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# WHY DO MIGRANTS REMIT? AN ANALYSIS FOR THE DOMINICAN SIERRA

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## ABSTRACT

Two contrasting hypotheses about what motivates Dominican migrants to send remittances to their rural parents in the Sierra are tested: (1) an investment in potential bequests and (2) an insurance contract between parents and migrant children. Remittances from young migrants, males, and migrants who want to return to the Sierra follow a pattern consistent with investment. In contrast, female migrants with no intention of returning to the Sierra play the role of insurers. The gender composition of the migrant siblings affects this remittance task-sharing, since women with no remitting brothers show interest in inheritance, while men with no sisters offer insurance.

## CONTENTS

## TABLES

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# 1. MIGRATION AND REMITTANCES

For many households in less developed countries, remittances that are sent by household members who have migrated to more developed countries constitute a fundamental source of income, insurance, and eventual capital accumulation. Understanding what motivates these migrants to remit back to their families and how much they will remit is thus important in explaining the levels of welfare achieved by households sending migrants out. This is particularly the case in the Sierra of the Dominican Republic, a poor rural region in the Northwestern mountains that has been a longstanding and prominent source of migration to the United States. Remittance flows from migrants represent a growing source of income, welfare, and investment for the families in the Dominican Sierra.

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) or 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). This ignores the control migrants have over the income that they earn through migration. Hence the

individual migrant's motivations to remit need to be taken into account in explaining remittance flows and their impact on household welfare. In this paper, we consider a situation where the decision to send a migrant has already been taken and ask what motivates this migrant to remit at a certain level, given the status of his/her parents and siblings back in the home country, 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.

A number of studies have focused on the decision to remit as a trade between the household and the migrant. If remittances are part of an insurance contract between the household and the migrants, trade is over states-of-nature (Cox 1990; Cox and Jimenez 1992). Alternatively, trade may happen over time, in which case migrants may send remittances in order to (1) reimburse the household for past expenditures such as schooling or costs directly related to migration or (2) 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, 1994; Guarnizo 1993).

Direct field observations in the Dominican Sierra suggests that both insurance and investment are indeed important determinants of remitting, but that the specific motivations to remit are highly varied among heterogenous populations of both migrants and receiving households. Hence, in accordance with recent studies that have stressed the fundamental importance of accounting for heterogeneity in explaining rural household behavior (e.g., de Janvry, Fafchamps, and Sadoulet 1991; de Janvry and Sadoulet 1992),

we focus on heterogeneity in types of migrants and types of receiving 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 from a survey of Dominican Sierra households. Approximately 40 percent of these households have migrant children in urban zones of the Dominican Republic or the United States and 52 percent of these migrants are sending remittances.

The first model specifies an insurance contract between the household and the migrant with the purpose of providing strictly instantaneous risk-coping for the household. Because migrants' incomes are uncorrelated with those of their parents, they can help smooth consumption when the rural household faces an income shock. Due to the lack of information about reciprocal flows from the rural household to the migrants, we cannot distinguish this model from a pure altruism model that would yield the same predictions (Ligon 1995; Hayashi, Altonji, and Summers 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. Results show that, among all migrant

children, female migrants, male migrants with no brothers who have migrated, and migrants who do not intend to return are more likely to fulfill insurer roles.

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 (for example, Becker 1981; Bernheim, Schleifer, and Summers 1985; Cox 1987) and developing (Hoddinott 1992, 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, we cannot distinguish this remittance behavior from that of an altruistic migrant who is sending money in order to help his parents invest so that they will achieve a higher level of utility in the future. Results show that, among all migrant children, men, younger migrants, migrants who intend to return, men with brothers who have migrated, and women with no brothers remitting are more likely to send remittances for the purpose of household investment and subsequent inheritance.

In what follows, Section 2 presents the insurance and investment models. Section 3 discusses the data and offers descriptive statistics on the migrants and their rural parents' households. Section 4 gives the econometric specification of the equations to be estimated and discusses the results obtained. Section 5 summarizes and concludes.

## 2. INSURANCE AND INVESTMENT AS DETERMINANTS OF REMITTANCES

### 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, Hayashi, and Kotlikoff (1992) show that, in this framework, altruism will not be separated from life-cycle risk-sharing. 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 thus requires information about flows in both directions.

