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Those in Kayes

The Impact of Remittances on their Recipients in Africa

by

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Abstract: This article briefly describes the Soninke labor migration, understood as a means of diversifying risk in a context of missing insurance and credit markets. Historical and anthropological studies on this ethnic group suggest that it is not only the well-being of those left behind which is insured by the migrants, but also the pride of the clan. A simple partial-equilibrium microeconomic model is developed for encapsulating this view, and it brings out the moral hazard problem involved. This prediction is tested econometrically using an original data set collected in the Kayes area (Western Mali), the main source of Soninke labor migration to France. The results undermine the standard approach of migration based on relative deprivation.

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Those in Kayes. The Impact of Remittances on their Recipients in Africa.

1. Introduction

The literature on the impact of emigration on those remaining behind is very active. Rivera-Batiz (1982) showed, using a general equilibrium model without remittances, that those remaining behind incur a welfare loss. The set of possible transactions shrinks, as those remaining behind cannot anymore exchange non-tradable goods with the migrants. Under standard assumptions about preferences and technology, this entails a welfare loss. However, this neglects the important phenomenon of remittances. Djajic (1986) then showed that these transfers improve welfare in the country of origin, even of those who do not receive remittances, because the latter enlarge the set of possible exchange of tradable and non-tradable goods. The net effect is then ambiguous.

Many empirical studies have been devoted to the impact of remittances, in the context of international migrations as well as domestic rural-to-urban migrations. Rempel and Lobdell (1978) use household survey data from rural Kenya and conclude that remittances from rural-to-urban migrants have little impact on the development of the region of origin. By contrast, Collier and Lal (1984) show in the case of Kenya again, that remittances enable the recipient families to hold more productive capital than the others. In his early study of migration from Kasumpa village in Zambia, Bates (1976) shows that households earning lower incomes in the village receive more remittances from town than richer ones, after controlling for demographic composition. Stark, Taylor and Yitzhaki (1988) show that this type of transfers reduces income inequality in a Mexican village having migrants in the USA, but suggest that the poorest are excluded from migrating. Banerjee and Kanbur (1981) and Faini and Venturini (1993) conclude, by different routes, that migration benefits more the middle income classes of the society of origin than the two extremes of the distribution, in India and Southern Europe respectively. On the contrary, Gustafsson and Makonnen (1993) conclude that poverty in Lesotho would go up by about 15 % were the flow of transfers sent by the migrants working in the mines in South Africa to stop.

The wide diversity of empirical results on the effects of migration and remittances on the migrants' economy of origin is matched by the variety of theoretical models presented. The early ones focused on the differentials in wages and employment conditions between rural and urban areas or between countries. In the Todaro model, for example, the potential migrant compares the present value of expected urban earnings to the present value of rural earnings (Todaro, 1969). Bates (1976) emphasizes the inter-temporal investment dimension, within a life-cycle framework. The "new economics of labor migration" (Stark, 1991) views migration as an intra-family co-insurance arrangement aimed at minimizing income risks and smoothing consumption. The basis for this approach is that income risks are strongly correlated locally in the rural areas of low-income countries. This implies that formal institutions for managing risk are imperfect or absent, giving rural households an incentive to self-insure through the geographical dispersion of their members. Families can then rely on the migrants for financial support in case of transitory income shocks due to unforeseen bad local conditions (*e.g.* weather variation, disease, pests and fire, fall in crop price, etc.).

Lucas and Stark (1985) analyze various potential motivations explaining why migrants transfer some income to their relatives remained in the village, for testing various forms of altruistic or egoistic behavior. Using survey data on Botswana, they conclude that mixed motivations of moderate altruism or enlightened egoism seem to prevail. Their empirical analysis supports the view that the migrants do provide some insurance services, by transferring more money when a drought threatens the livestock. They also show that wealthier families receive more than poorer ones, suggesting that the migrants are defending their inheritance rights or their ability to come back to the village with dignity. Hoddinott (1992) gets a similar result using a household survey conducted in Kenya. Our analysis below provides some additional elements shedding some more light on why richer families get more remittances. Similarly, de la Brière *et al*. (2002) find evidence of these two effects using data from the Dominican Sierra, bringing out how gender affects the migrant's remittance behavior.

However, the geographical dispersion of the individuals who might benefit from such a risk-pooling arrangement makes it difficult to monitor performance and creates moral hazard (e.g. Binswanger

and Rosenzweig, 1986, Newbery, 1989, Platteau, 1991). Without monitoring, each participant in the insurance pool has an incentive to underreport income or to reduce effort in order either to be eligible for financial assistance or to be dispensed from supporting others. Thus, while the distance between contracting agents provides a risk-pooling benefit, it also increases information and enforcement costs.

Many theoretical papers have emphasized the trade-off between incentives and insurance, but few empirical tests have appeared in the recent literature. Exceptions include Dubois (2002) and Wydick (1999). We are not aware of a paper investigating empirically whether migration as an insurance mechanism actually gives rise to moral hazard. The present paper aims at filling this gap. We use original data collected in the Kayes area in Western Mali to investigate whether migration and remittances are an impediment to technical efficiency in agriculture because of moral hazard. We find that the farmers left behind in the village indulge in some "shirking", when they are insured by one or several migrants from their family. We use a survey conducted by one of the authors in eight villages of the area, between January and April 1997. More than 300 randomly selected households were surveyed. An important share of their income is made of remittances from migrant workers, and there is some evidence that migration is to some extent an insurance arrangement (Gubert, 2002). The findings presented below support conventional wisdom about the effects of insurance with imperfect monitoring of effort: the more insurance is provided by the migrants, the less incentive their families have to work. This result provides some insights into the relationship between labor migration and agricultural production.

The Kayes area is especially interesting for several reasons. First, most Malian migrants to France come from this place. In view of the political turmoil surrounding illegal immigration from this country that occurred in France, there is a need for some dispassionate empirical analysis of the determinants and the consequences of this migration flow. In 1997, just after our survey was performed, France launched a new policy of "co-development" aimed at complementing repressive measures against illegal immigration at the other end with an aid program promoting stay-at-home development in the migrants' countries. As the main source of Sub-Saharan Africans to France, the Kayes area is one of the main targets of this co-

development. Documenting the effects of remittances on the families left behind is thus important for designing appropriate policies to be implemented there.

