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Why Do Migrants Remit? An Analysis for the Dominican Sierra

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Abstract

Two contrasting hypotheses about what determines remittances sent by Dominican migrants to their rural parents in the Sierra are tested: (a) an insurance contract taken by parents with their migrant children and (b) an investment by migrants in potential bequests. Results show that remittances from male and young migrants follow a pattern consistent with investment. In contrast, female migrants play the role of insurers. The gender composition of migrants in the household affects these motivations since men with remitting brothers invest more while men with no other migrant in the household remit to insure their parents.

Key words: migration, remittances, insurance, inheritance

JEL classification number: 8230

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I. Migration and remittances

For many households in less developed countries, remittances sent by household members who migrated to urban centers or more developed countries constitute a fundamental source of income, insurance, and eventual capital accumulation. This is particularly the case in the Sierra of the Dominican Republic, a poor rural region in the Northwestern mountains which has been a long-standing and prominent source of migration to the United States. Understanding what motivates these migrants to remit back to their families is important in explaining the levels of welfare achieved by emitting households: not only does this permit to explain how much migrants will remit, but the purpose for which they remit might also influence the way in which the household can use these remittances.

The role of remittances has been a crucial element in explaining household strategies toward migration. However, in most models that use remittances to explain migration, the fact that the migrant will remit and the level of remittances are taken for granted, conditional on the expected risk and return achieved in migration. The decision to send a migrant may thus be motivated by insurance (Rosenzweig, 1988), by portfolio diversification where remittances offer a risk-return option to be weighted against local sources of income (Stark 1978; Stark and Lehvari, 1982; Lambert, 1993), or by need for liquidity to invest in local income generation (Taylor and Wyatt). To be complete, these models should take into account the fact that migrants have control over the income which they earn through migration, and hence should incorporate individual migrants' decisions to remit in the specification of household migration strategies. It is this latter decision which we explore in this paper. We consider a situation where the decision to send a migrant has already been taken and ask what motivates a migrant to remit at a certain level given the status of his/her parents and siblings back in the home village, his/her personal and economic status in the place of migration, and eventual existence of other migrants in the household who may also be remitting.[2]

A number of studies have focused on the decision to remit as a trade between the household and the migrant. Trade may be over states of nature, in which case remittances are part of an insurance contract between the household and the migrant (Lucas and Stark, 1985; Stark and Lucas, 1988). Trade may alternatively be over time, in which case migrants may send remittances in order to a) reimburse the household for past expenditures such as

[2] This remittance behavior would be consistent with an incentive compatible contract between the household and the migrant about the joint decision to send a migrant and to remit given the choice of who will migrate. This is not done here because we do not have information on the household prior to sending the migrant that could help explain the migration decision.

schooling or costs directly related to migration (Stark and Lucas, 1988; Brown, 1997), b) transfer resources through the phases of life cycle (Poirine, 1997; Cox, 1990, and Cox and Jimenez, 1992, for social security), or c) invest for the future either out of a concern for inheritance or as a way to maintain status and return home in dignity (Lucas and Stark, 1985; Hoddinott, 1992 and 1994; Guarnizo, 1993; Brown, 1997).

Direct field observations in the Dominican Sierra suggested that both insurance and investment are indeed important determinants of remitting, but that the specific motivations to remit vary across types of migrants and types of households. Hence, in accordance with recent studies which have stressed the fundamental importance of accounting for heterogeneity in explaining rural household behavior (e.g., de Janvry, Fafchamps, and Sadoulet, 1991), we focus on heterogeneity among types of migrants and types of households in explaining the decision to remit and the amounts remitted. Migrants differ, in particular, by gender, age, levels of education, marital status, number of own dependents, years of migration in the United States, and characteristics of siblings that may have also migrated and may or may not be remitting. Parent households differ by income level, incidence of income shocks, demographic characteristics, and level and composition of assets owned.

We develop two models that focus on insurance and investment as the two main alternative motivations to remit while stressing the role of migrant and household heterogeneity. We jointly test these models with data we collected through a survey of Dominican Sierra households. Approximately 40% of these households have migrant children in urban zones of the Dominican Republic or the United States and 52% of these migrants are sending remittances.

The first model specifies an insurance contract between the household and the migrant with the purpose of strict instantaneous risk-coping by the household. Because migrants' incomes are uncorrelated with their parents', they can help smooth consumption when the rural household faces an income shock. Due to lack of information about reciprocal flows from the rural household to the migrants, we cannot distinguish this model from a pure altruism model which would yield the same predictions (Ligon, 1995; Hayashi *et al.*, 1996). We therefore assume that the migrant is playing the role of an insurer and derive the conditions under which the parent can design an optimal contract for such insurance.[3] Results show that, among all migrant children, female migrants and male migrants with no siblings who have migrated are more likely to fulfill insurer roles.

[3] We do not need to know whether the insurance contract was designed before the migrant went or after his/her departure.

The second model specifies the decision to remit by a particular migrant as a contribution to investment in household assets later to be inherited. It is based on models found in the literature related to intervivos transfers or bequests in developed (e.g., Becker, 1981; Bernheim *et al.*, 1985; Cox, 1987) and developing (Hoddinott, 1992 and 1994; Subramanian, 1994) economies. When a migrant sends remittances to increase his inheritance, remittances may both increase the size of the bequest by raising the amount of money available for investment by the rural household, and also modify the parents' behavior into investing more so as to motivate the migrant to send more remittances. Again, this behavior cannot be distinguished from that of an altruistic migrant who is sending money in order to help his parents invest so they achieve a higher level of utility in the future. Results show that, among all migrant children, men, younger migrants, and men with brothers who have migrated are more likely to send remittances for the purpose of household investment and subsequent inheritance.

In what follows, Section II presents the insurance and investment models. Section III discusses the data and offers descriptive statistics on the migrants and their rural parents' households. Section IV gives the econometric specification of the equations to be estimated and discusses the results obtained. Section V summarizes and concludes.

II. Insurance and investment as determinants of remittances

2.1. Insurance

If the migrant and her family engage in full risk-sharing, income transfers should occur among them to smooth both consumption streams. Altruism may help enforce the contract. Altonji *et al.* (1992) show that, in this framework, life-cycle risk-sharing cannot be distinguished from altruism: both effects imply that extended family members will experience equal changes in the marginal utility of their incomes. Transfers will flow towards the one who suffered an income shock. Full identification of the model requires information about flows in both directions.

