatory rationing, in which only a fraction of B firms gain access to trade credit. To see this formally, let β_A^* and β_B^* denote the minimum trade margin that an A and B-type clients, respectively, must receive in order not to breach the contract. Similarly, let α_A^* and α_B^* denote the minimum trade margin suppliers must make in order to screen A and B clients, respectively. Whenever suppliers refuse to screen B clients, we have:

$$\beta_A^* \equiv \frac{1 - \delta\theta\mu_A - \delta(1-\theta)\mu_B}{1 + \delta - \delta\theta\mu_A - \delta(1-\theta)\mu_B} \tag{2.7}$$

$$\alpha_A^* \equiv \frac{1-\tau}{\tau} + \frac{c(1-\delta\tau)}{\delta\tau(1-\mu_A)} \tag{2.8}$$

$$\alpha_B^* \equiv \frac{1-\tau}{\tau} + \frac{c(1-\delta\tau+\delta\theta(\mu_B-\mu_A))}{\delta\tau(1-\mu_B)} \tag{2.9}$$

$$\beta_B^* \equiv 1 - \delta \tag{2.10}$$

This leads to the following Proposition:

Proposition 2. *(Proof in appendix).*

(1) If $\alpha_A^* + \beta_A^* < \kappa < \alpha_B^* + \beta_B^*$, the only self-enforcing trust-based equilibria that exist are equilibria in which suppliers provide trade credit only to competent A firms.

(2) If $\kappa > \alpha_A^* + \beta_A^*$ and κ is sufficiently larger than $\alpha_B^* + \beta_B^*$, the only self-enforcing trust-based equilibria that exist are equilibria in which suppliers provide trade credit to competent A and B firms but require a higher minimum profit rate before screening B firms.

(3) For intermediate values of κ, a third, the only self-enforcing trust-based equilibria that exist are hybrid equilibria in which price discrimination and discriminatory rationing coexist.

[15] Discrimination can also be obtained if firm populations differ in the probability τ of continuing a commercial relationship; or if screening costs vary by firm type, i.e., if $c_A < c_B$ for A firms, as assumed for instance in Cornell & Welch (1996).

Proposition 2 demonstrates that five types of trade credit equilibria are theoretically possible in the presence of statistically different firm populations: equal treatment for all; price discrimination; price discrimination with discriminatory rationing; discriminatory exclusion; and no exchange.[16] How severe statistical discrimination is depends principally on the level of screening costs c and the difference between firm populations $\mu_B - \mu_A$: the higher screening costs are and the larger the gap between the two populations, the more likely discrimination is. When discriminatory exclusion is an equilibrium, it constitutes a best response for all suppliers: even those who belong to the B group discriminate against their own kind. This is in contrast with a situation in which discrimination is due to prejudice, in which case B suppliers would presumably not refuse trade credit to B clients. Here, what induces suppliers to discriminate is their desire to save on screening costs by refusing to consider B clients because they come from a worse population.

Of the five possible equilibria, discriminatory exclusion is potentially the most damaging for B firms because it can be self-fulfilling and even self-reinforcing over time. To see why, suppose that entrepreneurs learn from experience, for instance, because they become more efficient traders and better payers through contact with established businesses. Formally, let the proportion of incompetent firms μ_i, $i \in \{A, B\}$, fall with exposure to established businesses. It is then easy to show that if an easily identifiable group gains prominence in business, it may keep it forever. Suppose that, thanks to luck, historical conditions, or government support, a group of A firms manage to establish themselves. Further assume that, thanks to learning among A firms, μ_A falls sufficiently that granting trade credit to A firms becomes individual rational. Trade credit then begins to flow among A firms. Inexperienced A firms are screened by established A businesses. Through this process, they progressively learn and adopt more sophisticated business practices, which make them more reliable commercial partners. Learning among A firms brings μ_A further down, making it *less* likely that the screening equilibrium condition will be violated. Learning through screening thus makes discriminatory exclusion a self-reinforcing process. In these circumstances, the development of a prosperous business community, once started, ends up marginalizing less experienced groups.

[16] This list should not be considered as exhaustive. Other possible equilibria include no screening for all and screening of B clients only.

Discrimination need not be the sole possible explanation for this state of affairs, however. Network effects can also theoretically account for the prominence of ethnically homogeneous business groups. They are examined in the next section.

2.2. Reputation and Network Effects

Network effects may affect the allocation trade credit through the circulation of information, and the use of social sanctions. The circulation of business-relevant information within a closely knit, ethnically or religiously homogeneous community benefits its members. In particular, the dissemination of information about reliable clients and suppliers helps members of the community identify trustworthy commercial partners. Such network effects have been studied in other markets – in particular, labor (see Montgomery (1991) and the references cited therein). The circulation of information within a business network also makes group sanctions possible: the community can punish breach of contract by jointly refusing to deal with bad payers (e.g. Kandori 1992, Greif 1993, Greif 1994).[17] Exclusion from other forms of economic and social interactions may also be used to punish deviance (e.g. Basu 1986, Spagnolo N.d., Ligon, Thomas & Worrall 2001). Group punishment makes firms more confident they will not be cheated by group members. As a result, they may prefer to trade within their community. Whenever business communities are built along ethnic, religious, or gender lines, network effects result in apparent discrimination.

We now investigate the possibility that network effects influence the allocation of trade credit. For the sake of generality, we adopt minimal assumptions regarding the role that networks play in economic exchange: we simply assume that firms in a particular group share information about each other. Behind this assumption is the idea that clients come recommended by members of their community. Provided the source of information is known to the supplier, recommendations can be used to screen trade credit applicants. It may even enable them to receive instant credit (e.g. Fafchamps 2003*b*, Fafchamps 1997, Fafchamps & Minten 1999, Fafchamps 2000). Unknown prospective customers can, as before, be screened at a cost c. The possibility of group punishment – exclusion from trade and social ostracism – is ignored

[17] For a discussion on how joint punishment can be enforced, see also Ellison (1994) and Fafchamps (2003*b*). A shared sense of moral outrage may help ensure widespread participation even if the punishment imposes a cost on the punishing party and is not otherwise individually rational. Platteau (1994) discusses the relationship between ethics and markets. Raub & Weesie (1990) illustrate how the contract enforcement advantage of closed groups ('cliques' in the language of sociology; Mitchell (1969)) extends to interconnected networks.

from the formal presentation;[18] including it would only magnify network effects.

We focus on one situation of interest: that in which one group has established a dominant position upon a particular activity. We call them the 'in' group, indexed with subscript I.[19] Other competent agents – the 'out' group, indexed with subscript O – belong to the population at large and are assumed not to benefit from network effects. Extending the model to competing networks is left for future research. We now show that networking can yield patterns of discrimination that are difficult to distinguish from statistical discrimination. To show this formally, let β_I^* and β_O^* be the trade margins that are just sufficient to deter breach of contract among 'in' and 'out' firms, respectively. Define α_I^* and α_O^* as the trade margins required for 'in' and 'out' suppliers to screen unknown prospective customers, respectively. When 'in' suppliers refuse to screen 'out' clients, simple algebra yields:

$$\beta_I^* = \frac{1-\delta\mu}{1+\delta\theta-\delta\mu\theta} \tag{2.11}$$

$$\beta_O^* = \frac{1-\delta\mu}{1+\delta-\delta\mu} \tag{2.12}$$

$$\alpha_I^* = \frac{1-\tau}{\tau-(1-\theta)(1-\mu)} + \frac{c(1-\delta(\tau-(1-\theta)(1-\mu)))}{\delta(1-\mu)(\tau-(1-\theta)(1-\mu))} \tag{2.13}$$

$$\alpha_O^* = \frac{1-\tau}{\tau} + \frac{c(1-\delta\tau)}{\delta\tau(1-\mu)} \tag{2.14}$$

Armed with these expressions, we can now state the following proposition:

Proposition 3. *(Proof in appendix).*

(1) If $\alpha_I^*+\beta_O^* \leq \kappa$ and $\beta_I^* \leq \kappa$, the only self-enforcing trust-based equilibria that exist are equilibria in which 'out' clients are all screened but 'in' clients receive instant credit from 'in' suppliers. If, in addition, $\beta_I^*+\alpha_I^* > \kappa$, 'in' suppliers charge a higher price to 'out' than 'in' clients.

(2) Let $\beta_O^{**} == \tau-(1-\mu)(1-\theta)$. If $\beta_I^* < \kappa$, $\beta_O^{**}+\alpha_I^* > \kappa$, and $\beta_O^{**}+\alpha_O^* < \kappa$, the only self-enforcing trust-based equilibria that exist are equilibria in which 'in' suppliers refuse to screen 'out' clients but 'out' suppliers accept to screen them. These conditions are more likely to be satisfied when θ is small, that is,

[18] Information sharing makes it theoretically possible to construct reputational equilibria in which breach of contract is punished by exclusion from future trade credit with all members of the group. Voluntary participation to collective punishment raises complex enforcement issues that are discussed in Fafchamps (2003*b*).

[19] Since 'in' agents are established firms, they are, by definition, competent. One could, of course, conceive a more general model in which all the network does is provide a signal that is more precise than ethnicity, but does not predict competence perfectly. It should be intuitively clear that as long as the signal transmitted by the network is sufficiently precise, the results derived here carry through (e.g. Taylor 1997, Fafchamps 1997).

when the proportion of insiders in the economy is large. Discriminatory rationing (in which 'in' suppliers randomize) may also arise.

(3) For high enough screening costs, the only self-enforcing trust-based equilibria that exist are equilibria in which 'out' clients are never screened and thus never receive trade credit; the latter form a 'flea-market' economy that operates at the margin of a closely knit business community where trade credit is the norm.

Proposition 3 shows that network effects are theoretically capable of generating equilibrium configurations that resemble those resulting from statistical discrimination. The reason is that if members of a particular ethnic group manage to establish an information sharing network among themselves, they will trade with each other more easily than with outsiders. The higher payoffs of well connected firms can be understood as returns to 'social capital' cit (e.g. Coleman 1988, Putnam, Leonardi & Nanetti 1993). Clients outside the group may then find themselves discriminated against, either through prices, rationing or exclusion. This occurs even though, strictly speaking, they are not the victim of discrimination. Rather, they are disadvantaged because they do not belong to an information diffusion network.[20] It is the absence of a general information sharing mechanism including members of all ethnic groups that makes deals across ethnic boundaries difficult.[21]

The model presented in this section has illustrated that statistical discrimination and network effects have superficially similar effects on rationing and exclusion from trade. The presence of statistical discrimination explains why members of a disadvantaged group can be treated in a less desirable fashion – i.e., by being excluded from trade or treated in a less trusting manner. Network effects can have similar consequences.