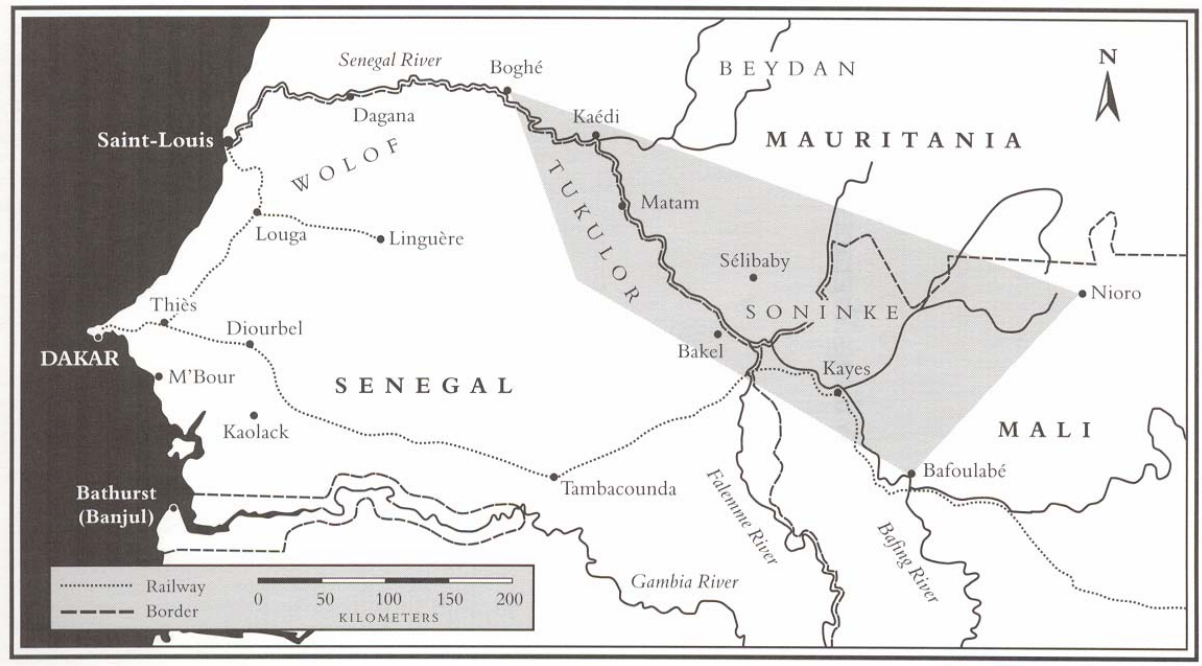
Second, a close examination of the data shows that all the people of the Kayes area are not equally concerned by migration to France. One ethnic group, namely the Soninke, is significantly more involved than the others. Its region of origin straddles the borders between Mali, Mauritania, and Senegal, along the Senegal River (see map.1). In fact, whether these African migrants to France (and nowadays to many other countries, including Japan and the USA) are Malian, Mauritanian or Senegalese nationals matters less than their ethnic origin. Because migrant networks reduce information and psychological costs at the other end, by providing specific job information, accommodation and supportive relationship, migrants connected by ethnic links are vastly more represented than the others. This fact suggests that a pure economics approach to African migration would necessarily miss a crucial point, and that some help from anthropology is required.

This group has been involved in migrations for centuries and has been thoroughly studied by anthropologists and historians. This provides a rich opportunity for combining the tools of empirical economics with those from these neighboring social sciences. In particular, the recent book by the late Francois Manchuelle (1997) is an incredible sum of historical and anthropological information on this group. The next section is largely based on it, and summarizes some relevant aspects of this historical experience. They suggest that the economist's view of migration as an insurance device, while basically correct, must be qualified to fit the facts. The social-anthropological dimension helps to understand its determinants more accurately. The objective pursued by this insurance system is not only to protect the family left behind from income or consumption fluctuations, but also to defend and reinforce a given social status.[1] This important nuance can be accommodated without any major theoretical revolution. The social status of the whole clan would be seriously tarnished if the consumption of those remaining in the

[1] The idea that migration is motivated by status considerations has already been put forward in Stark's relative deprivation approach (*e.g.* Stark, 1984). However, relative income considerations in our framework play a different role than in his approach, which fits better some of the facts brought out by anthropologists and historians (foremost

village was to fall drastically in the wake of a failed harvest. Defending the family's pride is the main motivation behind the willingness of the migrants to cover the risks of those remaining in the village through transfers (see *e.g*. Manchuelle, p.20). It is less an aversion to consumption fluctuations which is at stake than the shame that would affect the whole clan if the family was to be visibly weakened after an exogenous shock.

Map 1: Geographical Origin of the Soninke Migrants



Source: Manchuelle (1997) (originally from Diarra, 1969).

The simple theoretical model presented in section 3 captures this phenomenon by emphasizing the utility cost of a shortfall of consumption below some family-specific threshold, rather than the usual consumption-smoothing objective. This view was very much supported by our survey, showing that the village families can quantify with some precision their "needs" and their "deficit". This model lays the ground for the econometric analysis, by bringing out the type of moral hazard involved, as the effort level of the village family is not contractible with the insuring migrant. After a presentation of the data and

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among these facts is the downward social spread of Soninke labour migration, when Stark's theory would predict an upward social spread of migration).

some summary statistics in section 4, the main prediction of our model is tested through the estimation of a production function using panel data with household-specific fixed effects in section 5. Some robustness checks are performed about the moral hazard diagnosis in section 6. Section 7 summarizes the findings of the paper.

2. The Genesis of the Soninke Migration

The Soninke lived originally in the upper Senegal River Valley, which encompasses what are nowadays Eastern Senegal, Southern Mauritania and Western Mali. Today, some of their descendants may be found in Central Africa, in Europe and even in North America and Japan. Originally, the Soninke community was a highly hierarchical society, with a rigid caste system, which is still affecting people's behavior. There was a strong separation between slaves, artisans, and aristocrats from the "chiefdom", *i.e.* members of the village community with specialized functions (either economic, religious or military). In fact, the fate of the slaves was often preferable to that of many craftsmen, if they had belonged to rich families for more than one generation.

History

During the 18th century, the upper Senegal River area was the chief grain producer of West Africa, exporting its millet either to the north, trading with the white nomads of the desert, or to the south. Production was largely performed by slaves, who accounted for between one third and one half of the population. Many religious men and other free people were involved in trade. The Soninke country was in direct contact with the desert people, who were selling salt, livestock, and gum Arabic, in exchange for grain and slaves, as well as for grazing rights during the dry season. The Soninke were importing more of these goods from the desert than their consumption needs, and formed trading expeditions toward the south, for on-selling these goods and the millet as far south as the north of modern Cote d'Ivoire and Guinea. They brought back such southern products as cola nuts, and most importantly slaves.

At the end of the 18th century, traders from Europe, especially from France, came to participate in this commerce. The French built the fort of Bakel, along the Senegal River, to the west of the Soninke

land, for housing a trading post. Their aim was to take advantage of the possibility of shipping the cargo down the Senegal River, downstream of Bakel, up to Saint Louis and the Atlantic Ocean. The Soninke soon realized that it was quite inefficient to keep on producing in the upper Senegal River valley, and then to transport the produce to Bakel for trading it against slaves and the manufactured goods brought there by the European traders. Sailing on this part of the river, upstream from Bakel, is uneasy, and becomes impossible from November on, especially during the driest years. They found far more efficient to migrate for the rainy season to the Bakel area, to go and grow cereals, and then more and more groundnuts, on rented land. The produce could be sold on the spot, and this allowed sailing back upstream much earlier in the year. This so-called “navetane” system of temporary migration formed the basis of the enrichment of many Soninke families.

Later, as this trade was growing in size, new jobs became available on the steam boats transporting these goods up to Saint-Louis, and from there to France. The Soninke migrants were then hired as “laptots” (indigenous sailors) on these boats, getting in these jobs higher earnings than as “navetanes”. Young men of royal lineage were particularly attracted by these earnings, which allowed them to accumulate quickly a substantial capital and to be less dependent from their elders. At first, they were sailing between Bakel and Saint-Louis, and sometimes further up to Dakar. A direct route to Dakar was also opened in 1923, as the railway between Thiès and Kayes was completed. The latter runs through the groundnut basin of Senegal, and many young men then migrated there as “navetanes”, around Kaolack. Aristocrats were more attracted by sailor positions, and quickly got jobs on ocean going ships sailing from Dakar to Bordeaux or Marseilles. There, they established the first Soninke communities in France, from which they moved to other cities, including Paris. This movement went on expanding up to the present time. Most of the time, they hold low-qualification jobs and live in poor conditions in immigrants’ hostels. They save most of their earnings for preparing their return to their country. They invest in small productive projects there to some extent, but mainly in their social network, which will ensure their dignity and their subsistence for their old days.

Social Anthropology

In fact, Soninke migrants do not uniformly come from all the social strata. Only families with a fairly high social status are investing in circular migration. Among them, the religious caste and the aristocrats, and their slaves, are particularly concerned. The participation of slaves in circular migration needs to be explained. The Soninke aristocracy has been widely criticized in the literature because of the harsh way it treated slaves. This is particularly true for slaves of the first generation, who were living with their masters. As soon as they got married, slaves of the second generation benefited from a more favorable treatment, close to the serf's one in Europe in the Middle Ages or in Russia before the October revolution. They could till their own plot of land in exchange for some labor time spent on their masters' plots. Many slaves were thus reasonably well off and could buy in turn their own slaves to support them in their old days.