Our Dominican data set only contains information about remittances received by the rural household. We develop a traditional model of insurance where the migrant plays the insurer for her family back home. 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 on the part of her family. Remittances are thus a strictly 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 probability $\pi$ and income $Y\mathbb{N}$ with probability $1-\pi$. There is no uncertainty about these probabilities. Assume that $\Delta = Y - Y\mathbb{N} > 0$ represents an unexpected income shock. The parent might want to enter an

insurance contract with his or her 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 $a\Delta$ when the shock hits, with $0 \leq a \leq 1$. We consider a model where the parent is the principal who chooses both the premium $p$ and coverage $a$, taking into account the migrant child's preferences.

The parent will choose $p$ such that the child is at her reservation utility level in the contract, that is, the child 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 her or his expected utility from the contract and chooses the optimal level of coverage, $a^*$. In this formulation, it is obvious that remittances should respond to shocks with $\frac{dR}{d\Delta} > 0$, as the transfer is proportional to the shock.

Suppose, additionally, that the premium is greater than the expected pay-out and less than the actual pay-out, which implies a net cost of insurance for both parties, that is, $a\Delta \geq p \geq (1-\pi)a\Delta$.

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

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

where $u$ is the migrant's 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

$$u'(y)[p - a\Delta(1 - \pi)] + \frac{1}{2}u''(y)[\pi p^2 + (1 - \pi)(p - a\Delta)^2] = 0 . \quad \textbf{(2)}$$

Let $\xi = -\frac{u''(y)}{u'(y)}$ be the child's absolute risk-aversion. Appendix 1 provides the calculations to solve this equation.

The only feasible premium level for the child to participate in the contract is then

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

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

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

where $v$ is the parent's utility function.

We substitute for $p^*$ as given in equation (3) and derive the first order condition (see Appendix 1). Let us call $\chi = -\frac{v''(y)}{v'(y)}$ the parent's absolute risk aversion. We then obtain

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

The optimal level of coverage is given by

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

Now let us look at how $a^*$ varies with $\chi$ and $\xi$:

$$\frac{da^*}{d\xi} = -\frac{1}{\xi}a^* < 0,$$

that is, the less risk-averse the migrant is, the larger the coverage will be, and

$$\frac{da^*}{d\chi} = \frac{1}{\xi}\frac{\chi\Delta(1-\pi)(\chi\Delta+1+\pi)+1}{\sqrt[3]{\chi^2\Delta^2(1-\pi)+2\chi\Delta(1-\pi)+1}} > 0,$$

that is, a more risk-averse parent will take a greater insurance coverage. 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.

## INVESTMENT AND INHERITANCE

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

1. By increasing the total size of the bequest as the parents' total income increases.
2. By increasing the inheritance value of each unit of the bequest according to the type of investment undertaken by the parent. For example, if migrants are more interested in certain kinds of investments, remittances could influence the parents' decision on the composition of investments and hence the particular kinds of assets that will be bequeathed to the migrant.
3. By increasing the migrant's probability of inheriting or the share of the parent's bequest accruing to him.

Cases 2 and 3 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 (for example, a savings account in the place of migration) and a risky asset (the migrant's potential bequest, where the risk comes from the fact that the investment will only yield at the parents' death). The migrant saves at a constant rate, $s$. One unit of the safe asset yields $(1 + i)$ in the next period. The investment in the bequest will yield at time $t + 1$ if the father dies. The inheritance increases with the following law of motion:

$$A_{t+1} = A_t + \alpha(A_t, r_t; z^i)(Y_p + r_t),$$

where $A_{t+1}$, $A_t$ are the parental assets at time $t$+1 and $t$, respectively; $Y_p$ is the parents' income; $r_t$ are remittances; and $\alpha(A_t,r_t;z^i)$ is the reward function with $z^i$ some parents' household characteristics that will shift this function. $\alpha$ is a concave function such that

$$\alpha'_{A_t} > 0, \alpha'_{r_t} > 0, \alpha''_{A_t} < 0, \alpha''_{r_t} < 0, \alpha''_{A_t,r_t} > 0 .$$

The last term being positive represents case 2. It would equal 0 in case 1.