Social networks often are organized around ethnicity for a variety of reasons such as intermarriage, spatially segregated residence, language, or culturally determined interest in particular activities (e.g.,

[20] This begs the question of why outsiders do not respond by creating their own information sharing group. One possible explanation is that ethnic heterogeneity hinders outsiders' effort to construct an independent network. Outsiders may also find it more attractive to individually join the existing network, e.g., through marriage, conversion, or friendship, instead of forming a competing network which would, initially at least, be very small. The tension between an 'integration' strategy and a 'self-segregation' strategy may thus undermine outsiders' efforts. These issues deserve further research.

[21] To the extent that B firms are unreliable because of their lack of experience, setting up a credit reference system may actually make it harder for them to join the mainstream (e.g. Fafchamps 2003*b*, Fafchamps 1997). Indeed, their initial incompetence gets widely advertised, making it potentially difficult for them to be granted a second chance.

going to church) or sports (e.g., golf). If business networks develop around ethnicity, the arguments presented in this section demonstrate under what circumstances ethnic bias will last. We now take these ideas to the data.

3. The Data

Surveys of traders of domestic agricultural products were conducted in 1999/2000 in Benin (August-September 1999) and Malawi (August 1999-February 2000). A market-level survey was also conducted in order to obtain information on the marketing environment. The work was coordinated by the International Food Policy Research Institute (IFPRI), Oxford University, and the World Bank. Data collection in the field was directed by the Laboratoire d'Analyse et de Recherche Economique et Sociale (LARES) in Benin, and by the Agricultural Policy Research Unit (APRU) in Malawi. A similar survey was conducted in Madagascar in the Fall of 2001. Survey work was undertaken in collaboration between Cornell University, Oxford University, and the local Ministry of Scientific Research (FOFIFA). Funding for survey work was provided by USAID and the Pew project.

All three surveys focus on agricultural traders at both the wholesaler and retailer level.[22] Survey sites are market towns active in agricultural products. 24 markets were selected in Benin, 30 in Madagascar, and 40 markets in Malawi based on their trade importance and the availability of secondary price data. Due to the absence of reliable census information on the population of traders in both countries, a census of traders was conducted in each selected market.

In Benin, the survey team counted all traders present on the market in a given day. This count was supplemented by lists of traders obtained from the ONASA (Office National d'Appui à la Sécurité Alimentaire) and the regional bureaus of the Ministry of Commerce. These lists include larger traders

[22] Efforts to include agricultural inputs and cash crops into the survey were largely unsucessful. In Benin, it became clear early on that fertilizer and seed trade are closely linked to the production of cotton. Cotton marketing is under the monopoly of a parastatal enterprise, the Societé Nationale de Promotion Agricole (SONAPRA). Input trading is done primarily through village cooperatives called Groupements Villageois (GV), rather than by individual traders. The GVs purchase inputs from 9 government-licensed fertilizer importers and distribute these inputs among their members. The marketing of cotton, the dominant export crop, goes entirely through SONAPRA.

In the case of Malawi, the distribution of fertilizer and other agricultural inputs is dominated by few very large firms, such as OPTICHEM and Norsk/Hydro. Inputs are distributed throughout the country by traders operating as selling agents for large corporations. A specific survey was organized for these selling agents, who do not conduct purchases, but who do sell independently. Results are not discussed here. A handfull of independent tobacco traders are recorded in the Malawi survey.

who need not have a stall on the market itself. The two lists and the count were combined to construct a frame from which a sample was randomly drawn, resulting in a total sample of 663 agricultural traders.

In Malawi, a reconnaissance survey of traders was conducted in July-August 1999 to count and identify traders according to their status (independent, buying agent, or selling agent), their level (retail or wholesale), and the types of products they trade. The information on the name, type, and location of traders from the reconnaissance survey were entered into a spreadsheet and the sample was drawn randomly from the census data using a computer algorithm. A total sample of 738 traders was interviewed in Malawi.

In Madagascar, three main agricultural regions were selected (Fianarantsoa, Majunga, and Antananarivo) and the sampling frame within these regions was set up as follows. Traders were surveyed in three different types of location: big and small urban markets in the main town of every province (faritany) and district (fivondronana); urban areas outside urban markets; and rural markets at the level of the rural county (firaisana). Rural firaisanas were selected through stratified sampling based on agro-ecological characteristics so as to be representative of the various kind of marketed products and marketing seasons. Traders traders operating in urban markets are mostly wholesalers, semi-wholesalers, and retailers. Urban traders located outside regular markets are bigger traders, processors (e.g., rice millers) and wholesalers. Traders operating on rural markets are mostly big and small assemblers and itinerant traders. A first trader survey was undertaken in 1997 in the same location. Only 30% of the surveyed 1997 traders were still operating in 2001. The 2001 sample is constructed so as to be representative of the trader population in 2001.

The questionnaire collects detailed information on the characteristics of the trader as well as on trade credit, contract enforcement and dispute settlement, information, and property rights enforcement. The characteristics of surveyed traders is summarized in Table 1. Traders are primarily middle-aged individuals with several years of experience in trade. Schooling is higher in Madagascar, lower in Benin where trade experience is higher. In contrast with the other two countries, a majority of Beninese agricultural traders below to at least one trader organization. This results from a government effort to support trade by encouraging associations. Trade is a more common occupation in Benin, especially

among women. This is reflected in the higher number of relatives in trade and the majority of mothers whose main occupation is trade. On average, surveyed traders have enjoyed a growth in their working capital and social networks since start-up.

In Table 2 we report the gender, ethnicity, and religion of surveyed traders. These characteristics are easily observable (e.g., name, attire) and are natural candidates for an investigation of discrimination. We see that agricultural trade is primarily a female occupation in Benin and Madagascar. For each sample, we distinguish between 6 major ethnic groups, plus a residual category. The determinants of ethnicity vary between the three countries. In Benin, language is the main criterion for deciding someone's ethnic group. In contrast, ethnicity in Madagascar is determined with reference to the region in which someone's ancestors are buried. There is considerable ethnic diversity in each sample. Of the three surveyed countries, Benin has the highest level of religious diversity, with Muslims and Christians at par and a large minority of respondents who describe themselves as followers of traditional religions. In Malawi and Madagascar, the overwhelming majority of traders are Christian.

Each country sample covers between 20 and 25 districts, each with a slightly different gender, ethnic, or religious make-up. Discrimination and group membership are thus likely to operate differently in different districts. What matters is whether a trader is part of the 'mainstream', that is, is like the majority of traders in his or her immediate vicinity. To capture this idea, we construct a measure of membership in dominant local groups as follows. Within each district, we compute the proportion of each gender, ethnic, and religious group in the sample. We then construct a variable that takes the value 1 if a trader has the same gender, ethnicity, or religion as the majority of other traders in the district. Districts where no group has more than 50% of surveyed traders are regarded as having no majority group. Averages are displayed at the bottom of Table 2. We see, for instance, that in Benin some 44% of respondents are member of the locally dominant ethnic group albeit, in the sample as a whole, no group has more than 23%. The same is true for religion. This is because ethnicity and religion are geographically concentrated.

Our main dependent variables are summarized in Table 3. Together they capture key dimensions of

the transaction technology in each country. The first two variables are our measures of trust.[23] They are responses to questions 'does any of your suppliers let you buy on credit?' and 'do you let any of your client buy on credit?'.These questions basically measure whether credit is offered. This is credit of very short duration – three quarter of the cases, the duration of the credit is equal or less than 7 days. We see that trade credit is much more likely to be offered in Benin and Madagascar than in Malawi. The next variable is a response to the question 'if your client does not pay, will his or her other suppliers know it?'. This is our measure of information sharing. We see that in all three countries roughly two third of the respondents claim that some suppliers would get to know about it, representing a moderate level of information sharing (e.g. Fafchamps & Minten 1999, Fafchamps & Minten 2001*a*). Our final two variables measure actual trade credit usage. We see that the average percentage of purchases and sales on credit is small, especially in Malawi.

4. Econometric Analysis

4.1. Testing for ethnicity, gender, and religion

Having familiarized ourselves with the conceptual framework and the data, we begin by testing whether gender, religion, and ethnicity affect the transaction technology in a way that is common across locations. To this effect, we regress our five measures of transaction technology on gender, ethnicity, and religion. To avoid omitted variable bias, we control for personal characteristics of the trader such as age and age squared, education, number of languages spoken, experience, and working capital.[24] Because our three variables of interest vary systematically across districts, we include district dummies as well to control for location-specific effects that are not due to gender, ethnicity, or religion. This means that our regression coefficients are only identified by variation across traders within districts. Each regression is estimated for each of the three countries separately. For each regression, we conduct a joint significance test for ethnicity and for religion dummies. We also examine the sign of the coefficients. We expect women to be at an advantage in Benin and Madagascar since they represent the majority of traders. We also expect

[23] Payment by check, another indicator of trust, represents only a minute proportion of all payments, thereby precluding any statistical analysis.

[24] Because of possible endogeneity bias, working capital is instrumented using conditions at start-up.

ethnic and religious groups that represent a smaller proportion of traders to receive and give less supplier credit.

An example of the kind of regression we estimate is given in Table 4 for our first transaction technology variable. To save space, results are simply summarized here. We find that, once we control for personal characteristics and district dummies, gender is seldom significant. The only regression in which gender is significant (percentage of purchases on credit in Benin), the coefficient is negative, contrary to expectations. Ethnicity seldom plays a significant role in trade credit. When it occasionally tests significant, individual coefficients do not have the expected sign (i.e., a small ethnic group is shown to have better access to credit). The only exception is information sharing, for which ethnicity is jointly significant in all three countries. In Benin, one coefficient has the expected sign: the Nago, which represent close to one fourth of the Beninese sample, have a strong positive coefficient. But so do the Dendi, who are a small group. In the other countries, no clear pattern can be seen since none of the ethnicity coefficient is individually significant and many signs for minor groups are positive.

Religion is a different story. Muslim traders in Malawi and non-Christian traders in Madagascar more often report being offered credit by suppliers. Purchases on credit also represent a significantly larger share of total purchases. In contrast, non-Christian Beninese traders do not receive more credit but offer more credit to clients. While these results are not fully consistent (credit from suppliers in Malawi and Madagasar, credit to clients in Benin; very small sample of non-Christians in Madagascar), they appear to suggest that Christian traders are less inclined towards trade credit and, by implication, less trusting and less trusted. These findings are consistent, for instance, with the work of Ensminger (1992) who report that Islam penetrated cattle trade in Kenya because it fostered trust. Greif (1994) also emphasizes the role of religion in trade, but in his work on Genoese merchants, comes to a different conclusion regarding which 'culture' is more emphatic to trade.