Initially based on the ownership of the fertile land located near the river, power and honor in the Soninke society were highly dependent on wealth and on the number of clients. Slaves were playing a major part, and many of them were able to gain some political and economic influence within their master's clan. Observers are often surprised that most slaves decided to stay with their masters after the abolition of slavery, although they could legally leave them. What the abolition of slavery actually did was to strengthen their bargaining position to some extent, by allowing them to leave their former masters in case of conflict. But it did not fundamentally alter the economic link between them. Former slaves were still highly dependent on their master to find a spouse, and their children were still entrusted to them. The lot of slaves owned by wealthy families was actually much preferable than that of most free individuals (especially the artisans). Former slaves and their descendants did improve their legal rights, but even today, they still bear the constraints related to their social status. The most surprising is their role in the migration system. Very often, they are allowed to migrate far away, even in France. This is partly due to the fact that their wife and children are staying behind, but this is endogenous to some extent. A returning migrant with a large capital can earn a fairly high social status in his society, even if he belongs to the former slave caste. He must give a share of his capital to his master, who will give him in return a position

in his clientele, with some positive fall out. His new status within the clientele will be marked by the performance of some visible tasks in some ceremonies, and by various gifts that he will receive regularly.

Therefore, the Soninke, who comprise a large share of the African migrants to France, or to other places in Africa, Europe, or even America, belong in fact to some relatively high-ranking clans, whose wealth and size ensure prestige and political clout in their society of origin. Prestige accrues to the one who gives, as in most other African societies, and the welfare of his clientele guarantees it (N'Diaye, 1995). The "griots" (praise singers) ensure his reputation, as a function of the gifts received, and it will spill over to the whole clan. By giving away a share of his earnings in favor of his clan, the migrant reinforces both his position within the clan, and the status of his clan within the Soninke society. His own position within the society thus depends as much on that of his clan as on his own one.

The following model aims at translating this anthropological information into the language of standard microeconomics. It is a simple partial equilibrium model, focusing on the main point of the subsequent empirical exercise, i.e. an analysis on the impact of remittances on the behavior of those left behind. It may thus be viewed as a complement to de la Brière *et al*. (2002), who focus on the determinants of remittances.

3. Theoretical Framework

Yields in agricultural production in the Kayes area are extremely unpredictable, especially since the climatic changes of the 1970s and 1980s. A drought or an insect invasion can reduce output drastically, or even wipe it out. Let *y* be output and *e* the effort level exerted by the family to get it, with productivity α. Risk is simply captured by the following production function:

$$y = \alpha e , \tag{1}$$

where $\alpha \in [0, \bar{\alpha}]$, with cumulative distribution function $F(\alpha)$, and density function $f(\alpha)$. Denote $E\,\alpha$ its expected value.

A glance at the data and many discussions with migrants during our fieldwork suggested that remittances are part of a partial insurance arrangement between the migrants and their families, as

sketched above.[2] Because of high transaction costs in transferring funds or goods, one does not observe frequently the small transfers involved in the usual neo-classical theory of insurance for smoothing consumption. A coarser mechanism is at work, aimed at avoiding any fall in consumption below a given level.[3] The threshold that triggers the transfer varies across households, according to their social status. It is much higher for families belonging to the upper social strata than for artisans or small farmers. A noble family forced to lower significantly its standards of living in times of hardship would loose its prestige and fall down the social ladder. This risk has two opposing effects on the production effort of the village family. On the one hand, the family could step up its effort, in order to self-insure against the shame and hardship entailed by a consumption shortfall. On the other hand, the promised support by the migrants mitigates the expected damage, and reduces the incentive to work.

***The Incentive to Shirk*.**

Let γ denote the family's consumption norm. Each family is assumed to have an entitlement over an amount of remittances $\gamma - y$ whenever its income falls below γ.

Define the family's transfer entitlement as:

$$\max\{\gamma - y, 0\}. \qquad (2)$$

This assumes that the migrant can observe the level of output, maybe indirectly through trusted witnesses. But he cannot base its promised transfer on the effort level made for producing it, either because it is not observed, or at least not verifiable. Hence, migrants cannot use credible threats for punishing moral hazard, as discussed by Fafchamps (1992). Moreover, village households use tricks for blurring the signals that the migrant could receive about their effort. For example, a comparison of family output with that of others could serve as an indicator of effort, according to the mechanism of yardstick competition (Shleifer, 1985, Lazear and Rosen, 1981). However, this signal can be manipulated, if the agricultural households collude for sending false signals to the migrants. Acts of collusion, such as

[2] Gubert (2002) provides empirical evidence consistent with this theoretical approach to migration and remittances. She finds that negative agricultural shocks substantially raise cash transfers and in kind remittances. Her findings also suggest that remittances respond to unforeseen events such as funerals or illness.

announcing fictitious natural disasters, were actually observed in the Kayes area. Peer pressure could also make family output an unreliable signal, because "zealous" families (*i.e.* those not exploiting their informational rent) could be constrained by others to reduce their effort. This mechanism might induce the household to shirk and to rely on the migrant for subsistence. According to Fafchamps (1992), ex-ante financial support is another way to mitigate opportunistic behavior. In the Kayes area, the data suggest that even if the bulk of remittances occurs after the harvest, some liquid assets are supplied by the migrants before the start of the agricultural season, enabling their families to purchase the required inputs. Nevertheless, this does not prevent shirking.[4]

On the other hand, there are escape clauses allowing the migrant to default on his commitment, like illness or a spell of unemployment. This creates another informational asymmetry, which is beneficial to the migrant. The latter decides freely to send funds or not. If he decided not to, his family could not ascertain whether this was due to temporary money problems or to intentional default on the contract. Various factors, including moral commitment or the migrants' desire to be regarded as generous people and to reinforce their position within their clan induce most of them not to shirk.[5] We do not model this in our partial-equilibrium analysis. Yet, the possible remittance failure is taken into account as it alters the reliability of the insurance mechanism. This is done as follows. Let λ be the probability that the family gets support from the migrant when a shock occurs, i.e. that the transfer entitlement is delivered. This measures the reliability of the insurance mechanism. In the empirical analysis below, the ratio of the number of family out-migrants to the number of family members living in the village of origin is used as a proxy for λ.[6] In the theoretical model, λ is exogenous[7].

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[3] In other words, only the lower part of the income distribution is insured.

[4] One could argue that family members share naturally a great deal of information, so that the informational asymmetry assumption is untenable. However, most migrants in our sample live in France and only visit their home village every third year on average. This leaves a lot of room for asymmetric information.

[5] Additional support for this assumption comes from our survey data. Of those who had migrated to France for more than six months at the time of interviews, 86.8% had remitted money or goods in the previous twelve months. During this period, cash and in kind remittances sent per migrant amounted to 400,465 CFA F, worth about US$ 600.

[6] This assumption stems from the observation that the likelihood of a family receiving assistance increases with the number of migrant sons, as in Hoddinott (1992).

Then, the expected value of the transfer entitlement (2) is:

$$H(\gamma, e) = \gamma F(\gamma / e) - e\tilde{\alpha}(\gamma / e), \tag{3}$$

where:

$$\tilde{\alpha}(\gamma / e) = \int_0^{\gamma / e} \alpha f(\alpha) d\alpha. \tag{4}$$

The latter measures the set of possible values of α such that output falls below the consumption norm. This is an index of exposure to productivity risk. The larger $\tilde{\alpha}(\gamma / e)$, the more exposed is the family to a consumption shortfall. It is a decreasing function of the effort level *e*. Hence, the village family can reduce its exposure to productivity risk by increasing its production effort. Its maximum value is $\tilde{\alpha}(\gamma / e) = E\alpha$; in this case the family is bound to face a production shortfall below the consumption norm with probability 1, because the effort level is too low ($e \leq \gamma / \overline{\alpha}$). Then $H(\gamma, e) = \gamma - E\alpha e$, as $F(\gamma / e) = 1$ and $\tilde{\alpha}(\gamma / e) = E\alpha$.