Our Dominican data set only contains information about remittances received by the rural household. We develop an insurance model where the migrant accepts to perform the role of insurer for her family. An underlying assumption of the model is that remittances are not invested or that this is not taken into account by the migrant who therefore does not try to encourage risk-management behavior by his family. Remittances are thus a strict risk-

coping device in a static one-period framework. If such a static contract is at play, remittances should flow to the family when the latter experiences an income shock.

Consider a risk-averse parent who receives income Y with known probability π and income $Y-\Delta$ with probability $1-\pi$, where $\Delta>0$ represents a random income shock. The parent might want to enter an insurance contract with his risk-averse migrant child. If the parent was willing to pay a premium p (for example, any costs incurred by the parent on behalf of the migrant or alternatively the commitment to insure if the migrant faces a shock), the migrant will pay the parent $R=a\Delta$ when the shock hits, with $0\le a\le 1$. We consider a model where the parent is the principal who chooses both the premium p and coverage a, taking into account his migrant child's preferences.

The parent will choose p such that the child is at her reservation utility level in the contract, i.e., she is not worse-off being the insurer than not participating in the contract. Once p is chosen as a function of a, the parent maximizes his expected utility from the contract and chooses the optimal level of coverage a^*. For the contract to exist, the premium must be greater than the expected pay-out for the child and less than the actual pay-out when a shock occurs (implying a net average cost to the parent in exchange for a net transfer in periods of income shock), i.e., $a\Delta \ge p \ge (1-\pi)a\Delta$.

We first solve for the migrant's participation constraint. She will only accept contracts such that:

$$\pi u(y+p)+(1-\pi)u(y+p-a\Delta)\ge u(y), \tag{1}$$

where u is her utility function and y her income.

At the reservation utility level, equation (1) is an equality. A second-order Taylor expansion of the left-hand side around y yields:

$$u'(y)[p-a\Delta(1-\pi)]+\frac{1}{2}u''(y)\left[\pi p^2+(1-\pi)(p-a\Delta)^2\right]\approx 0. \tag{2}$$

Let $\xi=-\dfrac{u''(y)}{u'(y)}$ be the child's absolute risk-aversion. The only feasible premium level for the child to participate in the contract is then (see Appendix):

$$p^*(a)=a\Delta(1-\pi)+\frac{1}{\xi}-\frac{\sqrt{1-\pi(1-\pi)\xi^2a^2\Delta^2}}{\xi}. \tag{3}$$

We now solve the parent's utility maximization problem, taking into account his migrant child's reservation utility:

$$\max_a \ \pi v\left(Y-p^*\right)+(1-\pi)v\left[Y-p^*-\Delta(1-a)\right],$$

where v is the parent's utility function.

Substituting for p° as given in (3) and deriving the first order condition (see Appendix), we obtain the optimal level of coverage:

$$a^{\circ} = \frac{1}{\sqrt{\Delta^2(1-\pi)\xi^2 + 2\Delta(1-\pi)\xi\left(1+\frac{\xi}{\chi}\right)+\left(1+\frac{\xi}{\chi}\right)^2}} = a^{\circ}(-\Delta,-(1-\pi),+\chi,-\xi),$$

where $\chi = -\frac{v''(Y)}{v'(Y)}$ is the parent's absolute risk aversion. With costly coverage, parents will opt for a lower coverage if the size of the shocks and the incidence of shocks increase. They will want more coverage if they are more risk averse, but will obtain less coverage if the migrant is more risk averse as the cost of insurance rises. Remittances received will thus be:

$$r^{*} = a^{*}\Delta = r^{*}(+\Delta,-(1-\pi),+\chi,-\xi).$$

They increase with the size of the shock and the parent's level of risk aversion, and they decrease with the child's level of risk aversion. As absolute risk-aversion decreases with wealth, richer migrants will send more when a shock hits their parents and relatively poorer parents will receive larger remittances in times of shocks.

2.2. Investment and inheritance

If the migrant is interested in his future inheritance and therefore takes into account his parents' investment behavior when sending money, there are potentially three ways in which his remittances might influence that behavior:

a. By increasing the total size of the bequest as the parents' total income increases.

b. By increasing the inheritance value of the bequest. If migrants are more interested in certain kinds of investments (e.g., pastures to hold livestock in the Dominican Sierra), remittances could influence the parents' decision on the composition of investments and hence the particular kinds of assets which will be bequeathed to the migrant.

c. By increasing his probability of inheriting relative to that of other siblings or the share of the parent's bequest accruing to him.

Cases b. and c. above have been partly captured by Hoddinott (1994) in a static framework. Here, we use a more appropriate dynamic framework.

Suppose that the migrant is maximizing the utility of an investment portfolio. He can choose between two assets: a safe asset (e.g., a savings account in the place of migration) and a risky asset (his potential bequest where the risk comes from the fact that the investment will only yield at the uncertain time of the parents' death). The migrant saves at a constant rate s. One unit of the safe asset yields $(1+i)$ in the next period. Investment in the bequest will yield in the next period only if the father dies. The inheritance increases with the following law of motion:

$$A_{t+1}^{p} = \alpha\left(A_t^p, r_t; z^p\right)\left(A_t^p + Y_t + r_t\right)(1+i'),$$

where A_t^p are the parental assets at time t,

Y_t is the parents' autonomous income,

r_t are remittances,

i' is the rate of appreciation of parent's assets,

and $\alpha\left(A_t^p, r_t; z^p\right) > 0$ is the reward function, where z^p are parent household characteristics which shift this function. This reward increases with A^p at a decreasing rate as the marginal propensity to save increases at a decreasing rate with the parents' asset position. If cases b. or c. above apply, there are increasing returns in remitting as remittances increase the value of inheritable assets for the migrants or his share in inheritable assets. Hence, $\frac{\partial \alpha}{\partial r_t} = \alpha_{r_t} > 0$ and $\frac{\partial^2 \alpha}{\partial r_t^2} = \alpha_{r_t r_t} < 0$.