4.2. Testing for locally dominant groups

The lack of strong gender and ethnicity effect and the ambiguity of the reported religion effect may be due to an inappropriate aggregation scale. For dummies to be significant, a particular group – based on gender, ethnicity or religion – would have to be better trusted over a very large geographical area. This

need not be the case if the effect of trust and discrimination operate only at the local level. If this is true, what matters is not ethnicity per se but whether a trader is member of whichever group is locally dominant.

To investigate this possibility, we construct an indicator variable that takes the value one if the respondent has the same ethnicity as at least half of the other traders in the district. In districts where no group dominates, the indicator variable is zero. With this definition, members of even small ethnic group may have a local advantage. Similar indicator variables are constructed for gender and religion. Mean values of the variable were reported in Table 2.

We add these variables to our regressions. Results, not shown here for lack of space, are mixed. While local group dummies are jointly significant in 5 cases out of 15, they do not always have the expected sign. Whenever the local ethnicity dummy is significant, it has the wrong sign. The national ethnicity dummies themselves become mostly non-significant. The local gender group variable is individually significant three times with the correct sign. But in Benin, when it is significant gender itself has a negative coefficient. The local religion group dummy is individually significant four times, always with the expected (positive) sign. Its presence does not subtract from the significance of the religion dummies, with Muslims more likely to offer and be offered trade credit.

4.3. Testing for network effects

Albeit our results so far provide mild evidence that religion matters, they are in contradiction with the many sociological studies who insist on the importance of ethnicity in African trade. In an attempt to resolve this contradiction, we investigate the possible existence of network effects. Ethnicity may matter not because of general trust within ethnic communities and because of possible discrimination along ethnic lines, but because it is a determinant of membership in trade networks (e.g. Cohen 1969, Meillassoux 1971, Amselle 1977).

To investigate network effects, we add four new variables to the regressions: the number of suppliers known, the number of clients known, the number of relatives in trade, and membership in a trader association. The four variables are instrumented using start-up working capital, numbers of suppliers and clients known, the number of relatives, and the average association membership in each district.

Results are much more encouraging: network variables are jointly significant in 12 regressions out of 15, albeit in three cases with the wrong sign. Religion effects again remain unchanged.

The conclusion we draw from this exercise is that networks matter. To be offered and to offer trade credit, knowing people seems more important than being of the 'correct' ethnicity or gender. These results confirm earlier work on the effect of network membership on trader performance (e.g. Fafchamps & Minten 2002, Fafchamps & Minten 2001*b*). In turn they raise the issue of how family background and ethnicity affect the formation of networks. To this issue we now turn.

5. Endogenous Networks

We investigate endogenous network formation in two steps. We first examine the determinants of networks at start-up. We then study the factors that affect the growth rate of networks over time. We also examine the role of working capital, in case ethnicity operates not through trade networks but through equity financing networks, i.e., parents and kin investing in the respondent's business.

Start-up network variables are the number of suppliers and clients known at start-up as well as start-up working capital. Means were reported in Table 1. Regressors include gender, ethnicity, and religion dummies as before. We also include personal characteristics such as age at start-up (and age squared), number of languages spoken, and years of schooling. Family background variables, such as profession of the parents and experience in trade, are added to control for possible financial effects and prior exposure to trade.

We estimate the regressions without and with local group effects. Regressions without local group variables show no effect of ethnicity or religion, except an occasional significant coefficient, always with the wrong sign. Results with local group effects are reported in Tables 5, 6, and 7. We see that ethnicity variables are never jointly significant, except in one case with the wrong sign: members of ethnic groups marginally represented in trade appear advantaged in start-up conditions, a result that contradicts the presence of ethnic favoritism. Religion is never significant. In contrast, gender is often significant and always negative: female traders start their business with fewer contacts and less capital. This is consistent with trade being a transient income generating activity for many African women, in which they enter

and exit depending upon family circumstances (Spring & McDade 1998).

Being of the same ethnic group as the majority of traders in the district has a negative effect on start-up contacts and capital in 6 out of 9 regressions – in one case, this effect is significant. Being of the same religion has a negative coefficient in 5 out of 9 regression and is never significant. In contrast, being of the same sex of the most local traders has a significant positive effect on trade contacts in Benin. Combined with the fact that being a women has a strong negative effect on start-up contacts, this suggests that Beninese male traders have more start-up contacts in districts where they represent the bulk of the traders.[25]

In contrast, family background is shown to have some effect on start-up conditions, especially trading experience. Better educated traders start with more working capital, possibly because they were able to save more money on an earlier, better paid wage job. To summarize, we fail to find strong evidence that ethnicity affects start-up networks and capital.

Let us now turn to growth of networks and working capital after start-up. If members of a particular gender, ethnic, or religious group are advantaged in business, they should accumulate contacts and capital faster. Results are summarized in Tables 8, 9, and 10 for known suppliers, known clients, and working capital. As before, regressors include gender, ethnicity, and religion dummies together with district dummies. Personal characteristics include the age of trader at start-up (and age squared), number of languages, and years of schooling. Years of trading experience control for the time elapsed since start-up. Since both experience and the dependent variable are expressed in log, the (conditional) annual growth rate can be calculated as the coefficient of experience divided by years of experience.[26] Start-up conditions are included as well as the number of relatives. As before, local group effects are included to test for location specific favoritism.

Results show that the number of suppliers and clients known increases on average at 8 to 20% during the initial year, but rises slower in subsequent years. Working capital grows much faster, at 5% per year on average in Benin and Malawi, and 9% in Madagascar. Being a woman has a negative effect on the

[25] If local group effects are not included in the regression, the female dummy has the same sign and remains significant, but with a much smaller coefficient in absolute value.

[26] A constant growth rate of the number of traders known was strongly rejected by the data: growth is faster initially.

growth of working capital in all three countries; the effect is significant in two of them. The effect is also strongly negative and significant in Benin if either the district dummies or the local group dummies are omitted from the regression. Although we do not have information on why female traders accumulate capital more slowly, this finding is consistent with the often made observation that African women use their personal income to pay for school fees and better child nutrition. Women also accumulate business contacts more slowly in Malawi and Madagascar, perhaps because their freedom to move from market to market is hindered by parenting responsibilities.

Ethnicity and religion dummies are occasionally significant, but usually with the wrong sign – ethnic groups that represent a smaller proportion of traders being shown to accumulate contacts and capital faster. The only exception is the Christian dummy in Benin, which is positive and significant for number of suppliers known. The same effect is not, however, observed for clients known, suggesting that the finding is not robust. Membership in locally dominant groups is never jointly significant. Individual dummies are occasionally significant, but always with the wrong (negative) sign.

There are some other results of interest. Education has a strong positive effect on the accumulation of working capital in all three countries, suggesting that better educated traders not only start with more capital but also accumulate faster. Traders who speak more languages tend to accumulate working capital faster in Benin and Madagascar.

6. Conclusions

In this paper, we have examined the role that gender, ethnicity, and religion play among agricultural traders. It is widely believed that these three factors play a paramount role in shaping African trade. It is common for African politicians and external observers alike to claim that trade is 'in the hands' of a particular group and to call for policy interventions to curb what is often thought to result from favoritism and discrimination.

Using surveys conducted in three African countries (Benin in West Africa, Malawi in Southern Africa, and Madagascar in the Indian ocean), we investigate these claims in detail. We begin with an examination of transactions practices, using the willingness to offer (very short-term) trade credit as a measure of trust.

We also measure information sharing about breach of contract as the likelihood that other suppliers would learn about non-payment. The effects of ethnicity, gender, and religion are tested both at the national level and at the local level, that is, relative to other traders in the same district.

Contrary to expectations, we find no conclusive evidence that members of a particular sex or ethnic group are more easily trusted by suppliers or that they trust clients more easily. Non-Christians – particularly Muslims – appear to trust and be trusted more, but the effect is apparent in only two of the three countries where Christians are an overwhelming majority. In Benin where Muslims represent 40% of the sample, no such effect is found. Perhaps it is being different from the rest (more devout?) that raises trust. This issue deserves more investigation.

In contrast, network effects have a stronger and more systematic effect on trust and information sharing – albeit occasionally with the wrong sign. These results are to be interpreted in the light of other work that has shown strong returns to network capital in African trade and business (e.g. Fafchamps & Minten 2002, Fafchamps & Minten 2001*b*, Barr 2002).

Finding network effects does not, however, eliminate the possibility of discrimination on the basis of ethnicity and the like. It is indeed conceivable that members of the dominant trading group start their business with better contacts and better access to equity finance. They may also accumulate contacts and funds faster over time, thanks to favoritism. To investigate this possibility, we examine whether ethnicity, gender, and religion affect start-up conditions and growth over time.

We find that women accumulate working capital much slower than men, but this appears to have little to do with their being marginalized: the effect is strong in two of the three countries, including in Madagascar where women represent 60% of surveyed traders. Women also start business will less capital. In contrast, better educated traders start with more capital and accumulate it faster. Ethnicity and religion appear to have little if any systematic effect on start-up conditions and accumulation of network and working capital. Whenever a relationship is found, it usually is contrary to what would occur if favoritism based on ethnicity and religion were present.

Taken together, these results suggest that ethnicity and religion only have limited effects on agricultural trade in the three countries studied. Whenever present, these effects tend to be country specific so

that it would be hazardous to extrapolate them to other countries. Gender matters more, but at least part of the gender effect reflect the different role women play in the household – particularly the tendency to initiate smaller, more transient businesses and to siphon funds off the business, possibly to finance investment in children.

The result presented here do not rule out the existence of strong ethnic, gender, or religious bias in other African countries. But one should be cautious not to generalize these local situations to all of Africa. Our surveys suggest instead that, in the three countries studied, agricultural trade is open to all, irrespective of gender, ethnicity, or religion. Networks matter, and better connected traders have larger and more prosperous businesses. But members of all groups start more or less from an equal footing to accumulate network and working capital. This ease of entry probably explain why scores of Africans, many of whom women, flock into agricultural trade as an income earning opportunity (Barrett 1997).