In this model, the incentive to shirk comes from the impact of effort on the expected transfer entitlement $H(\gamma, e)$ so defined. The latter is the difference between the expected value of getting the consumption norm to which the family is entitled and the expected output in case of bad luck. Notice that (minus) the productivity risk index (4) measures the marginal impact of effort on the expected value of the transfer entitlement. The other terms in the derivative of $H(\gamma, e)$ with respect to *e* cancel out. Hence, the larger the exposure to risk chosen by the village family, the more counter-productive is the marginal production effort in terms of transfer entitlement.

The Combined Impact on Utility

Let us now turn to the second effect of the risk of a consumption shortfall, which mitigates the disincentive effect identified above. We want to capture the fact that it would be a shame for all the family members if the standard of living of those in the village was visibly affected by a negative shock. This is modeled by assuming that a consumption shortfall below the norm γ has an additional negative impact,

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[7] De la Brière *et al*. (2002) determine endogenously a parameter *a* that plays roughly the same role as this λ.

beyond the mere cut in consumption. A simple way to capture this is to assume that the utility derived by the village family from consumption *c* is:

$$u = c - \beta \max\{\gamma - c, 0\}. \tag{5}$$

The positive parameter β captures the additional negative effect resulting from a decrease in consumption below γ. This specification entails that there is a kink in the utility function, at the level of the family's consumption norm.

Define now the utility-adjusted reliability of the migration-based insurance system as:

$$\tilde{\lambda} = \lambda - (1-\lambda)\beta. \tag{6}$$

This parameter is increasing in λ, and captures the combined effect of the two opposing effects identified above. It allows to determine conveniently the relationship between expected utility and effort as in the following proposition.

Proposition 1: (i) The expected utility from consumption achieved by the household can be written as a function of effort as follows:

$$Eu|e = E\alpha\, e + \tilde{\lambda}\, H(\gamma, e); \tag{7}$$

(ii) It is an increasing function of *e*, and it is convex if $\lambda \geq \dfrac{\beta}{1+\beta}$.

Proof: If $e \geq \gamma / \bar{\alpha}$, the relationship between expected utility from consumption and effort can be written as:

$$Eu|e = \lambda\, \gamma\, F(\gamma / e) + (1-\lambda) \int_0^{\gamma/e} [(1+\beta)\, \alpha\, e - \beta\, \gamma] f(\alpha)\, d\alpha + \int_{\gamma/e}^{\bar{\alpha}} \alpha\, e\, f(\alpha) d\alpha. \tag{8}$$

One can then derive (7) by using definitions (3), (4) and (6), and re-arranging the terms.

The first and second derivatives of this function can be calculated as:

$$\frac{\partial\, Eu|e}{\partial\, e} = E\alpha - \tilde{\lambda}\, \tilde{\alpha}\, (\gamma / e) > 0 \text{ and } \frac{\partial^2 Eu|e}{\partial\, e^2} = \tilde{\lambda} \frac{\gamma^2}{e^3} f\left(\frac{\gamma}{e}\right) > 0, \text{ if } \tilde{\lambda} > 0. \tag{9}$$

The case where $e < \gamma / \bar{\alpha}$ can be analyzed in a straightforward way, as $H(\gamma, e) = \gamma - E\alpha\, e$.

Determination of the Effort Level

Now assume that the village family is a unitary household seeking to maximize:

$$\max_{e} E\,u|e - \frac{\omega}{2}e^2, \tag{10}$$

where ωe is the marginal disutility of effort, increasing in e[8].

Solving (10) shows that effort is a decreasing function of the risk-adjusted reliability of the transfer entitlement system. This is stated in the following proposition.

Proposition 2: (i) If $e \geq \gamma / \overline{\alpha}$, the effort level is given by:

$$e^* = \frac{E\alpha - \tilde{\lambda}\,\tilde{\alpha}(\gamma / e^*)}{\omega}. \tag{11}$$

(ii) if $e < \gamma / \overline{\alpha}$, the effort level is given by (11) after substituting $\tilde{\alpha}(\gamma / e^*) = E\alpha$.

Proof: Equation (11) is easily derived, using (9), from the first-order condition of problem (10):

$$\frac{\partial E\,u|e}{\partial e} = \omega e\,^{9}. \tag{12}$$

Figure 1 depicts the determination of e^* in a simple case, assuming that $\tilde{\lambda} > 0$. One can easily imagine from figure 1 what a case of multiple equilibria would be like. We do not pursue this idea here. In the case depicted, there is a unique equilibrium effort level, and it is a decreasing function of $\tilde{\lambda}$, the utility-adjusted reliability of the transfer entitlement system. Notice that the same property would follow, were the equilibrium point located on the horizontal segment of the effort function. This is the main

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[8] This objective function is generically quasi-linear, apart from the kink in the utility function at $c = \gamma$. It thus rules out the income effect which could actually affect the level of effort chosen by the family. However, giving more importance to the income effect would not affect significantly the predictions of this model, provided that consumption and leisure were normal goods.

[9] Notice that e^* is a fixed point of equation (11). There might thus be multiple equilibria, as both the left-hand side and the right-hand side of (11) are increasing in e. It is easily checked that the following conditions are sufficient for ensuring uniqueness: $\overline{\alpha}^3 f(\overline{\alpha}) < \omega\gamma$, and $\gamma f'(\alpha) > -3e f(\alpha)$. These are technical conditions ensuring that the kink in the effort-supply function at $e = \gamma/\overline{\alpha}$ is not "too sharp". They are easily satisfied, for example if $F(\alpha)$ is uniform.

property on which the empirical part focuses. It carries over from the effort supply function (11) to the expected output function, as follows:

$$Ey^* = (E\alpha - \tilde{\lambda}\,\tilde{\alpha}(\gamma / e^*))\,E\alpha / \omega, \tag{14}$$

in the case where e^* is above the kink, and otherwise:

$$Ey^* = (1-\tilde{\lambda})\,E\alpha^2 / \omega. \tag{15}$$

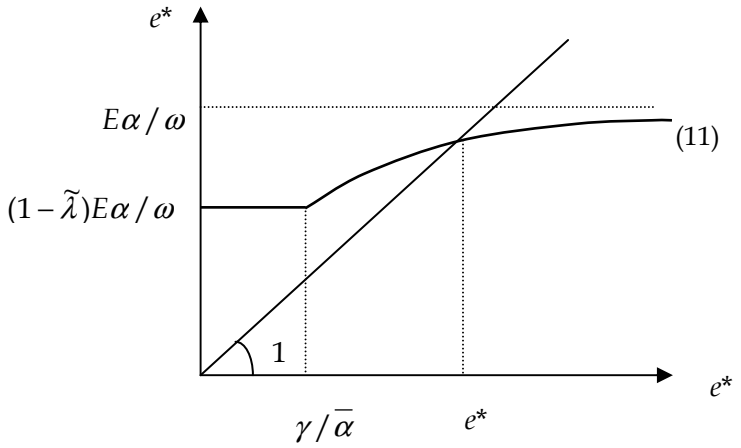

Figure 1: Determination of the Effort Level

It is easily checked that Ey^* is decreasing with the reliability of the transfer entitlement system $\tilde{\lambda}$, taking into account that the index of productivity below the consumption target $\tilde{\alpha}$ is increasing in $\tilde{\lambda}$. Hence, the property found in the effort function also holds for the expected output function.

To sum up, the main prediction of the model is as follows: the more reliable is the insurance mechanism, after adjusting for risk, the higher is the incentive to shirk, and the lower is the expected output. The remainder of the paper is devoted to testing this hypothesis through the estimation of a production function with household-specific effects.