The migrant maximizes the expected utility he derives from his portfolio:

$$\underset{r_t}{\text{Max}} \sum_t \delta^t \left[(1-\phi_{t+1})u\left(A_{NI,t+1}^m\right) + \phi_{t+1}\, u\left(A_{I,t+1}^m\right)\right],$$

where ϕ_{t+1} is probability of inheriting at time $t+1$,

$A_{NI,t+1}^m = \left(s\left(A_t^m + y_t\right) - r_t\right)(1+i)$ is the migrant's asset position at $t+1$ if no inheritance,

$A_{I,t+1}^m = \left(s\left(A_t^m + y_t\right) - r_t\right)(1+i) + \alpha\left(A_t^p + Y_t + r_t\right)(1+i')$ is the migrant's asset position if inheritance,

A_t^m is the migrant's asset position at t,

and y_t is the migrant's income at t.

The first-order condition is then:

$$-(1-\phi_{t+1})u'\left(A_{NI,t+1}^m\right)(1+i) + \phi_{t+1}\, u'\left(A_{I,t+1}^m\right)\left[-(1+i) + \alpha_{r_t}\left(A_t^p + Y_t + r_t\right)(1+i') + \alpha\left(1+i'\right)\right] = 0. \qquad (4)$$

For the migrant, the marginal returns of the two assets are thus:

$(1+i)$ when investing in the safe asset,

$\phi_{t+1}\left[\alpha_{r_t}\left(A_t^P + Y_t + r_t\right)+\alpha\right]\left(1+i'\right)$ when investing in inheritance.

The optimal allocation between these two assets is given by the condition:

$$\frac{u'\left(A^m_{NI,t+1}\right)}{u'\left(A^m_{I,t+1}\right)} = \frac{\phi_{t+1}}{1-\phi_{t+1}}\left\{-1+\left[\alpha_{r_t}\left(A_t^P + Y_t + r_t\right)+\alpha\right]\frac{1+i'}{1+i}\right\},$$

which shows that if $\alpha_{r_t} = 0$, the portfolio composition is not affected by remittances.

Applying the implicit function theorem to the first-order condition allows to determine how the optimal level of remittances, r_t^*, varies with parental assets, parental income, the probability of inheriting, the migrant's asset position, the migrant's income, the migrant's level of risk aversion, and a set of characteristics of the parent household. The appendix provides the derivation of the results obtained:

$r_t^* = r_t^*\left(+A_t^P, +Y_t, +\phi_{t+1}, +A_t^m, +y_{t+1}, -\xi_I, +z^P\right)$, where

ξ_I is the migrant's risk aversion at the level of assets A_I^m, and

z^P are parent household characteristics that affect α positively.

The positive effect of A_t^P and Y_t holds if ξ_I is less than a threshold ξ_A of risk aversion.[4] Similarly, the positive influence of z^P holds if ξ_I is less than a threshold ξ_z.

We thus conclude that, if a migrant sends remittances as a means of investing in inheritance, he will send more remittances when the parents' assets and income are higher if he is not too risk averse. He will also remit more if the probability of inheriting is higher, and if he is richer, wealthier, and less risk averse.

2.3. Summary of predictions

The results of the comparative statics experiments on the level of remittances derived from both models are summarized as follows:

Variable	Insurance model	Investment model
Migrant's income (y) and assets (A^m)	No direct effect	Positive
Migrant's risk-aversion (ξ)	Negative	Negative

[4] Only the sum of the parents' income and assets, $A_t^P + Y_t$, and not the two individual terms, influence the optimal level of remittances.

Parents' autonomous household income (Y)	No direct effect	Positive
Parents' risk-aversion (χ)	Positive	No direct effect
Shock on parents' income (Δ)	Positive	No direct effect
Parents' bequeathable assets (A^P)	No direct effect	Positive
Probability of inheriting (ϕ)	No direct effect	Positive
Parent's characteristics in investment (z^P)	No direct effect	Positive

As we do not know the probability of inheriting, we use the head of household's age as a proxy. There is nonetheless a potential problem in so far as age captures both the increasing probability of death (positive effect on remittances) and the decreasing investment propensity of the father as his planning horizon declines (negative effect on remittances). A priori, the sign is ambiguous. In our data, the second effect dominates, particularly if the migrant is young, in which case the father's reduced planning horizon weighs negatively on the incentive to remit.

III. The data

In the summer of 1994, 385 randomly selected farm households were surveyed in the Dominican Sierra. Information was gathered about production, assets, sources of income, and personal characteristics of household members above 12 years of age including all migrant children. Household heads were asked details about monetary remittances and their senders. No information was collected about out-transfers except for schooling purposes. In this regard, this data set is similar to the ones used by Knowles and Anker (1981) and Lucas and Stark (1985, 1988) where information is one-sided.[5] In the Sierra, a region of extensive poverty with a large share of the population born there settled in the United States, migration to the U.S. is overwhelmingly considered a first-choice. Such a move is, however, quite costly and households and individuals have differential access to this possibility (affordability of airfare, membership to migration networks, etc.). Migration to a Dominican city is a second-best choice for those who cannot go overseas, rarely a first step to migration abroad (Sambrook, 1992). A total of 76%

[5] Hoddinott (1994) uses one of the few data sets where some of the migrants were also interviewed. De la Cruz (1995) conducted a detailed case study of five Mexican families and their migrants in the United States. Her results suggest that men remit to invest while women remit to insure their family and assist siblings. In the literature about intervivos transfers, the PSID data used by Altonji *et al.* (1992, 1996) are some of the most complete to fully identify the different motivations to remit, including altruism.

of the households in the Sierra are linked to migration either because they receive remittances (49%), have migrant children (40%), or have siblings in the United States (57%).

In the analysis, we restrict our attention to migrant children of the household head because they are the main source of remittances and information is available in the survey about their characteristics and remittances. Of these migrant children, 26.9% migrated to the United States, mostly to New York and Florida. Most migration from the Sierra is permanent, with the average time spent in the location of migration equal to 5.8 years. Remarkable features are the high proportion of migrants who are women (52%), married (61.5%), with dependent children (51.7%), with no intention to return (86.5%), and coming back less than three times a year to the Sierra (95.8%), suggesting a highly mature migration pattern with a well entrenched migrant community in the places of destination. There is a higher percentage of male migrants who remit (57.5%) compared to women (46.5%). However, higher levels of remittances are sent by female compared to male migrants (RD$4,820 vs. 3,234),[6] by married compared to single migrants (RD$5,817 vs. 1,475), and by individuals under 28 years of age compared to older migrants (RD$3,563 vs. 3,144).