7. Appendix: Proofs of the Propositions

Proof of Proposition 1

Steady state payoffs are:

$$V^S = \frac{(1-\delta\mu)(\alpha\tau - 1 + \tau) - c\delta(1-\tau)}{(1-\delta)(1+\delta-\delta\mu-\delta\tau)} \tag{7.1}$$

$$V^N = \frac{\delta(1-\mu)(\alpha\tau - 1 + \tau) - c(1-\delta\tau)}{(1-\delta)(1+\delta-\delta\mu-\delta\tau)} \tag{7.2}$$

$$V^C = \frac{(1-\delta\mu)(\beta\tau + 1 - \tau)}{(1-\delta)(1+\delta-\delta\mu-\delta\tau)} \tag{7.3}$$

$$V^U = \frac{\delta(1-\mu)(\beta\tau + 1 - \tau)}{(1-\delta)(1+\delta-\delta\mu-\delta\tau)} \tag{7.4}$$

Let us now turn to the seven equilibrium conditions EC1-EC7. Equilibrium condition EC4 is always satisfied, implying that trust-based strategies cannot prevent breach of contract at the end of a relationship. It is easy to verify from equations (A3) and (A4) that EC2 and EC6 are always satisfied. EC1 holds as long as EC5 does. EC3, EC5, and EC7 are thus the only constraints to consider.

By plugging equations (A3) and (A4) into EC3 and simplifying, we obtain:

$$\beta \geq \frac{1-\delta\mu}{1+\delta-\delta\mu} = \beta^* \tag{RC}$$

Using equation (A2), the screening condition EC6 can similarly be simplified as:

$$\alpha \geq \frac{1-\tau}{\tau} + \frac{c(1-\delta\tau)}{\tau\delta(1-\mu)} \tag{SC}$$

For EC7 to be satisfied, the proportion μ of incompetent firms in the economy must such that:

$$\mu \geq \frac{c+\alpha}{1+\alpha} \tag{EC7'}$$

Rearranging (RC), (SC) and (EC7') proves both part 1 and part 2.■

Proof of Proposition 2:

Part (1):

Define a discriminatory exclusion equilibrium (DEE) as one in which suppliers screen A firms but not B firms; as a result, B firms never receive trade credit. With probability $1-\theta$, unmatched suppliers meet B clients; in a DEE they refuse to screen them and choose instead to wait until the next trading round. With probability θ, they are matched with A firms which they screen. A μ_A proportion of them turn out to be reliable and become long-term clients; the others cheat and are discarded. Screening costs θc are lower than if all trade credit applicants are screened. In such an equilibrium, suppliers' expected payoffs are:

$$V^S = \tau(\alpha + \delta V^S) + (1-\tau)(-1 + \delta V^N) \tag{7.5}$$

$$V^N = \delta V^N(\theta\mu_A + 1 - \theta) + \delta V^S\theta(1-\mu_A) - \theta c \tag{7.6}$$

Since in a DEE all suppliers behave in the same way, A clients receive trade credit from competent A

and B suppliers alike. The expected payoffs of matched and unmatched A firms are, respectively:

$$V_A^C = \tau(\beta + \delta V_A^C) + (1-\tau)(1 + \delta V_A^U) \tag{7.7}$$

$$V_A^U = (\theta\mu_A + (1-\theta)\mu_B)\delta V_A^U + (\theta(1-\mu_A) + (1-\theta)(1-\mu_B))\delta V_A^C \tag{7.8}$$

By construction, all B clients remain forever unmatched and their expected payoff V_B^U is 0. If, by chance, a B client was able to establish a trade credit relationship with a supplier, its expected payoff would be:

$$V_B^C = \tau(\beta + \delta V_B^C) + (1-\tau) \tag{7.9}$$

Steady state equilibrium values for V^S, V^N, V_A^C, V_A^N, and V_B^C can be derived from the above equations; they are similar to equations (A1) to (A4) and are skipped for the sake of brevity.

For a DEE to be self-enforcing, several equilibrium conditions must be satisfied, four of which deserve consideration: A clients must pay their suppliers (EC8); suppliers must screen A clients (EC9); they must not screen B clients (EC10); and B cannot credibly induce suppliers to screen them by offering to pay a higher price. We begin with the first three conditions:

$$\beta + \delta V_A^C \geq 1 + \delta V_A^U \tag{EC8}$$

$$V^N \geq 0 \tag{EC9}$$

$$V^N \geq (\theta\mu_A + (1-\theta)\mu_B)\delta V^N + (\theta(1-\mu_A) + (1-\theta)(1-\mu_B))\delta V^S - c \tag{EC10}$$

Replacing by equilibrium values and solving for β and α, we get:

$$\beta \geq \beta_A^* \equiv \frac{1 - \delta\theta\mu_A - \delta(1-\theta)\mu_B}{1 + \delta - \delta\theta\mu_A - \delta(1-\theta)\mu_B} \tag{EC8'}$$

$$\alpha \geq \alpha_A^* \equiv \frac{1-\tau}{\tau} + \frac{c(1-\delta\tau)}{\delta\tau(1-\mu_A)} \tag{EC9'}$$

$$\alpha \leq \alpha_B^* \equiv \frac{1-\tau}{\tau} + \frac{c(1-\delta\tau+\delta\theta(\mu_B-\mu_A))}{\delta\tau(1-\mu_B)} \tag{EC10'}$$

The repayment condition EC8' is essentially the same as that derived in Section 2, except that the

matching probabilities are slightly different. For the two screening conditions EC9' and EC10' to hold simultaneously, α_B^* must be greater than α_A^*. If $c = 0$, this requirement cannot be satisfied. Suppose that $c > 0$. Since, by assumption, $\mu_B > \mu_A$, the denominator of the c term is lower and the numerator larger in EC10' than in EC9'. Consequently, whenever $\mu_B > \mu_A$, then $\alpha_B^* > \alpha_A^*$ irrespective of the values of δ, τ, θ, c, μ_A and μ_B and there exist values of α that satisfy both screening conditions (EC9') and (EC10'). The larger the gap between μ_B and μ_A, the larger the set of values of α for which both conditions hold. For conditions (EC8') to (EC10') to be satisfied simultaneously, the combined gains from trade κ must be large enough to ensure that there exist values α and β such that $\beta > \beta_A^*$, $\alpha \geq \alpha_A^*$, and $\alpha + \beta = \kappa$. If this requirement does not hold, suppliers will refuse to screen anyone and trade credit will not be offered.

So far we have implicitly assumed that suppliers charge the same price to all clients, irrespective of their ethnic background. Could B clients induce suppliers to screen them by offering to pay a price higher than that charged to A firms? To verify that the DEE is robust to such offers, we examine whether a supplier could improve its lot by departing from discriminatory exclusion in exchange for a higher sale price – and thus a higher α. Since we are considering a single deviation from the equilibrium path, we assume that other suppliers continue to exclude B firms from trade credit. If a B client can credibly offer to split gains from trade κ in such a way that $\alpha > \alpha_B^*$, then discriminatory exclusion is not self-enforcing.[27] Such an offer is credible only if repayment by the B firm is self-enforcing, i.e., if:

$$\beta + \delta V_B^C \geq 1 + V_B^N \qquad \text{(EC11)}$$

Replacing V_B^C and V_B^N by their equilibrium value, we get:

$$\beta \geq \beta_B^* \equiv 1 - \delta \qquad \text{(EC11')}$$

where β_B^* is the profit margin that is just sufficient to induce an otherwise excluded B firm to repay trade credit. As is apparent from comparing (EC8') to (EC11'), $\beta_B^* < \beta_A^*$: B firms who are lucky enough

[27] More precisely, it is not sustainable without a meta-punishment that deters suppliers from accepting higher prices from B clients. Since both supplier and client have an incentive to conceal that a higher price was charged, enforcing such a meta-punishment is problematic. We prefer to focus here on decentralizable punishment mechanisms.

to receive credit from one supplier in a DEE are more reliable than A firms. The reason is that they value the relationship more than A firms since, unlike A firms, they would not receive trade credit from another supplier if they cheat.

If $\beta_B^* + \alpha_B^* > \kappa$, there exist no attribution of the gains from trade such that the supplier can be induced to screen a B firm and the B firm can be induced to pay the supplier. A DEE is thus self-enforcing if the value of κ is such that:

$$\alpha_A^* + \beta_A^* < \kappa < \alpha_B^* + \beta_B^* \tag{EC12}$$

For such a κ to exist, $\alpha_A^* + \beta_A^* - \alpha_B^* - \beta_B^*$ must be negative, i.e., we must have:

$$\frac{\delta^2(1-\theta\mu_A-(1-\theta)\mu_B)}{1+\delta-\delta\theta\mu_A-\delta(1-\theta)\mu_B} - \frac{c(\mu_B-\mu_A)(1-\delta\tau+\delta\theta(1-\mu_A))}{\delta\tau(1-\mu_A)(1-\mu_B)} < 0 \tag{EC13}$$

The first term corresponds to $\beta_A^* - \beta_B^*$; it is positive. The second term corresponds to $\alpha_A^* - \alpha_B^*$; it is negative whenever $c > 0$ and $\mu_B > \mu_A$. It is also decreasing (more negative) in c and $\mu_B - \mu_A$. Since (EC13) is linear in c, it is obvious that, for any set of parameter values, there exist a screening cost c, say c^*, such that, for all $c > c^*$, (EC13) is negative. For any $c > c^*$, therefore, there exist values of κ that satisfy equation (EC12) and for which the DEE is self-enforcing. This completes part (1).

Part (2):

When discriminatory exclusion is not self-enforcing, price discrimination may nevertheless arise. To see why, consider an equilibrium in which all agents, irrespective of their type, are screened by suppliers. The minimum level of β that deters breach of contract is thus the same for all. It is equal to β_A^* from (EC8). The minimum level of α that is needed to induce suppliers to screen, however, depends on the client's ethnicity. The difference between the two can be computed to be:[28]

$$\alpha_B^{**} - \alpha_A^{**} = \frac{c(\mu_B-\mu_A)(1+\delta(1-\tau)-\delta\theta\mu_A-\delta(1-\theta)\mu_B)}{\delta\tau(1-\mu_A)(1-\mu_B)} \tag{7.10}$$

[28] Equation (7.10) is derived as follows. Equilibrium values for $gsize9V^S$ and V^N are computed assuming that all firms are screened as in section 2. α_A^{**} and α_B^{**} can then be computed from the screening conditions $\mu_i\delta V^N + (1-\mu_i)\delta V^S \geq \delta V^N$, for $i \in \{A, B\}gsize11$.

The sign of $\alpha_B^{**} - \alpha_A^{**}$ is the same as the

sign of $\mu_B - \mu_A$: suppliers require a higher minimum profit rate before screening client populations with a higher proportion of incompetent firms. Since the buyer's profit rate is equal to $\kappa - \alpha$, a higher α means that β must be lower. This does not, however, imply that price discrimination arises whenever observable characteristics such as ethnicity help predict competence; as long as $\alpha_B^{**} + \beta_A^{*} < \kappa$, suppliers can charge the same price to all. In that case, there exists a supplier margin $\alpha > \alpha_B^{**}$ that satisfies both screening conditions and deters breach (i.e., $\beta = \kappa - \alpha \geq \beta_A^{*}$). Whether or not suppliers can set such a price depends on their bargaining power. Powerful buyers may try to force the price below α_B^{**}. Only suppliers dealing with A buyers may agree to do so, in which case A and B buyers will pay a different price. Price discrimination is thus more likely when suppliers' market power is weak.