4. Data and Summary Statistics

The data set comes from a survey conducted by one of the authors in eight villages in the Kayes area, along the Senegal River, between January and April 1997.[10] Two main ethnic groups live there, generally in separate villages: the Soninke and the Khassonke. In order to have roughly an equal number of households from each group, the villages have been separately drawn at random by ethnic affiliation, within about 50 kilometers from Kayes, both upstream and downstream along the Senegal River. Because Khassonke villages are generally smaller in size, a sample of three Soninke villages and five Khassonke villages was drawn. In the former, households were drawn at random, while the whole population of the latter was included in the sample. The resulting sample has 305 rural households. Following Meillassoux (1975), a household was defined as "a group of individuals who produce in common on at least one field, receive food out of a common store and eat from a single pot". It corresponds to what we call "family" in the theoretical model above. In the Sahelian area, it is typically comprised of the family head, his wives, his young brothers, and their dependents over two or three generations.

Household Characteristics

Table 1. Distribution of sample households by migration status and ethnic group

Ethnic group	Soninke	Khassonke	Other	Total
Number of households	148	145	12	305
Number of households with at least one migrant	127 (85.8 %)	90 (62.1 %)	7 (58.3 %)	224 (73.4 %)
Number of households with at least one migrant abroad	124 (83.8 %)	53 (36.6 %)	5 (41.7 %)	182 (59.7 %)

Source: Gubert, 2000.

A migrant household is defined by the following characteristics: at least one person who was previously a member of the household has left for more than six months to live or work elsewhere, either in Mali or abroad. Women who out-migrated for marriage and children below 18 years of age at the time of interviews were excluded.[11] Of the 305 rural households in the survey, 224 sent at least one household member in the migrant labor force (73.4%) and 182 sent at least one household member abroad (59.7%).

[10] *i.e.* Djimekon, Fanguine Koto, Moussa Waguya, Kerouane, Dyalla Khasso, Somankidi, Diakandape and Gakoura.
[11] Women provide only minimal assistance to their parents once they are married. Hoddinott (1994) reports a similar result using survey data from Kenya.

Their distribution by ethnic group is given in table 1. It shows that the incidence of migration is more frequent among Soninke households, and especially so for migration abroad.

Migrant households reported on average 2.6 migrants, with a minimum of 1 and a maximum of 11. Table 2 reports the average amount of remittances received per household according to the number of out-migrants. The figures include both cash and in kind remittances and refer to 1996.[12] The amounts at stake are considerable: using the World Bank's poverty line of $1 a day (or, equivalently of CFA F 700 a day), remittances received per household represents on average no less than the annual income required for keeping three individuals just above the poverty line.[13]

Table 2. Amount of Remittances Received per Household in 1996

Number of Migrants Within the Household (*)	Mean Amount of Remittances Received	Number of Households	Number of Migrants in France within the Household	Mean Amount of Remittances Received (**)	Number of Households
0	100,856	81	0	48,188	167
1	479,802	72	1	1,040,057	65
2	1,004,857	70	2	1,656,593	39
3	1,143,994	28	3	1,995,484	15
4	1,415,631	18	4	2,546,413	8
5	1,562,826	14	5	2,598,363	6
6	2,401,997	16	> 5	3,918,465	5
> 6	2,182,542	6	-	-	-
All	799,918	305	All	740,145	305

Source: Gubert, 2000. Amounts in CFA francs (1 US $ ≅ 700 CFA F in 1996).
(*): Male adults aged 18 or more, who have left their village for more than six months.
(**): Remittances from France only.

As a result, remittances play a critical part in the economies of the sample households, as shown by table 3. In 1996, they accounted for 40.1% of total gross income for all the 305 households, and 50.8% of total gross income for all the 182 households with at least one member abroad. For households not involved in international migration, farm revenues, measured as the sum of the value of all crops and

[12] Migrants living in France often send goods instead of money. More precisely, families receive order forms that can be traded for goods with local suppliers. Suppliers are then directly paid by the migrants. This is probably aimed more at involving witnesses in the transfer process than at influencing the consumption pattern of the village household, because of fungibility.
[13] Many households receive remittances from distant relatives or friends too. This explains why some non-migrant households get a positive amount of remittances.

animal products either marketed or home-consumed during the year, are by far the most important source of income. Another striking feature emerges from these figures, providing some support to the prediction of our model. Farm- and non-farm earned incomes per capita in households with international migrants are much lower on average than those of non-migrant households. Such a result might reflect the disincentive effect of remittances on the productive behavior of agricultural households. Some stronger evidence is provided below[14].

Table 3. Sources of Income in 1996

	Income per Capita (CFA F) Households without Migrant Abroad (n=123)	**Income per Capita (CFA F) Households with Migrants Abroad (n=182)**
Farm-earned income	30,400 (44.7%)	22,139 (20.9%)
Non-farm earned income	19,904 (29.3%)	6,214 (5.9%)
Remittances	10,415 (15.3%)	53,810 (50.8%)
Pensions, rents	7,227 (10.6%)	23,714 (22.4%)
Total	67,946	105,878

Source: Gubert, 2000. Amounts in CFA francs (1 US $ ≅ 700 CFA F in 1996).

Farming Performance

The lower income earned from farming by migrant households is not due to obvious differences in cultivation practices, like crop choice or use of farming equipment. The survey was specifically designed to assess the impact of migration and remittances on agriculture, and it provides some rich and reliable information on each household's cultivated plots. The data include location of plots, types of crop, production levels, amounts of male and female labor inputs and amounts of other inputs such as hired labor, fertilizer and equipment. Data on the level of outputs were first collected using local measurement

[14] This result agrees with those in Bates (1996), or in Stark (1991) on relative deprivation. However, its interpretation is the opposite: households with migrants can afford to produce less income locally than the others, and still remain richer.

units (*muud*) and then converted to kilograms. Information on farm operations, inputs and outputs on each of the households' plots concerns the 1996 wet season.

The farming system is typical of rain-fed agriculture in Sahelian Africa. Active members of a household work on common plots, the output from which is used for fulfilling the basic consumption needs of the household. Each household owns on average two such common plots. In addition, each woman of the household cultivates one or more individual plot and has full control over the output from her field(s). On average, each woman controls two individual plots[15]. Crop choice is different by gender: plots controlled by men are generally devoted to cereals (sorghum and maize) while plots controlled by women are mainly devoted to groundnuts. Migrant and non-migrant households show similar patterns in crop choices with all farms cultivating sorghum, maize and groundnuts, as shown by table 4. Agricultural production is mainly devoted to family consumption: sales of crops are infrequent and account for a negligible fraction of total income. Despite increased population pressure, land remains abundant and extensively farmed in all eight villages.

Table 4. Distribution of Common Plots by Primary Crop and Migration Status in 1996

Crop	All (%)	Non-Migrant (%)	Migrant (%)
Sorghum	45.8	48.8	44.7
Maize	45.1	44.4	45.4
Rice	1.3	0.6	1.5
Millet	1.3	2.5	0.8
Groundnuts	4.7	3.1	5.3
Gombo	1.6	0.6	1.9
Others	0.2	0	0.2

Source: Gubert, 2000.

Tables 5 and 6 provide information concerning farm tools, labor force and crop output among the sample households, by migration status. Two farming units were dropped from the sample because they did not actually till any fields during the 1996 wet season. A significant difference comes out from

[15] The data reveal no statistically significant difference in the number of common plots per household and in the number of individual plots per woman between migrant and non migrant households.

comparing the two sub-samples regarding their equipment. The figures shown in the top part of table 5 suggest that the adoption of modern agricultural tools such as ox plough or cart is strongly and positively correlated with out-migration. Moreover, discussions with farmers during our fieldwork revealed that the acquisition of productive agricultural assets always followed migration, suggesting, as first pointed out by Stark (1978), that migration contributes to relax the credit constraint through remittances.