Households with migrant children have on average 2.8 migrants per household, which leaves 6 persons living in the house.[7] The potential inheritance children might receive varies widely, both in terms of land size and land types. For these households, remittances (from migrant children and siblings) represent an important share of total income (18%), with other incomes coming from the imputed value of food for home consumption (27.2%), the sale of farm products (24.4%), agricultural wages (16.1%), and non-agricultural activities (13.6%).

Exposure to health risks is important: 44% of the households reported illnesses of some household members during the last twelve months preceding the survey. On average, nearly a month (24 work days) was lost in a household, amounting to a loss of RD$720 to 960[8] while other costs (medicines, transportation) amounted to RD$5,250. Households with migrant children handle risk differently than those who do not have any connection to migration networks (no children and no siblings). Households with migrants cope with risk by making use of household savings and calling on help from children in the United States. In contrast, households with no migrants

[6] Exchange rate: US$1.00 = RD$12.85 in the Summer 1994 in the Sierra.
[7] Among those house-dwellers, on average, one is an extended family member or some friend.
[8] Computed using the value of the rural daily wage of RD$30 to 40.

cope with risk by taking loans. Remittances thus play a meaningful role as a source of insurance for those households with migrants.

These descriptive statistics suggest that remittances play a role for asset accumulation and as a source of insurance. However, different categories of migrants may have different underlying motivations for sending remittances. We proceed to test which behavioral model best explains the observed remittances of each category of migrants.

IV. Econometric analysis

In both the insurance and investment for inheritance models, corner solutions are possible when migrants are not sending money to their parents. Half of the migrants actually do not remit. Because of this phenomenon, these models call for a censored regression analysis. The reduced-form equation for remittances is thus:

$$r^* = r^*\left(A^m, y, \xi, Y, \chi, \Delta, A^p, \phi, z^p, z^m\right) + u$$
$$\begin{cases} r = r^* \text{ if } r^* > 0 \\ r = 0 \text{ otherwise} \end{cases}$$

where r is the observed remittance sent by migrant, r^* is the corresponding latent variable, and u is an i.i.d. normal variable with expectation 0.

Since information about migrants' income and asset position are not available in the data, we use a prediction function à la Mincer where:

$$\begin{Bmatrix} y \\ A^m \end{Bmatrix} = f\left(G, Age, Age^2, E, T, T^2, US, C\right), \text{ with:}$$

G the migrant's gender,

Age the migrant's age,

E the schooling level expressed by four dummies corresponding to discrete levels of education (1 to 4 years of schooling, 4 to 8 years, some secondary schooling, and post-secondary schooling), with no schooling as the reference category,

T the time spent at the migration location,

US a dummy variable for living in the United States, and

C a dummy variable for whether the migrant has children of his own in the place of migration as this is expected to create competition for the income from which remittances can be sent.

In the remittance equation, the migrant's share of parents' inheritable assets (A^P, equal to the ratio of total land to the number of children) only include land as we do not have information on quality of the house, cattle, or businesses owned before the year of the survey, while current year data are all potentially subject to an endogeneity problem. Land is in any case by far the most important inheritable asset for the farm households surveyed. We used land owned in 1992 to correct for possible purchases in 1993-94 that would be directly correlated to remittances. The shock on parental income (Δ) is proxied by the total number of working days lost in the year because of illnesses.[9] The migrant's and parents' levels of risk-aversion are proxied by their income levels. Hence, the sign of Y in the remittance function reflects both the direct effect of this variable and its indirect effect through risk aversion. The probability of inheriting (ϕ) is proxied by the age of the household head. Migrants coming back frequently are more likely to bring their remittances home directly rather than send them which might cause some measurement error as the question about remittances asked only for monetary transfers which were sent to the rural family. Frequency of visits is therefore included as a shifter (z^m). Finally, the composition of land bequests by type of land use is included (z^p), as common wisdom in the Sierra associates pasture and cattle with migrants, with absentee owners controlling an increasing land acreage for extensive cattle-ranching (Peralta, 1994). Cattle production is also a less labor-intensive activity and a more liquid asset than coffee plantations. On the other hand, due to their production cycle, coffee plantations are an investment which signals longer planning horizons.

A test of endogeneity of the household income[10] is weakly significant in the remittance regressions. We therefore use a prediction of income ($\hat{Y}$) in these regressions as a function of the household's assets in terms of human capital, migration assets, and productive assets including business ownership, animals, and land. Total predicted income is then divided by the number of persons living in the house to obtain an income per capita measure.[11]

Based on the comparative statics derived from the models, the expected signs of the coefficients of the included variables are as follows:

Coefficients	Insurance model	Investment model

[9] Alternative variables used were total monetary spending due to illnesses and the number of adults and children who were sick, but none of those were significant.
[10] We used a test similar to the test described in Smith and Blundell, 1986.
[11] Alternative measures were an adult-equivalent household size and the consumer/worker ratio.

Migrant's asset and income function ($A^m, y, -\xi$)	+	+
Predicted parent per capita household income ($\hat{Y}$, $-\chi$)	–	+
Number of lost working days (Δ)	+	0
Migrant's share of parents' inheritable assets (A^p)	0	+
Age of household head (ϕ)	0	+
Proportion of land in coffee plantations ($\pm z^p$)	0	+/–
Proportion of land in planted forests ($\pm z^p$)	0	+/–
Proportion of land in pastures ($\pm z^p$)	0	+/–
Frequency of visits (z^m)	–	–

4.1. Estimation of remittances for all migrants

In a first step, we estimate a remittance function for all migrants (model 0). For this remittance function, like all subsequent models, use of a Tobit was statistically rejected in favor of a two stage Heckman approach[12]. Expected remittances can thus increase due to both a change in the probability to remit and a change in the expected amount remitted given the decision to remit. While we have no model to explain one decision separately from the other, the decision to remit may be affected by unobserved fixed transactions costs that make it respond to the determinants of remittances differentially from the amount remitted. The results are presented in Table 1. The expected level of remittances is significantly related to all migrants' income variables, with years of migration affecting the decision to remit and age, education levels, and migration to the United States strongly influencing the amount remitted. Parents' household income has a significantly negative coefficient on both the probability to remit and the amount sent, suggesting that insurance matters, but the number of working days lost is not significant, thus providing only a weak test of the insurance model. The migrant's share of inheritable land is positively significant on the amount remitted, which is consistent with the inheritance model. Migrants show a differential interest in land in pastures through their probability of remitting. Migrants' interest in investing in cattle-ranching has been signaled by Ravelo and del Rosario (1986) and Peralta (1994) in the Sierra, by Lucas and Stark (1985) in Botswana, and de la

[12] The Tobit model is tested using the likelihood ratio test based on Cragg, and Fin and Schmidt, mentioned in Greene, 1997 (p. 970). The Heckman model can be estimated either by ML technique or with the two-step estimator in which selectivity is corrected in the remittance function with the Inverse Mills Ratio from the probit of remitting equation. Although the ML estimator is more efficient, both estimates are consistent. The ML did not converge for models 0 to 2, so we report ML estimates for model 4 and the two-step estimates for models 0 to 2.