Part (3):

A third, hybrid equilibrium is also possible in which price discrimination and discriminatory rationing coexist. To see how such an equilibrium may arise, go back to our discussion of discriminatory exclusion. Consider what happens when c is just below c^*, i.e., when:

$$\kappa = \alpha_A^{*} + \beta_A^{*} = \alpha_B^{*} + \beta_B^{*} + \varepsilon \tag{7.11}$$

with ε small. Discriminatory exclusion is not self-enforcing, but this cannot imply that all B firms suddenly get access to trade credit, even at a higher price. The reason is that, if they did, the level of profit required for them to respect contracts would jump from β_B^{*} to the much higher β_A^{*}: the profit rates required to deter breach and guarantee the screening of B firms would exceed total gains from trade κ. Consequently, when c falls just below c^*, only a fraction of the B firms, say γ, can gain access to trade credit. Let β_B^{o} be the minimum profit level that ensures trade credit repayment when the likelihood of being screened by a supplier is γ:

$$\beta_B^{o} = \frac{1 - \delta + \delta\gamma - \delta\gamma\mu_A\theta - \delta\gamma\mu_B(1-\theta)}{1 + \delta\gamma - \delta\gamma\mu_A\theta - \delta\gamma\mu_B(1-\theta)} \tag{7.12}$$

Clearly, β_B^{o} is an increasing function of γ: the more likely B are to receive trade credit after cheating on a

supplier, the harder it is to deter breach. By keeping γ low enough, it can be ensured that $\alpha_B^* + \beta_B^o \leq \kappa$.

For a particular level of discriminatory rationing γ to be an equilibrium, suppliers must randomize. For randomization to constitute a best response, suppliers must be indifferent between screening and not screening B firms. This condition is satisfied only when their margin on B sales is equal to α_B^*. Furthermore, it must not be possible for B firms to credibly offer a buying price higher than α_B^*, otherwise suppliers would not be indifferent between screening and not screening, and randomization would not be optimal. Consequently, for discriminatory rationing to be self-enforcing, it must be that:

$$\alpha_B^* + \beta_B^o = \kappa \tag{7.13}$$

Equation (7.13) thus implicitly determines the equilibrium value of γ and thus the fraction of B clients that suffer from discriminatory rationing. It also indicates that discriminatory rationing must coexist with price discrimination: since $\gamma < 1$ only when $\beta_A^* > \kappa - \alpha_B^* = \beta_B^o$, it follows that the price charged to B firms must exceed that charged to A firms. As μ_B falls relative to μ_A, discriminatory rationing becomes less severe: α_B^* falls, leading to an increase in β_B^o, and thus to a rise in γ. When γ reaches 1, discriminatory rationing disappears, and $\beta_B^o = \beta_A^*$: A firms and B firms have the same breach deterrence condition. Price discrimination may persist, although it is no longer necessary for the equilibrium to be sustainable. This completes the proof.■

Proof of Proposition 3:

Part (1):

We begin by showing that network effects can support steady state equilibria in which 'out' clients are all screened but 'in' clients receive instant credit from 'in' suppliers. We call such equilibria preferential treatment equilibria or PTE. Let θ be the proportion of 'out' firms among unmatched firms.[29] Payoffs

[29] As in the previous two sections, we abstract from the fact that the proportion of unmatched firms depends on strategies. See Fafchamps (1996b) for a thorough treatment.

to matched suppliers and clients in a PTE are given by, respectively:

$$V_k^S = \tau(\alpha + \delta V_k^S) + (1-\tau)(-1 + \delta V_k^N) k \in \{I, O\} \tag{7.14}$$

$$V_k^C = \tau(\beta + \delta V_k^C) + (1-\tau)(1 + \delta V_k^U) k \in \{I, O\} \tag{7.15}$$

Payoffs to unmatched suppliers are:

$$V_I^N = \theta(\mu\delta V_I^N + (1-\mu)\delta V_I^S - c) + (1-\theta)(\mu\delta V_I^N + (1-\mu)(\alpha + \delta V_I^S)) \tag{7.16}$$

$$V_O^N = \mu\delta V_O^N + (1-\mu)\delta V_O^S - c \tag{7.17}$$

Payoffs to unmatched clients can be similarly derived as:

$$V_I^U = \theta(\mu\delta V_I^U + (1-\mu)\delta V_I^C) + (1-\theta)(\mu\delta V_I^U + (1-\mu)(\beta + \delta V_I^C)) \tag{7.18}$$

$$V_O^U = \mu\delta V_O^U + (1-\mu)\delta V_O^C - c \tag{7.19}$$

In a PTE, expected discounted payoffs of 'in' suppliers and clients are higher than those of 'out' firms: 'in' suppliers save on screening and establish full business relationships faster; 'in' clients receive trade credit more rapidly. For a PTE to be self-enforcing, breach deterrence and screening conditions must be satisfied as in sections 1 and 2.

It is easy to verify that $\beta_I^* > \beta_O^*$ always: it is easier to deter breach of contract among 'out' firms because they face a higher penalty. Similarly, it is straightforward to verify that $\alpha_I^* > \alpha_O^*$ always: 'in' suppliers are more tempted than 'out' suppliers to stop screening unknown firms because they can hope to be matched with a known firm in a subsequent period. In contrast, it is never in insiders' interest to refuse instant credit to recommended clients (as long as $\beta_I > \beta_I^*$, of course). For a PTE to be sustainable, total gains from trade κ must be sufficient to ensure that trade margins exist that satisfy the above equilibrium conditions, i.e., it must be that $\alpha_I^* + \beta_O^* \leq \kappa$ and $\beta_I^* \leq \kappa$. If, in addition, $\beta_I^* + \alpha_I^* > \kappa$, 'in' suppliers have to charge a higher price to 'out' than 'in' clients. The reason is that 'in' clients have to be cajoled into repaying suppliers (i.e., $\beta_I^* > \beta_O^*$), while 'in' suppliers have to be bribed into screening 'out' clients (i.e.,

$\alpha_I^* > 0$). Price discrimination may thus arise in a PTE.

Part (2):

To see why network effects can lead to discriminatory exclusion, note that, for trade between 'in' suppliers and 'out' clients to be possible, it must be that $\alpha_I^* + \beta_O^* \leq \kappa$: 'in' suppliers must be compensated for the risk they take in screening unknown firms, and 'out' clients must be motivated to pay suppliers. If total gains from trade κ are not sufficient to ensure that both conditions are satisfied, 'in' suppliers cannot be convinced to screen outsiders. They may continue to offer instant credit to insiders, however. This can be shown formally by considering an equilibrium in which 'in' suppliers offer instant trade credit to 'in' clients but refuse to deal with outsiders. Depending on parameter values, 'out' suppliers may find it optimal to screen clients or to refuse credit to all.

Let us first consider the case in which 'out' suppliers screen clients. Call this equilibrium an outsider exclusion equilibrium (OEE). In an OEE, 'in' clients face the same payoffs as in a PTE and the breach deterrence condition is satisfied for $\beta_I \geq \beta_I^*$. For outsiders, the breach deterrence conditions is now satisfied for:

$$\beta \geq \beta_O^{**} \equiv \frac{1 - \delta\mu - \delta\theta + \delta\theta\mu}{\tau - (1-\mu)(1-\theta)} \tag{7.20}$$

Threshold trade margins for suppliers are the same as in the PTE; 'in' suppliers refuse to screen 'out' clients as long as $\alpha_I < \alpha_I^*$; 'out' suppliers screen all clients whenever $\alpha_O > \alpha_O^*$.

An OEE is sustainable provided that $\beta_I^* < \kappa$, $\beta_O^{**} + \alpha_I^* > \kappa$, and $\beta_O^{**} + \alpha_O^* < \kappa$. Since $\alpha_O^* < \alpha_I^*$ always (see above), it is possible to satisfy the second and third conditions simultaneously. That the three conditions are satisfied for some parameter values is straightforward to verify numerically. It is also easy to check that these conditions are more likely to be satisfied when θ is small, that is, when the proportion of insiders in the economy is large. Discriminatory exclusion can thus result from network effects. Discriminatory rationing may also arise. This can be shown using the same approach as in section 2.[30]

[30] The need for randomization can be seen by noting that $\beta_O^{**} < \beta_O^*$: if, in the vicinity of $\beta_O = \beta_O^{**}$, all out clients were to be suddenly screened by in suppliers, there would be a jump in the breach deterrence condition from β_O^{**} to the higher β_O^*. This jump may violate the requirement that $\alpha_I^* + \beta_O^* < \kappa$, therefore requiring that 'in' suppliers randomize.

Part (3):

If 'out' suppliers find screening too costly, network effects lead to what we may call a closed-shop equilibrium (CSE): only members of the network receive trade credit; outsiders are excluded from receiving any trade credit. To show that a CSE is possible, we must demonstrate that the breach deterrence condition can be satisfied for 'in' clients while at the same time the screening condition is not satisfied for 'out' clients. It is easy to verify that the former holds whenever $\beta_I \geq 1 - \delta\mu - \delta\theta + \delta\theta\mu$. The latter is satisfied if $\alpha_O < \alpha_O^*$. Provided, therefore, that

$$\alpha_O^* > 1 - \delta\mu - \delta\theta + \delta\theta\mu \tag{7.21}$$

there exist values of κ such that a CSE is sustainable. Since α_O^* is an increasing function of c, it is clear that there always exists a high enough level of screening costs such that equation (7.21) is satisfied. A CSE is thus more likely to arise when screening is very costly, as intuition would suggest.■

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Table 1. Characteristics of surveyed traders

Personal characteristics	**Benin**	**Malawi**	**Madagascar**
Age	40.7	33.4	36.2
Number of languages spoken	2.7	2.1	1.3
Years of schooling	2.0	5.6	8.4
Years of experience in trade	20.9	9.3	6.0
Business characteristics			
Working capital (in US$)	1169	580	4479
Membership in trader organization	62.4%	3.1%	10.5%
Number of suppliers known	23.7	21.5	12.2
Number of clients known	28.4	25.5	13.6
Number of close relatives in trade	2.9	1.4	1.1
Start-up conditions			
Start-up working capital (in US$)	166	80	431
Number of suppliers known at start-up	8.8	3.6	4.3
Number of clients known at start-up	11.2	4.4	4.7
Family background			
Occupation of father:			
Farmer	72.2%	64.8%	76.3%
Trader	20.2%	20.6%	12.4%
Wage worker	7.6%	14.6%	11.3%
Occupation of mother:			
Farmer/housewife	47.6%	87.0%	83.4%
Trader	51.9%	11.0%	14.4%
Wage worker	0.5%	2.0%	2.2%
Father's years of experience in trade	4.0	6.1	2.8
Mother's years of experience in trade	20.8	5.0	3.1
Number of relatives	10.2	6.7	8.2