Table 5. Farm Tools and Cultivation Labor, by Migration Status

	All (n=303)	Non-Migrant (n=81)	Migrant (n=222)	z (*)	P>|z|
Farm Tools					
% of households owning ox plough	19%	15%	20%	-1.07	0.28
% owning donkey plough	50%	30%	58%	-4.46	0.00
% owning cart	45%	25%	53%	-4.46	0.00
% owning seeder	13%	9%	15%	-1.42	0.16
% of plots with plough	77%	70%	80%	-2.49	0.01
Cultivation Family Labor					
Adult male labor	4.0	3.0	4.4	-4.24	0.00
Adult female labor	5.5	3.4	6.3	-6.21	0.00
Child labor	1.0	0.7	1.1	-1.97	0.05

Source: Gubert, 2000.
(*): Mean comparison test.

Table 6. Value of Aggregated Crop Output, by Migration Status (1,000 CFA F)

Crop Output	All (n=303)	Non Migrant (n=81)	Migrant (n=222)	t	P>|t|
1995 crop output	435.8	303.9	484.0	-4.15	0.00
1996 crop output	365.7	311.3	385.6	-1.85	0.07
1995 crop output per cultivator	45.2	46.3	44.9	0.37	0.71
1996 crop output per cultivator	42.9	54.4	38.07	3.28	0.00

Source: Gubert, 2000.
Note: For the computation of the number of cultivators, family members from 14 to 65 years of age were counted as one irrespective of gender, elders over 65 and children below 14 as one half.

The lower part of table 5 shows that these migrant households have also a higher labor endowment than the non-migrant ones. However, this evident richer endowment in agricultural productive assets does not translate into higher output. In fact, we have already seen exactly the opposite emerging from table 3, with farm income per capita being lower by about a third than that of non migrant

households. The data suggest that this is due to lower productivity. Table 6 shows that despite a better endowment in physical assets, migrant households do not achieve significantly higher yields in terms of the value of output per working household member than non migrant households. [16] Although yields do not differ appreciably across the two groups in 1995, they do significantly differ in 1996, with higher yields on non-migrant farms. Therefore, although the evidence presented so far only allows for an impressionistic assessment, it does not contradict the view that migrant households are exerting less effort in production. However, a more thorough econometric analysis is required to confirm this impression. The empirical analysis presented in the next section aims at bringing out more rigorously the technical inefficiency of the migrant households, while controlling for many other potential sources of lower performances.

4. Empirical Analysis

Our first objective in this section is to construct a relevant indicator of each household's unobserved technical efficiency with which to test the hypothesis formulated above. We follow Udry (1996) and estimate a plot-level production function using a panel estimation technique with household-specific fixed effects. We are able to do so because each household in our sample tills simultaneously several plots. On average, we have eight plots per household in 1996. The two dimensions of the panel are therefore plots and households. After eliminating observations with missing data, the sample consists of 291 farm households with usable data on a total of 2,248 cultivated plots. We then use the estimated unobservable household-specific fixed effects, which is a measure of their technical efficiency, to explicitly test the main prediction of our theoretical model.

Estimation of Households' Productive Efficiency

Let the production technology on each plot be described by the function:

$$\ln Y_{ih} = \ln f(X_{ih}, W_i, G_{ih}) + \mu_h + \varepsilon_{ih}, \qquad (16)$$

[16] The number of household members working on the farm is a proxy for the size of cultivated land, in a context of extensive farming.

where i indexes plots of land and h indexes households ($i = 1,\ldots,P$, $h = 1,\ldots,H$); X_{ih} is a vector of physical inputs used on plot i; W_i is a vector of observable plot characteristics; G_{ih} is a vector of characteristics of the individual who controls the plot; μ_h is a measure of unobservable household characteristics, and ε_{ih} is a disturbance term that summarizes the effects of unobserved plot quality variables and plot-specific production shocks. The error-component μ_h may be treated either as a fixed effect or as a random effect (Greene, 1997). The main problem with the latter approach is that unobserved heterogeneity, embodied in the error component μ_h, might be correlated with observed inputs. Then, least squares and generalized least squares yield biased and inconsistent estimates. In our case, the random effects approach was statistically rejected by the Hausman test (Hausman, 1978) in favor of the fixed effects approach ($\text{Chi}^2_{48} = 592.3$).

The last important issue to be addressed involves the specification of the functional form for $f(X_{ih}, W_i, G_{ih})$. Cases of zero-values of some input variables in our data set prevent the Cobb-Douglas specification from being directly applicable. We use the method proposed by Battese (1997), who shows that the "zero-observation" problem in the estimation of Cobb-Douglas production function may be solved by the use of dummy variables such that efficient estimators are obtained using the full data set. The functional form used is then given by:

$$\ln Y_{ih} = \delta D + \delta_x \ln[\max(X_{ih}, D)] + \delta_w \ln W_i + \delta_g \ln G_{ih} + \mu_h + \varepsilon_{ih} \qquad (17)$$

where $D = 1$ if $X_{ih} = 0$ and $D = 0$ if $X_{ih} > 0$.

The following variables are included in the regression:

- Physical inputs (X_{ih}): number of male cultivators aged 14-65, number of female cultivators aged 14-65, hired labor costs (including seasonal workers' wages), use of fertilizer (dummy variable with value 1 if fertilizer was used on the plot, 0 otherwise), use of equipment (dummies); number of ploughing tools ;
- Observable plot characteristics (W_i): type of crop (dummies), location of plot (distance from village), type of plot (dummy variable with value 1 if common and 0 if individual), type of crop

interacted with type of plot, type of crop interacted with village dummies (which capture climatic and environmental effects). Due to unreliable data, we do not have any precise information on plot size. This does not seem to be a clear concept in our sample farmers' minds. However, in a context of extensive farming, they don't need it, as there is a very strong correlation between labor input and plot size. Therefore, labor input combined with agricultural tools may be used as a proxy for the size of a plot.

- Observable characteristic of the individual who controls the plot (G_{ih}): age (gender is not included here since it is strongly correlated with the type of the plot).

The results of estimating equation (17) are reported in table A.1. (see Appendix). Only the coefficients on physical inputs, location of plot, type of plot and type of plot × type of crop are reported, but village indicators interacted with type of crop were also included in the regression.[17] Even if the analysis of technical efficiency is concerned primarily with the error terms rather than the parameter estimates, some comments are worth making. First, all input coefficients have positive and highly significant coefficients. The estimated coefficient for the dummy variable for no plough use is significantly negative implying that the intercept of the production function is lower for farmers who do not use a plough. Conversely, the estimated coefficient for the dummy variable for no use of hired labor is significantly positive implying that the intercept of the production function is higher for farmers who do not hire labor from outside the household. The reason for this result may be as follows. Binswanger and Rosenzweig (1986) have shown that whenever a worker is not the sole residual claimant of farm profits there is an incentive problem relative to work effort. This implies that hired labor is more costly than family labor because it either requires some supervisory inputs by family members or it leads to less effort in the absence of supervision. Second, the distance of the plots from the village is positively related to production levels up to a certain point (around 6.5 kilometers). More distant plots, however, are associated with lower production levels. Such a pattern may be due to high fixed travel costs for working on distant

[17] Interaction effects were also included to test the hypothesis of an identical technology across plots controlled by migrant and non-migrant households. Results indicated that this hypothesis cannot be rejected.

plots. Lastly, common plots, generally controlled by household heads, have significantly higher output than individual plots controlled by women. This result may be due to systematic differences in the size or quality of the plots farmed by men and women or to differences in labor intensity, as women often combine cultivation activities with child care (Udry, 1996).