Cruz (1995) in Mexico. Finally, the coefficient for the dummy variable indicating frequent visits is significantly negative, suggesting that these migrants bring gifts.

4.2. Motivations to remit among different migrant categories

If migrant heterogeneity matters in explaining their decisions to remit, taking it into account should lead to econometric models with variables that capture the roles of insurance and investment with greater statistical significance. To sort out what motivates different categories of migrants to remit, we use dummy variables that characterize specific migrant categories in interaction with the variables which provide tests for the models. At each step, we compare a "treatment group", e.g., males, and a "control group", e.g., females.[13] We also give the significance level of the total effect of the variable as it applies to all migrants and to the specific migrant category in order to identify the net effect of the variable for that migrant category. Table 2 presents the results for migrant categories by gender and age. In Table 3, we explore migrant composition effects whereby the decision to remit of a particular migrant is affected by existence of specific types of siblings that may also be remitting. The least significant variables z^p or interactive effects were eliminated from the estimation to facilitate the identification of the equations.

4.2.1. Gender differences and remittances

The rationale for analyzing the motive to remit by gender category is based on the fact that men and women in traditional Dominican society have very different roles and degrees of control over their households' incomes. Women are generally less concerned with inheritance in physical assets from their parents because they expect to return to the locality of their present or future husbands as opposed to that of their parents, which is more likely for men. We have seen from descriptive statistics that men tend to remit more often but that women tend to remit more than men. When gender effects are introduced in the remittances equation (Table 2, model 1), we see that female migrants are more explicitly motivated by insurance than male migrants: they respond differently from the entire group of migrants in sending higher remittances in response to lost working days due to illness (a significant

[13] Estimations were also performed by splitting the sample in the different categories but these do not provide a straightforward test of the behavioral models at play and, as sub-samples get smaller, the reliability of the estimates is put in question.

interaction lost days*female migrant) and in the total effect of lost working days on their level of remittances (total effect with a p-value = 0.03). Male migrants, by contrast, are more explicitly pursuing investment: we find a significant interaction between land inheritance and male migrant in the probability of remitting, and the total effect of inheritance on their level of remittances is highly significant. Male migrants also participate to insurance as the total effect of parents' household income on their remittances is significantly negative. We thus conclude that gender differences are indeed important in explaining remittances, with women more explicitly motivated by insurance and men by investment and inheritance.

4.2.2. Age of migrants and motivations to remit

Younger migrants may have longer investment horizons than older ones and may be less settled than older migrants in the place of migration. These younger migrants should thus be more motivated by inheritance in sending remittances. In our sample, the median age is just under 28 years, so we use this age to divide the sample in two groups. Results in Table 2, model 2, show that young migrants are definitely not motivated by insurance while older migrants are (effect of lost days). In contrast, they are more motivated than older migrants to remit for the sake of inheritance and the total effect of land inheritance is highly positive (p-value = 0.00) on their level of remittances. Young migrants are also differentially less interested in sending remittances for pastures while preferring to send for investment in coffee plantations and forests, which is consistent with their having longer planning horizons.

4.3. Composition effects on the motivation to remit

If there is a gender division in motivations to remit, such as "migrant men are sending remittances more as a way of investing in bequests" while "female migrants play the role of insurers", we would expect these effects, for a particular migrant, to be influenced by household composition, in particular the presence or not of other migrants in the household and the characteristics of these migrants.

4.3.1. Sole male remitter in the household versus remitting male with brothers also remitting (model 3)

In this model, since all migrants remit, the fit is an OLS instead of a two-stage approach. For a man who is the only male remitter in the household (he may have sisters remitting), the effects on remittances of parents' income level and of shocks to their income are not significant. This remitter is not motivated by insurance. By contrast, when a male remitter has brothers who also remit, the incentive to increase remittances for land inheritance (share of land inheritance) is stronger and the overall effect is highly significant. The presence of other male migrants who also remit, presumably equally motivated by investment, is thus an incentive to remit more. This suggests either the existence of economies of scale in investment (cooperation among remitting brothers) or of incentives to remit more in order to secure one's share of the inheritance when other brothers are competing, a result consistent with Hoddinott (1994). This migrant is strongly motivated by parents' holding land in pastures, suggesting a short run outlook in this migrant's investment program.

4.3.2. Male migrant with no other migrant versus male migrant with other migrants in the household (model 4)

In this case, by being the only migrant in the household, this male migrant has to cater to his parents' insurance needs in addition to his interest in investment. The insurance concern of this sole male migrant is evidenced by a differentially positive effect of the number of lost working days on the decision to remit and a large positive overall effect. At the same time, while all migrants are motivated by investment, a sole male migrant with the undivided burden of insuring the household is not able to pursue investment.

V. Conclusions

In this paper, we start from the premise that migrants have control over remittances and examine two types of motivations for migrant children to send remittances to their farming parents in the Dominican Sierra: insurance in response to shocks to parents' income and investment toward increasing future inheritance. By constructing decision making models to capture these two motivations, we show that data on remittances can be used to identify these motivations econometrically. Taking into account the heterogenous nature of migrant sons and daughters by gender, age, and composition effects among sibling migrants, the results show clear contrasts in motivations to remit. Insurance is the main motivation to remit for women migrants while investment toward inheritance is the main motivation to remit for men and younger migrants. Cooperation or competition effects induce higher levels of

remittances for investment purposes among male remitters with other brothers remitting. Only when a male is the sole migrant in the household does he remit for the explicit purpose of insurance when parents are subject to health shocks, limiting his ability to remit for investment.