Table 2. Potential discrimination factors

Gender	**Benin**	**Malawi**	**Madagascar**
Female	80.8%	36.3%	61.4%
Ethnicity			
Ethnic group 1	18.9%	23.9%	45.5%
Ethnic group 2	8.1%	17.6%	26.9%
Ethnic group 3	22.5%	4.7%	4.7%
Ethnic group 4	14.3%	22.9%	3.5%
Ethnic group 5	3.5%	4.9%	8.6%
Ethnic group 6	12.7%	17.5%	2.3%
Other ethnic group	20.1%	8.4%	8.5%
Religion			
Muslim	40.9%	16.7%	2.4%
Christian	43.2%	82.1%	94.1%
Other	15.9%	1.2%	3.5%
Membership in locally dominant group			
Member of main gender group in district	78.0%	69.9%	63.8%
Member of main ethnic group in district	43.6%	43.1%	54.7%
Member of main religion in district	75.6%	89.2%	94.1%

Table 3. Transaction technology	**Benin**	**Malawi**	**Madagascar**
Whether credit is offered by suppliers	*percentage of responses*		
No	38.2%	85.0%	44.9%
From some suppliers	56.8%	15.0%	43.6%
From all suppliers	5.0%	0.0%	11.5%
Whether respondent offers credit to clients			
No	23.7%	34.3%	31.9%
To some clients	73.9%	64.3%	67.5%
To all clients	2.4%	1.4%	0.7%
Information sharing with other suppliers			
No	54.6%	30.0%	70.8%
Some suppliers	37.3%	70.0%	27.0%
All suppliers	8.1%	0.0%	2.1%
Supplier credit	*sample average*		
Percentage of purchases on credit	22.7%	3.2%	25.3%
Percentage of sales on credit	23.3%	10.9%	15.6%
Number of observations	662	738	885

Table 4. Whether credit is offered by supplier

(estimator is ordered probit)		Benin		Malawi		Madagascar	
Nobs		607		730		879	
PseudoR-squared		0.171		0.125		0.254	
Possible discrimination factors	**Unit**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**
Gender	female=1	-0.227	-1.25	-0.238	-1.38	0.017	0.17
Ethnic group 2	yes=1	-0.236	-0.64	0.376	0.96	0.420	1.51
Ethnic group 3	yes=1	-0.344	-1.60	0.293	0.74	0.515	**1.81**
Ethnic group 4	yes=1	-0.065	-0.20	0.037	0.07	0.221	0.66
Ethnic group 5	yes=1	0.329	0.75	-0.022	-0.06	0.108	0.32
Ethnic group 6	yes=1	-0.136	-0.45	-0.500	-1.09	0.253	0.51
Other ethnicity	yes=1	-0.311	-1.17	-0.316	-0.67	0.686	**2.24**
Christian (Muslim is omitted category)	yes=1	-0.106	-0.56	-0.710	**-2.71**	-0.895	**-3.00**
Other religion	yes=1	-0.282	-1.25			-0.744	**-1.94**
Personal characteristics							
Age of trader	log	0.003	0.09	-0.107	**-2.31**	0.096	**3.82**
Age of trader, squared	log * log	0.000	0.13	0.001	1.59	-0.001	**-3.88**
Number of languages spoken	log	0.245	**1.96**	0.120	0.66	-0.183	-1.18
Number of years of schooling	level	0.013	0.60	0.062	**2.39**	0.013	0.87
Years of experience	log +1	0.209	**2.23**	0.441	**4.19**	0.175	**2.85**
Working capital (instrumented)	log	-0.359	**-3.81**	-0.299	**-3.12**	-0.115	**-2.74**
District dummies (20-25)				included but not shown			
_cut1		-3.863		-3.314		2.150	
_cut2		-1.523				4.106	
Joint test of ethnicity variables							
chi-square		5.42		9.71		8.54	
p-value		0.4908		0.1373		0.2014	
Joint test of religion variables							
chi-square		1.69		**7.36**		**9.13**	
p-value		0.4305		0.0067		0.0104	

Table 5. Number of suppliers known at start-up		**Benin**		**Malawi**		**Madagascar**	
Nobs		547		717		869	
PseudoR-squared		0.142		0.062		0.092	
Possible discrimination factors	**Unit**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**
Gender	female=1	-1.643	**-3.80**	-0.166	-0.98	-0.112	-1.44
Ethnic group 2	yes=1	0.085	0.21	-0.148	-0.45	0.644	**2.68**
Ethnic group 3	yes=1	0.056	0.24	0.149	0.45	0.595	**2.47**
Ethnic group 4	yes=1	0.472	1.23	-0.073	-0.22	0.599	**2.18**
Ethnic group 5	yes=1	0.605	1.16	0.264	0.62	0.501	**1.71**
Ethnic group 6	yes=1	0.484	1.31	-0.123	-0.34	0.933	**3.33**
Other ethnicity	yes=1	-0.141	-0.44	0.310	1.06	0.375	1.52
Christian (Muslim is omitted category)	yes=1	0.024	0.11	-0.067	-0.24	-0.141	-0.68
Other religion	yes=1	-0.043	-0.16			-0.275	-1.06
Personal characteristics							
Age at start-up	level	-0.021	-0.74	-0.005	-0.21	0.010	0.80
Age at start-up, squared	level ^2	0.000	0.59	0.000	0.10	-0.000	-0.90
Number of languages spoken	log	-0.203	-1.49	-0.160	-1.12	-0.299	**-2.93**
Number of years of schooling	level	0.008	0.38	0.035	**2.03**	-0.004	-0.41
Family background							
Father was a trader	yes=1	0.251	1.21	-0.072	-0.47	0.110	0.67
Father was an employee	yes=1	0.050	0.22	0.309	**2.12**	0.062	0.64
Mother was a trader	yes=1	0.157	0.64	0.157	0.84	-0.339	**-2.07**
Mother was an employee	yes=1	1.072	1.34	0.435	1.28	-0.095	-0.48
Father's years of experience as trader	log +1	0.029	0.42	0.090	**1.77**	0.015	0.25
Mother's years of experience as trader	log +1	0.034	0.50	0.025	0.48	0.163	**2.72**
Membership in local majority group							
Member of main gender group in district	yes=1	1.257	**2.69**	-0.120	-0.73	-0.102	-1.33
Member of main ethnic group in district	yes=1	-0.142	-0.46	-0.050	-0.29	-0.001	-0.01
Member of main religion in district	yes=1	-0.174	-0.97	-0.153	-0.65		
District dummies (20-25)				included but not shown			
Intercept		2.293	**3.35**	1.105	**1.80**	1.602	**1.78**
Selection-term		1.229		1.184		0.787	
Number of observations censored at 0		156		237		96	
Number of uncensored observations		391		480		773	
Joint test of ethnicity variables							
F		0.97		1.01		**2.59**	
p-value		0.4443		0.4146		0.0171	
Joint test of religion variables							
F		0.04		0.06		0.58	
p-value		0.9568		0.8098		0.5584	
Joint test of membership in majority group variables							
F		**2.81**		0.40		0.88	
p-value		0.0389		0.7555		0.4148	

Table 6. Number of clients known at start-up		**Benin**		**Malawi**		**Madagascar**	
Nobs		548		717		869	
PseudoR-squared		0.175		0.028		0.091	
Possible discrimination factors	**Unit**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**
Gender	female=1	-1.007	**-2.54**	-0.157	-1.19	-0.096	-1.29
Ethnic group 2	yes=1	-0.058	-0.16	0.148	0.57	0.259	1.13
Ethnic group 3	yes=1	-0.263	-1.21	0.220	0.84	0.262	1.14
Ethnic group 4	yes=1	0.017	0.05	0.212	0.80	0.368	1.40
Ethnic group 5	yes=1	0.133	0.26	0.230	0.68	0.282	1.01
Ethnic group 6	yes=1	0.509	1.53	0.415	1.44	0.595	**2.22**
Other ethnicity	yes=1	-0.026	-0.09	0.337	1.43	0.265	1.12
Christian (Muslim is omitted category)	yes=1	-0.222	-1.13	0.101	0.47	0.004	0.02
Other religion	yes=1	-0.006	-0.03			-0.106	-0.42
Personal characteristics							
Age at start-up	level	-0.009	-0.35	-0.010	-0.48	-0.003	-0.22
Age at start-up, squared	level ^2	0.000	0.62	0.000	0.55	0.000	0.20
Number of languages spoken	log	0.072	0.58	-0.102	-0.90	-0.340	**-3.46**
Number of years of schooling	level	0.012	0.64	0.011	0.83	-0.002	-0.18
Family background							
Father was a trader	yes=1	0.311	1.62	0.245	**2.00**	0.057	0.36
Father was an employee	yes=1	0.170	0.83	0.385	**3.31**	0.167	**1.79**
Mother was a trader	yes=1	0.291	1.27	-0.090	-0.61	-0.283	**-1.78**
Mother was an employee	yes=1	0.819	1.10	-0.192	-0.70	-0.412	**-2.13**
Father's years of experience as trader	log +1	0.058	0.92	-0.028	-0.68	0.038	0.67
Mother's years of experience as trader	log +1	-0.031	-0.49	0.044	1.06	0.126	**2.18**
Membership in local majority group							
Member of main gender group in district	yes=1	0.807	**1.88**	-0.059	-0.46	-0.075	-1.01
Member of main ethnic group in district	yes=1	0.253	0.90	0.125	0.89	-0.051	-0.47
Member of main religion in district	yes=1	0.057	0.35	-0.118	-0.64		
District dummies (20-25)				included but not shown			
Intercept		1.370	**2.18**	1.227	**2.51**	1.874	**2.15**
Selection-term		1.140		0.975		0.761	
Number of observations censored at 0		135		128		77	
Number of uncensored observations		413		589		792	
Joint test of ethnicity variables							
F		1.50		0.63		1.09	
p-value		0.1772		0.7072		0.3660	
Joint test of religion variables							
F		0.91		0.22		0.23	
p-value		0.4050		0.6390		0.7962	
Joint test of membership in majority group variables							
F		1.52		0.40		0.61	
p-value		0.2076		0.7509		0.5448	