The Determinants of Households' Efficiency

Now that equation (17) has been estimated, the hypothesis that we want to test is whether the reliability of the migration-based insurance mechanism, denoted by λ in our theoretical model, is negatively correlated with our measure of unobservable household-specific productivity level, measured by μ_h. We thus regress the household-specific fixed effects derived from equation (17) on a vector of observable household characteristics including our proxy for λ. By doing so, we assume that the household's decision to reduce its level of effort affects all plots equally. Household characteristics include the household's size, the percentage of educated members within the household, a dummy variable indicating whether the household earned any off-farm wages or rents during 1996, dummy variables related to the household's social status[18], the number of common plots divided by the total number of cultivated plots among the household, and the adjusted number of out-migrants divided by the number of resident members in the household. In order to get a dependable indicator of the reliability of the insurance mechanism, each migrant was first weighted by his estimated propensity to remit (see appendix A.1 for details). A dummy variable indicating whether the main ethnic group of the village is Khassonke is also included. The results from estimation by OLS are presented in Table 7. Estimates indicate that the null hypothesis of moral hazard, corresponding to a statistically negative coefficient associated with our measure of insurance reliability, is strongly supported by the data. The implicit

[18] As might be expected, the survey that we carried out included no direct question on social status. However, households' last name is a very reliable indicator of social status. Consider, for instance, the Diabira and Sarambounou families in the village of Gakoura, the Konate family in the village of Fanguine, the Sissoko family in both the villages of Moussawaguia and Djimekon and the Kouma family in the village of Kerouane, all belong to the upper social strata (*i.e.* all have a long period of residence in the village or can trace their ancestry back to the founders of the village).

insurance contractual arrangement between the migrants and their family could thus partly explain the poor performance of agriculture among migrant households.

Table 7. Determinants of technical efficiency

Dependent variable: Predicted household-specific fixed effects ($\hat{\mu}_h$)

Variables	**Coef.**	**t**	**P>|t|**	
Intercept	- 0.21	- 1.12	0.27	
Household observable characteristics				
Sum of weighted out-migrants/household size	- 1.19	- 2.12	0.03	**
% of educated members in the household	- 0.02	- 0.10	0.92	
Household size	-0.001	- 0.26	0.79	
Number of common plots /total number of cultivated plots	- 0.93	- 3.26	0.00	***
Social status (dummies)				
Noble	0.14	1.59	0.11	
Artisan caste	0.03	0.19	0.85	
Off-farm work (dummy)	- 0.10	- 1.27	0.20	
Village observable characteristic				
Main ethnic group (dummy: 1 if Khassonke)	1.10	12.54	0.00	***
Number of observations	291			
F(8, 282)	27.73			
Prob>F	0.00			
Adjusted R^2	0.44			

Note: t-ratios and test statistics are based on heteroscedastic-consistent estimates of the variance-covariance matrix. The omitted social category is "all others" (former slaves, shepherds).

Households' technical efficiency levels are influenced by other variables. The negative sign associated with the proportion of collectively cultivated plots may reflect an incentive problem insofar as each cultivating member is not the sole residual claimant on profits on those fields. It may also capture an organizational effect, as the work on common plots is performed under the authority of the elders, while the work on individual plots allows more personal initiative. More appropriate decisions might be taken in the latter case, while some more rigid behavior might be required in the former one, for comforting the elders' authority. Second, households' efficiency levels are significantly higher in Khassonke villages. The explanation may be as follows: the involvement of Khassonke villages in migration is more recent and far less intense than in neighboring villages. Acts of collusion between households and peer pressure are thus less likely to emerge, and a comparison of family output with that of others may provide the

migrants with an efficient mechanism for monitoring productivity. Lastly, it is worth mentioning that the dummy variables related to social status are not significant. This result suggests that all the variables included in the first regression to control for land quality actually did their job. Indeed, noble families are usually entitled to plots of higher fertility, mostly by the riverside.

5. Robustness Checks

The most important empirical issue concerns our proxy for λ, i.e. the ratio of the weighted sum of migrants to household size. First, does it properly measure the effect of the reliability of the insurance mechanism on technical efficiency? Following Greene (1997, p.981), the answer is no if the typical household who chooses to purchase insurance through migration was relatively less efficient to start with, whether or not it had a migrant.[19] If this self-selection problem was present, then the least squares coefficient in the regression of μ_h on λ would actually overestimate the insurance effect. In order to separate moral hazard effects from potential selection effects in the second regression, we apply the approach used in Horowitz and Lichtenberg (1993). We construct a "treatment effects model" based on a dichotomous selection mechanism. The estimation techniques are as follows (Heckman, 1979): we first model insurance decisions, i.e. migration participation, as a dichotomous choice. The model is estimated as a Probit equation using maximum likelihood methods. The estimated coefficients are then used to compute the selection variable which is included, in a second stage, in the efficiency model (see appendix for details). A test for selectivity bias is a test for a correlation between the errors of the Probit and the corrected OLS regression being not significantly different from zero. The results are presented in Table A.4. Since there is no significant correlation between the error terms, the selection variable and, consequently, household self-selection do not play much of a role in our case.

Second, it might be argued that since λ might be correlated with household relative wealth, the observed inverse relationship between λ and μ may simply result from a higher opportunity cost of

[19] Unobserved agricultural inputs such as soil quality could well be correlated with the migration decisions of farm households.

labor for migrant families, assuming that consumption and leisure are normal goods. However, our survey data does not provide any support to this argument. To begin with, summary statistics reveal that the correlation coefficient between λ and income per capita (including remittances) is rather low (0.18). To be more persuasive, we also introduced an indicator of household wealth in the regression in order to control for the opportunity cost of labor. The data show that the richest families within our sample are those with retired migrants who receive a pension from France. We therefore use the amount of old age pension received in 1996 divided by the number of persons living in the household to measure household wealth. Estimates show that there is no evidence of a lower technical efficiency among wealthy families.[20] There is no evidence, therefore, that a higher opportunity cost of labor underlies the technical efficiency differential between migrant and non-migrant families.

Third, it might be argued that migrant households do worse, not for lack of effort, but because those who are left behind are the least capable or because migrant households use much riskier agricultural practices. Indirect arguments contribute to disprove these hypotheses. In a previous study (see Gubert, 2000), we show that migration decisions are made by household heads and that the migrants are mainly selected on the basis of birthright. As a result, the family members that migrate are more likely to be the oldest sons, while those that remain in the local economy are more likely to be the youngest ones. To our knowledge, no study has shown that oldest sons were systematically more productive (nor more migration-prone) than their younger siblings. Of course, the oldest sons could be more educated. But because returns to schooling in the immigrant labor market are likely to be very low in France, we actually find a negative relationship between the probability of international migration and schooling.

6. Conclusions

The description of our survey data has revealed that, although migration has certainly helped the adoption of improved agricultural technology, migrant households do not show better agricultural performance than non-migrant households, quite the opposite. Our theoretical assumption is that the

implicit insurance contract between the migrant and his family gives rise to opportunistic behavior resulting in technical inefficiency among migrant households. The estimation of a production function using panel data with household-specific fixed effects does not reject this hypothesis. The sum of weighted out-migrants divided by the household size is our proxy for the reliability of the insurance mechanism. It has a significant and negative effect on households' unobserved level of productive efficiency. The hypothesis of a trade-off between insurance and labor efficiency has already been mentioned in the economic literature (Fafchamps, 1992). The new result of this article is to show that such a trade-off is likely to be observed in the specific context of contractual arrangements between a migrant and his family.

Should one be worried by such a free riding behavior and conclude that restrictions on emigration flows from the area or on remittances should be imposed for improving technical efficiency? Certainly not, as it would replace a distortion resulting from informational asymmetry by another distortion based on the coercive power of the state. Moreover, if a tax on remittances were introduced in France, the migrants would almost certainly choose another destination. Some of them have already chosen to live in other European countries, in the USA and even in Japan. Besides, in a society where touching a hoe was historically considered a dishonor for an aristocrat (Bathily, 1975), X-inefficiency may be one of the major ingredients of the prestigious image of a family, leaving the *miskino* (poor or "small" people) to use all means they have to provide for their families. Thus our results give a clear indication of how an aid policy in favor of the Kayes area should be designed. Clearly, it should not be targeted at promoting productive and labor-saving investments by migrant families, since they are already wasting the capital that they own. By contrast, policies targeted at helping non-migrant families could create enough emulation to encourage the former ones to be more efficient.