Identifying the reasons why migrants decide to remit allows to better understand why remittances matter in household strategies, beyond constituting an additional source of income for the household. By having control over the decision to remit, migrants send remittances for specific purposes which give them a differential value (positive or negative) for parents compared to unconditional transfers. If women remit largely for insurance, the timing of transfers gives parents a risk coping instrument that allows them to reduce costly risk management in generating autonomous income. This motivation enhances the welfare value of the money transferred. If males and young migrants remit for their parents to invest in bequeathable assets, this induces parents to invest remittances in order to increase the flow of transfers from abroad, possibly constraining the welfare value of the cash transfers away from consumption. In addition, if migrants have preferences for specific types of assets, such as pastures (all migrants and male migrants who are the sole remitters in the household) or forest and coffee plantations (young migrants), this distorts the investment program that parents would have followed with untied money transfers.

Policies targeted at favoring the successful migration of different classes of migrants will thus have differential effects on household welfare. In particular, little has been done to help women migrate successfully. Since they are differentially entrusted with insuring their parents and siblings, consolidating their success in migration may serve as an effective source of risk coping, with indirect efficiency consequences, for households in the emitting areas.

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Appendix[14]
Derivation of the Insurance and Investment Models

I. Insurance model

The migrant's participation constraint is such that:

$$\pi u(y+p)+(1-\pi)u(y+p-a\Delta)\geq u(y), \tag{1}$$

where u is his utility function and y his income.

At the reservation utility level, equation (1) is an equality. A second-order Taylor expansion of the left-hand side around y yields:

$$u'(y)[p-a\Delta(1-\pi)]+\frac{1}{2}u''(y)\left[\pi p^2+(1-\pi)(p-a\Delta)^2\right]\approx 0$$

from which we obtain

$$-\frac{u''(y)}{u'(y)}\approx\frac{2(p-a\Delta(1-\pi))}{\left[\pi p^2+(1-\pi)(p-a\Delta)^2\right]}.$$

Let $\xi=-\dfrac{u''(y)}{u'(y)}$ be the child's absolute risk-aversion. The above equation can be rewritten as:

$$\xi p^2-2[a\xi\Delta(1-\pi)+1]p+(1-\pi)a\Delta(\xi\Delta a+2)\approx 0. \tag{2}$$

This equation has two positive roots, both greater than $a\Delta(1-\pi)$:

$$p^*(a)=a\Delta(1-\pi)+\frac{1}{\xi}\pm\frac{\sqrt{1-\pi(1-\pi)\xi^2a^2\Delta^2}}{\xi}.$$

The largest root is greater than $a\Delta$ and therefore not acceptable.[15] The only feasible premium level for the child to participate in the contract is therefore:

$$p^*(a)=a\Delta(1-\pi)+\frac{1}{\xi}-\frac{\sqrt{1-\pi(1-\pi)\xi^2a^2\Delta^2}}{\xi}, \text{ given in the text.} \tag{3}$$

We now solve the parent's utility maximization problem, taking into account his migrant child's reservation utility. The parent's problem is to solve:

$$\max_a\left\{\pi v\left[Y-a\Delta(1-\pi)-\frac{1}{\xi}+\frac{\sqrt{1-\pi(1-\pi)\xi^2a^2\Delta^2}}{\xi}\right]+(1-\pi)v\left[Y+\Delta(-1+\pi a)-\frac{1}{\xi}+\frac{\sqrt{1-\pi(1-\pi)\xi^2a^2\Delta^2}}{\xi}\right]\right\}.$$

Let us denote $A=1-\pi(1-\pi)\xi^2a^2\Delta^2$. The first-order condition for this maximization problem is:

$$-\left[\left(1+\frac{\pi\xi a\Delta}{\sqrt{A}}\right)v'\left(Y-a\Delta(1-\pi)-\frac{1}{\xi}+\frac{\sqrt{A}}{\xi}\right)\right]+\left(1-\frac{(1-\pi)\xi a\Delta}{\sqrt{A}}\right)v'\left(Y+\Delta(-1+\pi a)-\frac{1}{\xi}+\frac{\sqrt{A}}{\xi}\right)=0.$$

Using a first-order Taylor expansion around Y, the first-order condition reduces to:

$$-\frac{\xi a\Delta}{\sqrt{A}}v'(Y)+\left[-\Delta+\frac{\xi\Delta^2}{\sqrt{A}}(1-\pi)a+\frac{\Delta a}{\sqrt{A}}\right]v''(Y)\approx 0.$$

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[14] Note: We suggest that this appendix be placed in the homepage of one of the authors to be readily accessible to readers on the Internet.

[15] $p_h^\circ(a)=a\Delta(1-\pi)+\dfrac{1}{\xi}+\dfrac{\sqrt{1-\pi(1-\pi)\xi^2a^2\Delta^2}}{\xi}>a\Delta \Rightarrow a<\dfrac{2}{\xi\Delta}$.

This is always true since $a\leq\dfrac{1}{\xi\Delta\sqrt{1-\pi(1-\pi)}}$ and $\pi(1-\pi)<\dfrac{1}{4}$.

Let us call $\chi = -\frac{v''(Y)}{v'(Y)}$ the parent's absolute risk aversion and replace A by its expression. We then obtain:

$$\chi\sqrt{1-\pi(1-\pi)\xi^2 a^2\Delta^2} = a[\xi + \chi + \xi\chi\Delta(1-\pi)].$$

Taking squares on both sides and solving for a positive yields the optimal a.

The optimal level of coverage is then $a^* = \frac{1}{\sqrt{\Delta^2(1-\pi)\xi^2 + 2\Delta(1-\pi)\xi\left(1+\frac{\xi}{\chi}\right)+\left(1+\frac{\xi}{\chi}\right)^2}}$.

II. Investment and inheritance

The migrant maximizes the utility he derives from his portfolio

$$\underset{\pi}{\text{Max}} \sum_t \delta^t\left[(1-\phi_{t+1})u\left(A^m_{NI,t+1}\right)+\phi_{t+1}u\left(A^m_{I,t+1}\right)\right],$$

where ϕ_{t+1} is probability of inheriting at time $t+1$,

$A^m_{NI,t+1} = \left(s\left(A^m_t + y_t\right) - r_t\right)(1+i)$ is migrant's asset position at $t+1$ if no inheritance,

$A^m_{I,t+1} = \left(s\left(A^m_t + y_t\right) - r_t\right)(1+i) + \alpha\left(A^p_t + Y_t + r_t\right)(1+i')$ is migrant's asset position if inheritance,

A^m_t is migrant's asset position at t

and y_t is migrant's income at time t.