Table 7. Start-up working capital		**Benin**		**Malawi**		**Madagascar**	
Nobs		531		717		869	
PseudoR-squared		0.073		0.094		0.079	
Possible discrimination factors	**Unit**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**
Gender	female=1	-0.001	0.00	-0.204	-1.17	-0.292	**-1.72**
Ethnic group 2	yes=1	0.008	0.02	0.365	1.07	0.268	0.52
Ethnic group 3	yes=1	0.353	1.44	0.270	0.78	0.306	0.59
Ethnic group 4	yes=1	-0.146	-0.37	0.235	0.68	0.322	0.54
Ethnic group 5	yes=1	1.119	**2.21**	-0.050	-0.11	1.033	1.63
Ethnic group 6	yes=1	-0.268	-0.73	0.245	0.65	1.033	**1.70**
Other ethnicity	yes=1	0.104	0.32	0.633	**2.05**	0.405	0.76
Christian (Muslim is omitted category)	yes=1	0.253	1.17	0.154	0.53	-0.478	-1.06
Other religion	yes=1	-0.099	-0.37			-0.248	-0.45
Personal characteristics							
Age at start-up	level	0.016	0.50	0.027	1.00	0.037	1.28
Age at start-up, squared	level ^2	0.000	0.08	0.000	0.11	-0.000	-0.86
Number of languages spoken	log	-0.043	-0.31	0.232	1.55	0.214	0.97
Number of years of schooling	level	0.081	**3.70**	0.075	**4.22**	0.088	**4.27**
Family background							
Father was a trader	yes=1	0.111	0.50	-0.143	-0.88	-0.557	-1.56
Father was an employee	yes=1	-0.094	-0.40	-0.027	-0.17	-0.220	-1.05
Mother was a trader	yes=1	0.309	1.24	0.280	1.42	0.095	0.27
Mother was an employee	yes=1	-0.387	-0.47	0.043	0.12	0.585	1.36
Father's years of experience as trader	log +1	-0.040	-0.54	0.114	**2.09**	0.081	0.62
Mother's years of experience as trader	log +1	-0.020	-0.29	-0.049	-0.89	0.263	**2.01**
Membership in local majority group							
Member of main gender group in district	yes=1	-0.671	-1.32	0.546	**3.22**	0.071	0.42
Member of main ethnic group in district	yes=1	-0.114	-0.39	0.246	1.33	-0.688	**-2.82**
Member of main religion in district	yes=1	-0.026	-0.14	-0.062	-0.25		
District dummies (20-25)				included but not shown			
Intercept		3.938	**5.36**	0.133	0.21	0.462	0.23
Selection-term		1.309		1.310		1.723	
Number of observations censored at 0		17		0		68	
Number of uncensored observations		514		717		801	
Joint test of ethnicity variables							
F		1.58		1.12		1.38	
p-value		0.1496		0.3510		0.2211	
Joint test of religion variables							
F		1.42		0.29		0.72	
p-value		0.2429		0.5933		0.4859	
Joint test of membership in majority group variables							
F		0.65		**3.98**		**4.09**	
p-value		0.5829		0.0080		0.0171	

Table 8. Growth in the number of suppliers know		**Benin**		**Malawi**		**Madagascar**	
Nobs		611		730		882	
PseudoR-squared		0.323		0.109		0.411	
Possible discrimination factors	**Unit**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**
Gender	female=1	0.347	1.26	-0.205	**-1.65**	-0.124	**-2.43**
Ethnic group 2	yes=1	0.068	0.29	0.157	0.66	0.213	**1.76**
Ethnic group 3	yes=1	0.151	1.08	0.180	0.74	0.314	**2.51**
Ethnic group 4	yes=1	0.354	1.58	0.127	0.41	0.418	**2.92**
Ethnic group 5	yes=1	0.162	0.61	-0.006	-0.03	0.093	0.63
Ethnic group 6	yes=1	0.345	**1.68**	0.049	0.19	0.297	1.56
Other ethnicity	yes=1	0.349	**2.07**	0.275	1.00	0.257	**1.93**
Christian (Muslim is omitted category)	yes=1	0.339	**2.81**	-0.084	-0.41		
Other religion	yes=1	0.120	0.83			0.290	**1.73**
Personal characteristics							
Age at start-up	level	0.009	0.50	0.034	**1.73**	0.000	0.02
Age at start-up, squared	level ^2	-0.000	-0.63	-0.000	-1.49	0.000	0.31
Number of languages spoken	log	0.058	0.76	0.088	0.81	-0.131	**-1.99**
Number of years of schooling	level	0.016	1.27	0.008	0.59	0.008	1.23
Start-up conditions							
Years since start-up	log +1	0.081	1.37	0.173	**2.84**	0.196	**6.03**
Number of suppliers known at start-up	log +1	0.705	**18.19**	0.645	**13.04**	0.739	**22.11**
Number of buyers known at start-up	log +1	-0.073	**-1.89**	-0.184	**-3.58**	-0.029	-0.88
Number of relatives	log +1	0.136	1.64	-0.043	-0.45	-0.038	-0.84
Start-up working capital	log +1	-0.042	**-1.69**	-0.012	-0.42	0.007	0.66
Membership in local majority group							
Member of main gender group in distri	yes=1	-0.558	**-1.91**	-0.015	-0.12	-0.024	-0.46
Member of main ethnic group in distric	yes=1	0.083	0.52	0.157	1.21	-0.002	-0.03
Member of main religion in district	yes=1	-0.096	-0.96	-0.104	-0.60	0.047	0.35
District dummies (20-25)				included but not shown			
Intercept		0.950	**1.94**	1.529	**2.72**	0.797	1.35
Selection-term		0.776		0.944		0.524	
Number of censored observations at 0		59		32		34	
Number of uncensored observations		552		698		848	
Joint test of ethnicity variables							
F		0.81		0.55		**2.43**	
p-value		0.5591		0.7664		0.0245	
Joint test of religion variables							
F		4.37		0.17		**3.01**	
p-value		0.0131		0.6812		0.0833	
Joint test of membership in majority group variables							
F		1.59		0.52		0.11	
p-value		0.1896		0.6669		0.9557	

Table 9. Growth in the number of clients known		**Benin**		**Malawi**		**Madagascar**	
Nobs		611		730		882	
PseudoR-squared		0.331		0.100		0.394	
Possible discrimination factors	**Unit**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**
Gender	female=1	0.266	0.96	-0.147	-1.30	-0.116	**-2.37**
Ethnic group 2	yes=1	0.044	0.19	-0.229	-1.05	0.241	**2.09**
Ethnic group 3	yes=1	0.125	0.89	-0.278	-1.25	0.269	**2.26**
Ethnic group 4	yes=1	0.174	0.78	-0.159	-0.56	0.381	**2.79**
Ethnic group 5	yes=1	-0.077	-0.29	-0.173	-0.83	0.097	0.70
Ethnic group 6	yes=1	0.084	0.41	-0.142	-0.58	0.328	**1.81**
Other ethnicity	yes=1	-0.144	-0.85	0.083	0.33	0.263	**2.07**
Christian (Muslim is omitted category)	yes=1	0.068	0.56	0.005	0.03		
Other religion	yes=1	-0.020	-0.14			0.311	**1.95**
Personal characteristics							
Age at start-up	level	-0.017	-0.91	0.029	1.64	-0.001	-0.10
Age at start-up, squared	level ^2	0.000	0.83	-0.000	-1.17	0.000	0.32
Number of languages spoken	log	0.094	1.23	0.167	**1.69**	-0.000	0.00
Number of years of schooling	level	-0.008	-0.68	-0.006	-0.52	-0.001	-0.25
Start-up conditions							
Years since start-up	log +1	0.064	1.08	0.164	**2.94**	0.182	**5.88**
Number of suppliers known at start-up	log +1	0.042	1.08	-0.036	-0.80	0.125	**3.92**
Number of buyers known at start-up	log +1	0.613	**15.86**	0.489	**10.38**	0.493	**15.49**
Number of relatives	log +1	0.263	**3.16**	0.104	1.19	-0.035	-0.81
Start-up working capital	log +1	-0.029	-1.16	-0.033	-1.32	-0.007	-0.66
Membership in local majority group							
Member of main gender group in distri	yes=1	-0.431	-1.47	-0.089	-0.79	0.033	0.68
Member of main ethnic group in distric	yes=1	-0.060	-0.38	0.126	1.06	0.038	0.53
Member of main religion in district	yes=1	-0.053	-0.53	-0.067	-0.42	0.071	0.56
District dummies (20-25)				included but not shown			
Intercept		1.377	**2.81**	1.329	**2.58**	1.388	**2.45**
Selection-term		0.781		0.867		0.501	
Number of censored observations at 0		47		8		24	
Number of uncensored observations		564		722		858	
Joint test of ethnicity variables							
F		0.65		0.80		**1.90**	
p-value		0.6915		0.5665		0.0787	
Joint test of religion variables							
F		0.30		0.00		**3.81**	
p-value		0.7396		0.9800		0.0513	
Joint test of membership in majority group variables							
F		0.87		0.61		0.36	
p-value		0.4579		0.6073		0.7817	