The migrant maximizes the expected utility he will derive from the portfolio at time $t + 1$:

$$\max_{r_t} \ (1 - \phi)u\left[y_{t+1} + (sy_t - r_t)(1 + i)\right] + \phi u\left[y_{t+1} + (sy_t - r_t)(1 + i) + A_t + \alpha(A_t,r_t;z^i)(Y_p + r_t)\right], \quad \textbf{(4)}$$

where $\phi$ is the parent's probability of death, and $y_{t+1}$ is the migrant's income at time $t + 1$.

Let us denote

$$y_S = y_{t+1} + (sy_t - r_t)(1 + i),$$

$$y_R = y_{t+1} + (sy_t - r_t)(1 + i) + A_t + \alpha(A_t,r_t;z^i)(Y_p + r_t).$$

The first-order condition is then

$$-(1 - \phi)(1 + i)u'\left[y_S\right] + \phi\left[-(1 + i) + \alpha'_{r_t}(A_t,r_t;z^i)(Y_p + r_t) + \alpha(A_t,r_t;z^i)\right]u'\left[y_R\right] = 0 . \quad \textbf{(5)}$$

The optimal allocation between safe asset and inheritance is such that

$$\frac{MU_{Y_S}}{MU_{Y_R}} = \frac{\phi}{1 - \phi}\left[-1 + \frac{\alpha'_{r_t}(A_t,r_t;z^i)(Y_p + r_t) + \alpha(A_t,r_t;z^i)}{1 + i}\right].$$

Applying the implicit function theorem to the first-order condition allows us to determine how remittances will vary as a function of parental assets, migrant's income, parental income, and parents' probability of death. Appendix 1 provides the detailed differentiations with respect to these variables.

First, let us see how remittances respond to parental assets:

$$\frac{dr_t}{dA_t} > 0 \text{ if } \xi_R < \frac{\left[\alpha''_{A_t r_t}(Y_p + r_t) + \alpha'_{A_t}\right]}{\left[-(1+i) + \alpha'_{r_t}(Y_p + r_t) + \alpha\right]\left[1 + \alpha'_{A_t}(Y_p + r_t)\right]} = \xi_A, \qquad \textbf{(6)}$$

with $\xi_R = -\frac{u''(y_R)}{u'(y_R)}$, the migrant's absolute risk-aversion at the level of income with bequest. If the migrant is not too risk-averse, he will send more remittances when the parents' assets increase.

Second, let us consider how remittances change with the parent's income:

$$\frac{dr_t}{dY_p} > 0 \text{ if } \xi_R < \frac{\alpha'_{r_t}}{\alpha\left[-(1+i) + \alpha'_{r_t}(Y_p + r_t) + \alpha\right]} = \xi_Y. \qquad \textbf{(7)}$$

We can show that the threshold value for the assets $\xi_A$ from equation (6) is smaller than $\xi_Y$ from equation (7). So, $\frac{dr_t}{dY_p} > 0$ for $\xi_R < \xi_A$. Hence, if the migrant is not too risk-averse, he will send more remittances when parental income increases.

Third, we prove that remittances increase with respect to $\phi$: $\frac{dr_t}{d\phi} > 0$. When parents are more likely to die, migrants are more likely to inherit and are more motivated to send remittances.

Fourth, let us consider the evolution of remittances with the migrant's income: as the migrant's absolute risk-aversion decreases with his income, thus $\frac{dr_t}{dy_t} > 0$.

Last, let us consider how remittances will respond to a change in the $z^i$ variables that shift the reward function downwards. Such a shift would occur, for example, for parents who also want to migrate or retire; in both cases, they might become less interested in investment as their planning horizon gets shorter.

$$\frac{dr_t}{dz^i} < 0 \text{ if } \xi_R < \frac{\left[\alpha''_{r_t z^i}(Y_p + r_t) + \alpha'_{z^i}\right]}{\left[-(1+i) + \alpha'_{r_t}(Y_p + r_t) + \alpha\right]\alpha'_{z^i}(Y_p + r_t)} . \quad \textbf{(8)}$$

Call this threshold value $\xi_Z$ ; we can again show that $\xi_A < \xi_Z$. We then have w $\frac{dr_t}{dz^i} < 0$ when $\xi_R < \xi_A$.