The first-order condition:

$$-(1-\phi_{t+1})u'\left(A^m_{NI,t+1}\right)(1+i)+\phi_{t+1}u'\left(A^m_{I,t+1}\right)\left[-(1+i)+\alpha_{r_t}\left(A^p_t + Y_t + r_t\right)(1+i')+\alpha(1+i')\right]=0 \qquad (4)$$

can be written as $F\left(r_t, A^m_t, Y_t, A^p_t; \phi_{t+1}, z^p\right) = 0$. (4')

We assume that the utility function is concave, therefore $\frac{dF}{dr_t} < 0$. By the implicit function theorem, the sign of $\frac{dr_t}{dx}$ will thus be the same as the sign of $\frac{dF}{dx}$.

1. Remittances and parental assets and income:

$$\frac{dF}{dY_t} = \frac{dF}{dA^p_t} = \phi_{t+1}(1+i')\left\{\left[\alpha_{A^p r_t}\left(A^p_t + Y_t + r_t\right)+\alpha_{r_t}+\alpha_{A^p_t}\right]u'\left(A^m_{I,t+1}\right)+\right.$$

$$\left.\left[-(1+i)+\alpha_{r_t}\left(A^p_t + Y_t + r_t\right)(1+i')+\alpha(1+i')\right]\left[\alpha+\alpha_{A^p}\left(A^p_t + Y_t + r_t\right)\right]u''\left(A^m_{I,t+1}\right)\right\},$$

so: $\frac{dF}{dA^p_t} > 0$ if $\xi < \xi_A = \frac{\alpha_{A^p r_t}\left(A^p_t + Y_t + r_t\right)+\alpha_{r_t}+\alpha_{A^p_t}}{\left[-(1+i)+\alpha_{r_t}\left(A^p_t + Y_t + r_t\right)(1+i')+\alpha(1+i')\right]\left[\alpha+\alpha_{A^p}\left(A^p_t + Y_t + r_t\right)\right]}$.

2. Remittances and probability of inheritance:

$$\frac{dF}{d\phi_{t+1}} = (1+i)u'\left(A^m_{NI,t+1}\right)+\left[-(1+i)+\alpha_{r_t}\left(A^p_t + Y_t + r_t\right)(1+i')+\alpha(1+i')\right]u'\left(A^m_{I,t+1}\right) > 0$$

as $\left[\alpha_{r_t}\left(A^p_t + Y_t + r_t\right)+\alpha\right](1+i') > 1+i$.

3. Remittances and migrant's assets:

$$\frac{dF}{dA_t^m} = s(1+i)\left\{-(1-\phi_{t+1})(1+i)u''\left(A_{NI,t+1}^m\right) + \phi_{t+1}\left[-(1+i)+\alpha_{r_t}\left(A_t^p + Y_t + r_t\right)(1+i') + \alpha(1+i')\right]u''\left(A_{I,t+1}^m\right)\right\}.$$

The term in curly brackets is similar to the first-order condition, except that we are now considering the second-order derivatives of the utility function.

If absolute risk-aversion is decreasing with income, then $\frac{dF}{dA_t^m} > 0$.

4. Remittances and upwards shifters z^p (i.e., with $\alpha_z > 0$):

$$\frac{dF}{dY_t} = \frac{dF}{dA_t^p} = \phi_{t+1}(1+i')\left\{\left[\alpha_{A_t^p r_t}\left(A_t^p + Y_t + r_t\right) + \alpha_{r_t} + \alpha_{A_t^p}\right]u'\left(A_{I,t+1}^m\right) + \right.$$

$$\left.\left[-(1+i)+\alpha_{r_t}\left(A_t^p + Y_t + r_t\right)(1+i') + \alpha(1+i')\right]\left[\alpha + \alpha_{A_t^p}\left(A_t^p + Y_t + r_t\right)\right]u''\left(A_{I,t+1}^m\right)\right\}.$$

Let us assume, additionally, that $\alpha_{z^p r_t}(Y_t + r_t) + \alpha_{z^p} > 0$,

so: $\frac{dF}{dz^p} > 0$ if $\xi < \xi_z = \dfrac{\alpha_{z^p r_t}\left(A_t^p + Y_t + r_t\right) + \alpha_{z^p}}{\left[-(1+i)+\alpha_{r_t}\left(A_t^p + Y_t + r_t\right)(1+i') + \alpha(1+i')\right]\alpha_{z^p}\left(A_t^p + Y_t + r_t\right)}$.

Table 1. Determinants of remittances

Endogenous variable:			Model 0 Probability to remit (Probit)		Remittance level[1] (OLS)	
Variables	Model variables	Units	Marginal effects	Significance p-value	Coefficient	Significance p-value
Migrant's asset and earnings function	A^m, y		Joint-test	0.00	Joint-test	0.00
Gender		dummy	0.1303	0.00		
Age		years			822	0.02
Age squared					-15.2	0.01
Time since first migrated		years	0.0058	0.00		
Time squared			-0.0031	0.00		
1 to 4 years of schooling		dummy	0.2160	0.04	3433	0.06
4 to 8 years of schooling		dummy	0.4370	0.00	6767	0.00
Some secondary schooling		dummy	0.2691	0.04	5036	0.03
Post-secondary schooling		dummy	0.4533	0.04	11259	0.00
Migrant in the U.S.		dummy	0.1973	0.00	11825	0.00
Parents' household income						
Predicted income per capita	Y	RD$	-0.00002	0.01	-0.24	0.01
Insurance						
Number of lost working days	Δ	days	0.0001	0.88	11.4	0.18
Investment						
Migrant's share of land inheritance	A^p	tareas			19.3	0.00
Age of head	ϕ	years	0.0061	0.17	-83.6	0.15
Proportion of pastures	z^p	percentage	0.0494	0.10	237	0.34
Other variables						
Migrant visits frequently	z^m	dummy	-0.3284	0.20	-10783	0.00
Constant					-14317	0.02
Inverse Mills ratio					6585	0.00
Goodness-of-fit			Log Likelihood = -226.4		R^2 = 0.49	
			% correct = 65.2		F(14,183) = 12.54	
Observations summary			Number of observation = 379; uncensored = 198			

[1] Remittances in RD pesos of 1994 (1US$= 12.85RD$).