Table 10. Growth in working capital		**Benin**		**Malawi**		**Madagascar**	
Nobs		592		730		828	
PseudoR-squared		0.218		0.222		0.254	
Possible discrimination factors	**Unit**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**
Gender	female=1	-0.333	-0.88	-0.807	**-6.09**	-0.405	**-3.77**
Ethnic group 2	yes=1	0.131	0.44	0.288	1.14	0.537	**2.04**
Ethnic group 3	yes=1	-0.175	-0.98	0.279	1.08	0.632	**2.33**
Ethnic group 4	yes=1	-0.079	-0.28	0.295	0.89	0.464	1.49
Ethnic group 5	yes=1	-0.306	-0.87	0.409	**1.69**	0.553	**1.75**
Ethnic group 6	yes=1	-0.104	-0.39	0.400	1.41	0.802	**1.97**
Other ethnicity	yes=1	-0.234	-1.08	0.588	**2.01**	0.513	**1.79**
Christian (Muslim is omitted category)	yes=1	0.122	0.80	0.020	0.09	-0.465	-1.57
Other religion	yes=1	0.101	0.55			0.129	0.35
Personal characteristics							
Age at start-up	level	0.001	0.05	0.051	**2.45**	0.076	**4.07**
Age at start-up, squared	level ^2	0.000	0.41	-0.001	**-2.08**	-0.001	**-3.30**
Number of languages spoken	log	0.324	**3.33**	-0.066	-0.57	0.274	**1.95**
Number of years of schooling	level	0.046	**2.93**	0.077	**5.50**	0.023	**1.76**
Start-up conditions							
Years since start-up	log +1	0.733	**9.75**	0.434	**6.68**	0.497	**7.12**
Number of suppliers known at start-up	log +1	-0.005	-0.10	-0.026	-0.49	0.235	**3.31**
Number of buyers known at start-up	log +1	0.104	**2.13**	-0.070	-1.28	-0.072	-1.02
Number of relatives	log +1	0.223	**2.08**	0.213	**2.08**	-0.260	**-2.67**
Start-up working capital	log +1	0.371	**11.65**	0.441	**14.96**	0.501	**19.75**
Membership in local majority group							
Member of main gender group in distri	yes=1	-0.529	-1.33	-0.295	**-2.24**	-0.040	-0.38
Member of main ethnic group in distric	yes=1	0.175	0.87	-0.101	-0.72	-0.038	-0.25
Member of main religion in district	yes=1	0.050	0.40	-0.106	-0.58		
District dummies (20-25)				included but not shown			
Intercept		7.714	**12.36**	4.492	**7.50**	0.221	0.18
Selection-term		0.981		1.010		1.089	
Number of uncensored observations		592		730		828	
Joint test of ethnicity variables							
F		0.47		0.97		1.02	
p-value		0.8273		0.4458		0.4107	
Joint test of religion variables							
F		0.33		0.01		**4.17**	
p-value		0.7196		0.9249		0.0158	
Joint test of membership in majority group variables							
F		0.88		2.03		0.10	
p-value		0.4512		0.1085		0.9052	

Figure 1. Trade Flows Between Matched Agents

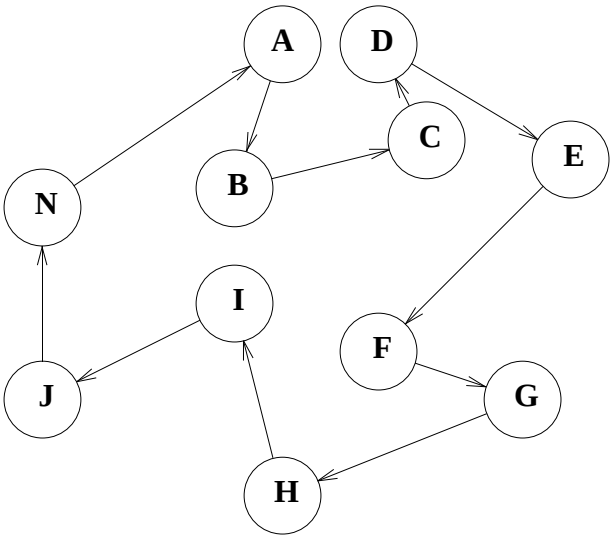

Figure 2. Game Between Matched Agents

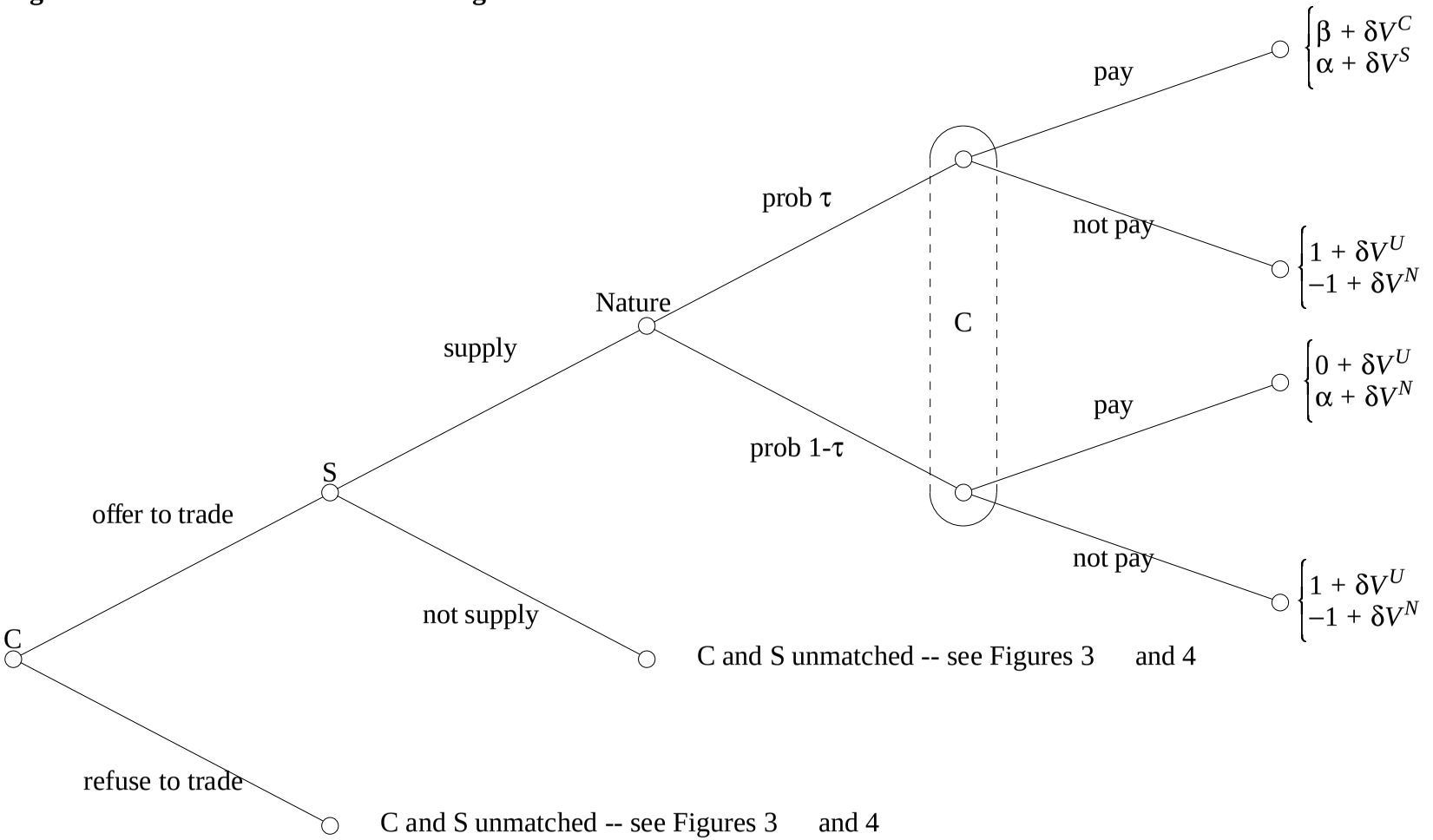

Figure 3. Game Between Unmatched Agents: 1/ Supplier's Perspective

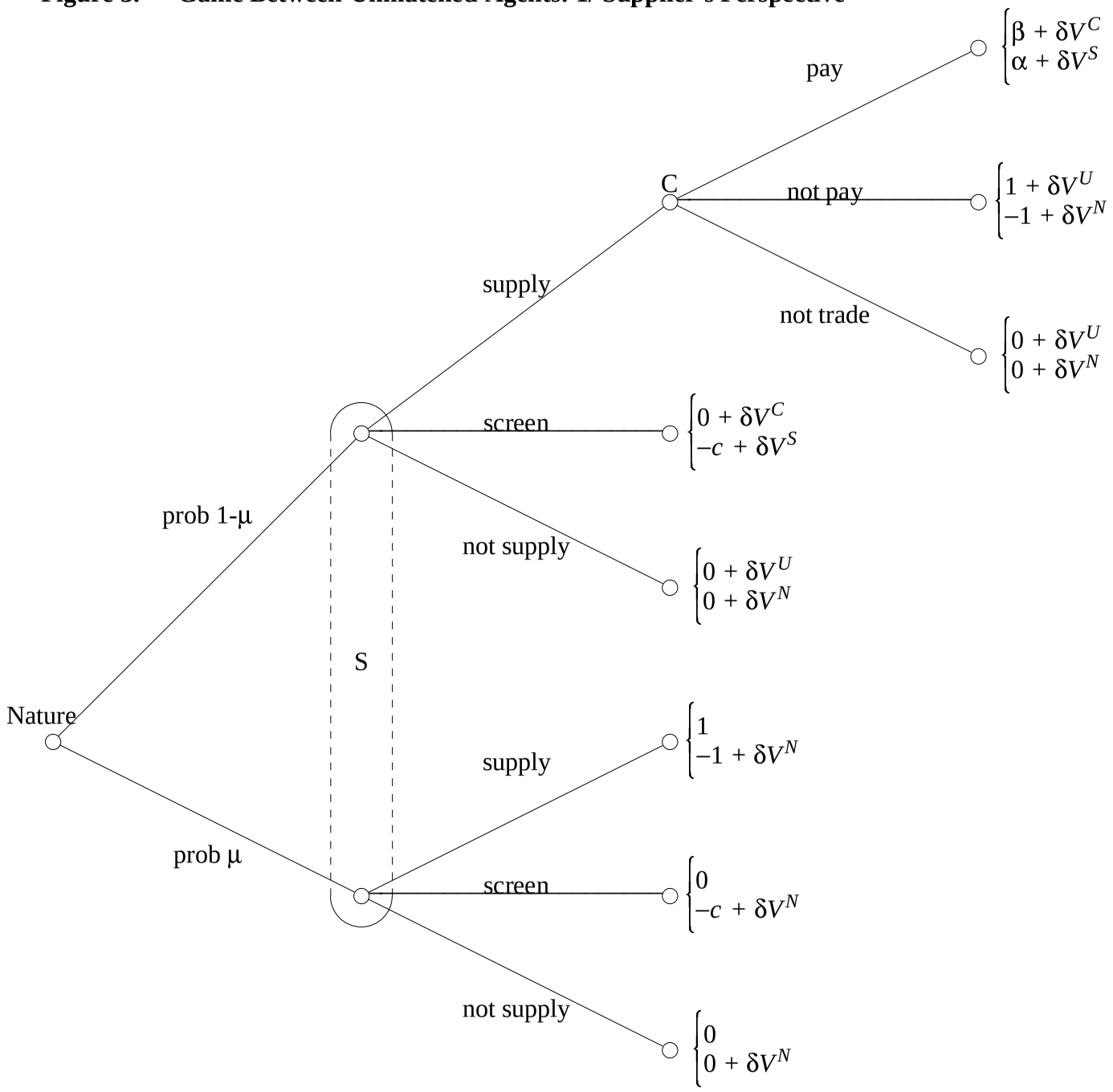

Figure 4. Game Between Unmatched Agents: 2/ Client's Perspective