If the migrant sends remittances as a means to invest in his inheritance, he will send more to a parent who is more likely to die. If the migrant's risk aversion is not too high, he will respond positively to more parental assets and income, and negatively to those parental features that will decrease the parents' investment behavior.

## SUMMARY OF PREDICTIONS

The results of the comparative statics experiments on the level of remittances derived from both models are summarized in the table below.

| Variable | Insurance Model | Investment Model |
|---|---|---|
| Migrant's income *(y)* | No direct effect | Positive |
| Migrant's risk-aversion *(>)* | Negative | Negative |
| Parents' household income *($Y_p$)* | No direct effect | Positive |
| Parents' risk-aversion *(P)* | Positive | No direct effect |
| Shock on parents' income *( )* | Positive | No direct effect |
| Parents' bequeathable assets *($A_t$)* | No direct effect | Positive |
| Parents' downward shifter variables *($z^j$)* | No direct effect | Negative |
| Parents' probability of death *(N)* | No direct effect | Positive |

As we do not know the parents' probability of death, we use the head of household's age as a proxy. This choice might be problematic 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 and wants to return to the land, in which case the father's reduced planning horizon weighs negatively on the incentive to remit.

## 3. THE DATA

In the summer of 1994, 385 rural households were surveyed in two watersheds of the Dominican Sierra. Interviews were conducted with the assistance of Plan Sierra, a local nongovernmental organization promoting soil conservation and reforestation. Information was gathered about production, assets (mainly land and cattle), sources of income, and personal characteristics of members of the household above 12 years of age,

]including all migrant children. Heads of household were also asked details about monetary remittances and their senders and information was obtained about migrant children. No information was obtained about out-transfers except for schooling purposes. This data set is quite similar to the ones used by Knowles and Anker (1981), Lucas and Stark (1985), and Stark and Lucas (1988), in which information is also one-sided.[1] In the Sierra, migration to the United States is generally considered a first-best choice. Such a move is, however, quite costly and households and individuals have differential access to this possibility (affordability of airfare, access to migration networks, and so on). Migration to a Dominican city is a second-best choice for those who cannot go overseas, and is rarely a first step to migration abroad (Sambrook 1992). A total of 76 percent of the households in the Sierra are linked to migration either because they receive remittances (49 percent), have migrant children (40 percent), or have siblings in the United States (57 percent).

In the analysis, we restrict our attention to migrant children of the household head because they are by far the main source of remittances and more information about their characteristics and monetary remittances is available. The value of food, clothes, durable goods, and possible labor and other gifts brought to the family when the migrant visits are not included.

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[1]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. In the literature about intervivos transfers, the Panel Study of Income Dynamics data used by Altonji, Hayashi, and Kotlikoff (1992, 1996) are some of the most complete to fully identify the different motivations to remit, including altruism.

Table 1 describes the characteristics of migrant children. Of them, 26.9 percent migrated to the United States, mostly to New York and Florida. Most migration from the Sierra is not seasonal but permanent, as shown by the average time spent in the location of migration (5.8 years). Remarkable features are the high proportion of migrants who are women (52 percent), are married (61.5 percent), have dependent children (51.7 percent), have no intention to return (86.5 percent), and come back less than three times a year to the Sierra (95.8 percent). These features suggest a highly mature migration pattern with a well entrenched migrant community in the places of destination.

As reported in Table 2, the incidence of remitters among migrants and the level of remittances among those who remit vary widely among categories of migrants, showing the importance of focusing on heterogeneity in explaining remittances. Migrants who intend to return send the largest amount (RD$7,500 or US$583). Higher levels of remittances are sent by individuals under 28 years of age compared to older migrants, and by female compared to male migrants.

Table 3 summarizes the characteristics of households with migrant children. As these are households with adult children, household heads are older (59.7 years) than the average in the Sierra (50.0 years). They also have more children (7.74 versus 5.76 in the entire sample), with an average of 2.82 migrants per household, which leaves 5.95 persons[2] living in the house. The potential inheritance their children might receive varies

[2]Among those house dwellers, on average, one is an extended family member or some friend. One more child generally lives in the village.