Table 2. Determinants of remittances by category of migrant: gender and age

Endogenous variable:	Model 1 Male versus female migrant Probability to remit (Probit)		Remittance level (OLS)	
Variables	Marginal	p-value	Coefficient	p-value
Migrant's earning function				
Joint test all income variables		0.00		0.00
Gender effect: Male migrant	0.6417	0.07	6489	0.33
Parents' household income				
Predicted income per capita	-0.00001	0.42	-0.02	0.88
Income*Male migrant	-0.00002	0.26	-0.27	0.15
Total effect of income for male migrant	-0.00003	0.01	-0.29	0.02
Insurance				
Number of lost working days	-0.0010	0.43	-5.20	0.63
Lost days*Female migrant	0.0015	0.34	27.26	0.08
Total effect of lost days for female migrant	0.0006	0.60	22.06	0.03
Investment				
Age of head	-0.0004	0.94	-17.40	0.80
Age of head*Male migrant	-0.0129	0.11	-91.46	0.37
Total effect of age of head for male migrant	-0.0134	0.02	-108.85	0.14
Migrant's share of land inheritance	-0.0027	0.22	18.07	0.55
Inheritance*Male migrant	-0.0032	0.10	2.06	0.95
Total effect of inheritance for male migrant	-0.0058	0.71	20.14	0.03
Other variables				
Migrant visits frequently	-0.0218	0.15	-10430	0.00
Constant term			-15818	0.01
Inverse Mills ratio			4376	0.06
Goodness-of-fit	Log likelihood = -221.5		R^2 = .50	
	% correct=66.8		F(24,173)=7.35	
Observations summary	Number of observations = 379; uncensored = 198			

Insignificant effects included but not reported: coffee plantation, managed forests, pastures.

Endogenous variable:	Model 2 Young versus old migrant† Probability to remit (Probit)		Remittance level (OLS)	
Variables	Marginal	p-value	Coefficient	p-value
Migrant's earning function				
Joint test all income variables		0.00		0.00
Age effect: Young migrant			9228	0.13
Parents' household income				
Predicted income per capita	-0.00004	0.03	0.04	0.71
Income*Young migrant			-0.23	0.14
Total effect of income for young migrant			-0.19	0.10
Insurance				
Number of lost working days	0.0002	0.85	-2.71	0.75
Lost days*Old migrant			25.53	0.04
Total effect of lost days for old migrant			22.83	0.01
Investment				
Age of head	-0.0032	0.48	36.85	0.61
Age of head*Young migrant			-97.90	0.29
Total effect of age of head for young migrant			-61.06	0.31
Migrant's share of land inheritance	-0.0007	0.43	0.82	0.94
Inheritance*Young migrant			27.10	0.05
Total effect of inheritance for young migrant			27.92	0.00
Proportion of coffee plantation	-0.3818	0.13		
Coffee*Young migrant	0.7961	0.01		
Total effect of coffee for young migrant	0.4142	0.13		
Proportion of forest	-1.2772	0.04		
Forest*Young migrant	1.4410	0.05		
Total effect of forest for young migrant	0.1637	0.67		
Proportion of pastures	0.3792	0.17		
Pastures*Young migrant	-0.8328	0.02		
Total effect of pastures for young migrant	-0.4536	0.10		
Other variables				
Migrant visits frequently	-0.3595	0.08	-8909	0.00
Constant term			-20818	0.01
Inverse Mills ratio			1629	0.00
	Log likelihood = -215.4		R^2 = .51	
	% correct=70.2		F(19,176)=9.53	
	Number of observations = 376; uncensored = 196			

† Young migrant: < 28 years old

Insignificant effects included but not reported: coffee plantation, managed forests, pastures.

Table 3. Determinants of remittances with migrant composition effects

Model 3 (OLS) Sole male remitter in the household vs male with brothers remitting Endogenous variable: level of remittances in RD pesos of 1994	Coefficient	p-value
Migrant's earning function		
Joint test all income variables		0.11
Migrant composition effect: Sole male remitter	-10728	0.17
Parents' household income		
Predicted income per capita	-0.21	0.11
Income*Sole male remitter	-0.35	0.88
Total effect of income for sole male remitter	-0.57	0.20
Insurance		
Number of lost working days	37.2	0.49
Lost days*Sole male remitter	-28.8	0.60
Total effect of lost days for sole male remitter	8.3	0.41
Investment		
Age of head	-44.0	0.72
Age of head*Male remitter with brothers	-168.7	0.19
Total effect of age of head for male remitter with brothers	-212.6	0.00
Migrant's share of land inheritance	-5.5	0.80
Inheritance*Male remitter with brothers	40.0	0.07
Total effect of inheritance for male remitter with brothers	34.6	0.00
Proportion of pastures	186	0.59
Pastures*Male remitter with brothers	5837	0.09
Total effect of pastures for male remitter with brothers	6023	0.08
Other variables		
Migrant visits frequently	-6508	0.01
Constant term	3630	0.63
Goodness-of-fit	R2 = 0.60	
Observations summary	Number of observations = 107	

Insignificant effects included but not reported: coffee plantation, managed forests.

Model 4 (Full Maximum Likelihood) Male migrant with no other migrant vs male with other migrants in the household Endogenous variable:	Remittance probability Marginal	p-value	Remittance level Coefficient	p-value
Migrant's earning function				
Joint test all income variables		0.00		0.00
Migrant composition effect: Sole male migrant	0.6678	0.06	-9949	0.86
Parents' household income				
Predicted income per capita	0.0000	0.02	-0.13	0.19
Income*Sole male migrant			-1.25	0.80
Total effect of income for sole male migrant			-1.39	0.78
Insurance				
Number of lost working days	-0.0016	0.18	1.07	0.91
Lost days*Sole male migrant	0.0117	0.04		
Total effect of lost days for sole male migrant	0.0101	0.07		
Investment				
Age of head	-0.0122	0.09	-73.8	0.24
Age of head*Sole male migrant	-0.0914	0.04	272.0	0.77
Total effect of age of head for sole male migrant	-0.1036	0.02	198.2	0.83
Migrant's share of land inheritance	0.0021	0.15	21.1	0.01
Inheritance*Sole male migrant			-72.5	0.16
Total effect of inheritance for sole male migrant			-51.4	0.33
Other variables				
Migrant visits frequently			-8940	0.00
Constant term			-572	0.94
Inverse Mills ratio			-3892	0.00
	Log Likelihood = -1128			
	Number of observations = 182			

Insignificant effects included but not reported: coffee plantation, managed forests, pastures.