Appendix

Table A.1. Cobb Douglas Production Function: Regression Results

Dependent Variable: Log (plot production, kg)

Variables	Coef.	t	P>|t|	
Intercept	2.57	7.12	0.00	***
Physical inputs (X_{ih})				
Male labor dummy	0.03	0.48	0.63	
Log(number of male cultivators)	0.18	3.50	0.00	***
Female labor dummy	-0.12	- 0.18	0.18	
Log(number of female cultivators)	0.14	2.81	0.00	***
Hired labor dummy	0.61	2.07	0.04	**
Log(hired labor costs)	0.10	2.90	0.00	***
Fertilizer dummy	0.13	2.14	0.03	**
Ox or donkey plough dummy	-0.13	- 2.47	0.01	**
Log(number of ploughing tools)	0.38	3.41	0.00	***
Sowing machine	0.42	3.68	0.00	***
Observable plot characteristics *(W_i)*				
Distance from village	0.13	3.97	0.00	***
Distance²	-0.01	- 2.74	0.01	***
Type of plot (1: common 0: individual)	0.91	3.41	0.00	***
Sorghum dummy	0.12	0.39	0.69	
Type of plot × Sorghum dummy	1.16	3.99	0.00	***
Maize dummy	0.57	2.00	0.05	**
Type of plot × Maize dummy	0.34	1.20	0.23	
Rice dummy	-0.82	- 2.72	0.01	***
Type of plot × Rice dummy	-0.67	- 1.15	0.25	
Groundnut dummy	0.52	2.04	0.04	**
Type of plot × Groundnut dummy	-1.10	- 2.54	0.01	**
Type of crop × Village dummies (28 dummies)	*(not reported here)*			
Observable characteristic of the plot manager (G_{ih})				
Age	0.01	7.86	0.00	***
Number of observations	2,248			
R²-within	0.61			
F(46, 2067)	62.99			
Prob>F	0.00			

Note: All the dummies relative to labor or ox plough take the value one when no labor or no ox plough was used on the plot (zero otherwise). Thus we expect negative signs. The omitted crop category is "all others" (millet, earth peas, gumbo and fonio).

A.1. Reliability of the Insurance Mechanism: Migrant's Weights Computation.

The migrants are not a homogeneous group and do not have, in particular, the same propensity to remit. The latter is strongly dependent on individual characteristics. We thus computed individual predicted probabilities to remit through the estimation of a Probit model. The dependent variable is dichotomous and has values one (or zero) if the migrant is a remitter (or is not a remitter). Each migrant was then weighted by his estimated propensity to remit.

Table A.2. Probit Model of Remittances

Variables	Coefficients	Marginal Effects	z	P>|z|	
Constant	- 5.26		- 7.06	0.00	***
Age	0.19	0.070	5.00	0.00	***
Age²/100	- 0.20	-0.073	- 4.20	0.00	***
International out-migrant	0.47	0.176	2.80	0.01	***
France	1.44	0.483	7.96	0.00	***
Household's head	1.11	0.286	2.60	0.01	***
Brother	0.61	0.206	2.77	0.01	***
Son	0.85	0.287	4.65	0.00	***
Number of observations	560				
Chi-squared (7)	312.07				
Pseudo-R²	0.42				

		Predicted		
		0	1	Total
Actual	0	169	52	211
	1	64	275	339
	Total	233	327	560

The mean predicted probabilities by place of residence are given in table A.3.

Table A.3. Mean Predicted Probabilities by Place of Residence

	Mean	Standard Error	n
Internal migrant	0.26	0.18	175
International migrant	0.77	0.27	385
France	0.90	0.13	276
Any foreign country except France	0.42	0.20	109

A.2. Test for Selectivity Bias

The procedure described below is the one proposed by Heckman (1979).

We first model insurance decisions (migration participation) as a dichotomous choice:

$$\begin{cases} M_h=1 \quad \text{if } \lambda_h^*>0 \\ M_h=0 \quad \text{if } \lambda_h^*\leq 0 \end{cases}, \text{ where } \lambda_h^* = \eta' w_h + u_h \tag{A.1}$$

As before, technical efficiency depends on household characteristics and on migration participation:

$$\hat{\mu}_h = \beta' Z_h + \xi M_h + v_h, \tag{A.2}$$

$(u_h, v_h) \sim$ bivariate normal $[0, 0, \sigma_u, \sigma_v, \rho]$.

If it is the case that migrant households are self-selected, then u_h and v_h are correlated and least squares estimates of ξ will overestimate the insurance effect. To correct for this problem, we define:

$$\Omega = \phi(\eta' w_h)\left[\frac{M}{\Phi(\eta' w_h)} - \frac{1-M}{1-\Phi(\eta' w_h)}\right],$$

where ϕ and Φ are the probability density and cumulative distribution function of the standard normal distribution, respectively, defined over the observable variables which determine migration status. Ω can be treated as a missing variable in equation (A.2). By finding instruments for this variable, it can be added to the specification of equation (A.2) which can then be consistently estimated by OLS.

A two-stage method is used to estimate the model. In the first stage, a Probit model of migration participation provides estimates of η. These estimates are then used to estimate Ω. In the second stage, this variable is added to equation (A.2) and the following equation is estimated:

$$\hat{\mu}_h = \beta' Z_h + \xi M_h + \rho\sigma \hat{\Omega}_h + \tau_h \tag{A.3}$$

where ρ is the correlation coefficient between the error terms u_h and v_h.

In order to get consistent and fully efficient estimates of the parameters, we use the maximum likelihood procedure to estimate the model. The results are presented in table A.4.

The result that z = - 0.43, not significantly different from zero, suggests that there is no significant correlation between the errors in (A.1) and (A.2). The estimated coefficients in table A.4. do not change much when Ω is dropped from the regression. As a result, household self-selection does not play much of a role in our analysis.

Table A.4. Results of the Selection Model

Variables	**Coef.**	**z**	**P>|z|**	
Selection (probit) equation				
Intercept	- 0.25	- 0.45	0.66	
Village dummies				
Djimekon	- 1.25	- 2.76	0.01	**
Fanguine	0.03	0.06	0.95	
Kerouane	- 0.85	- 2.56	0.01	**
Moussawaguia	0.08	0.14	0.89	
Dyalla	- 0.75	- 1.90	0.06	*
Somankidi	- 0.49	- 1.23	0.22	
Diakandape	- 0.56	- 1.39	0.17	
Age of household head	0.01	1.74	0.08	*
Social status (dummies)				
Noble	- 0.03	- 0.13	0.90	
Artisan caste	0.23	0.48	0.63	
Off-farm work (dummy)	- 0.41	- 1.82	0.07	*
Corrected regression				
Intercept	- 0.15	- 0.62	0.54	
Insurance (migration dummy)	- 0.26	- 1.83	0.07	*
% of educated members in the household	- 0.03	- 0.13	0.90	
Household size	0.002	0.56	0.57	
Number of individual plots /total number of cultivated plots	- 0.86	- 3.75	0.00	***
Social status (dummies)				
Noble	0.13	1.17	0.24	
Artisan caste	0.001	0.01	1.00	
Off-farm work (dummy)	- 0.10	- 1.19	0.23	
Main ethnic group (dummy: 1 if Khassonke)	1.11	11.52	0.00	***
σ	0.65	23.84	0.00	.
ρ	- 0.09	- 0.43	0.67	
Number of observations	291			
Log likelihood	-416.9			

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