**Table 1 Migrants' characteristics**

| Variable | Mean | Standard Deviation | Percent |
|---|---|---|---|
| Age (years) | 27.7 | 7.4 | |
| Time since first migrated (years) | 5.8 | 5.8 | |
| Education | | | |
| 1 to 4 years of schooling | | | 40.9 |
| 4 to 8 years of schooling | | | 39.8 |
| Some secondary schooling | | | 8.4 |
| Postsecondary schooling | | | 2.6 |
| Migrant in the United States | | | 26.9 |
| Women migrants | | | 52.0 |
| Married migrant | | | 61.5 |
| Have dependent children | | | 51.7 |
| Link to the family in the Domican Republic | | | |
| Intends to return | | | 13.5 |
| Comes back often | | | 4.2 |
| Number of observations = 379 | | | |

**Table 2 Percentage of migrants who remit and amount of remittance, by selected categories of migrant**

| | Categories | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | All migrants | Male | t-Test of difference | Female | Returning | t-Test of difference | Not returning | Young[a] | Older |
| Percentage who remit | 51.8 | 57.5 | ** | 46.5 | 71.7 | *** | 48.6 | 52.8 | 50.6 |
| Amount sent by remitters (RD$) | 3,971 | 3,234 | * | 4,820 | 7,499 | *** | 3,144 | 3,563 | 3,144 |
| Standard deviation | (6,409) | | | | | | | | |

Notes: Levels of significance for the t-test: *** at 1 percent, ** at 5 percent, * at 10 percent. RD$ = Dominican Republic peso (RD$12.85 = US$1 in 1994).

[a] "Young" is below 28 years old.

**Table 3 Characteristics of households with migrant children**

| Variable | Mean | Standard Deviation |
|---|---|---|
| Age of household head (years) | 59.69 | 9.97 |
| Household size[a] | 5.95 | 2.71 |
| Potential inheritance | | |
| Share of land inheritance per heir (tareas[b]) | 37.73 | 60.97 |
| Number of heirs | 7.74 | 3.64 |
| Owned land (tareas) | 101.56 | 164.31 |
| Percent of inheritance in | | |
| coffee | 1.83 | 7.84 |
| planted forest | 0.26 | 2.08 |
| pastures | 4.47 | 16.07 |
| Productive land[c]—amount (tareas) in | | |
| Coffee | 19.26 | 28.70 |
| Pastures | 51.71 | 110.95 |
| Food plots | 10.99 | 10.92 |
| Planted forests | 10.37 | 28.02 |
| Total land | 150.62 | 215.77 |
| Sources of income | | |
| Total income (RD$) | 42,042 | 36,110 |
| Inputed value of home consumption[d] (percent) | 27.2 | 19.6 |
| Sales of agricultural products (percent) | 3.5 | 6.2 |
| Sales of cattle (percent) | 5.1 | 9.6 |
| Sales of coffee (percent) | 15.8 | 21.2 |
| Agricultural wages (percent) | 16.1 | 24.3 |
| Nonagricultural income (percent) | 13.6 | 21.8 |
| Remittances (percent) | 18.8 | 22.3 |
| Exposure to risks | | |
| Number of workdays lost | 23.94 | 57.56 |
| Total monetary costs (RD$) | 5,244 | 28,784 |
| Number of observations = 134 | | |

Note: RD$ = Dominican Republic peso (RD$12.85 = US$1 in 1994).

[a] Total number of persons living in the house (including extended family members).
[b] 1 hectare = 16 tareas.
[c] Total land the household has access to (owned, jointly owned, occupied, sharecropped, lent).
[d] Includes food plot products and chicken, eggs, milk, pork.

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 (18.8 percent), second after the imputed value of food for home consumption.

Exposure to health risks is important: 44 percent of the households reported illnesses of some household members during the last 12 months preceding the survey. On average, nearly a month (24 workdays) was lost in each household, amounting to a loss of RD$720 to RD$960, while other costs (medicines, transportation) amounted to RD$5,244.

Table 4 contrasts how households with migrant children handle risk compared to 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 cope with risk by taking loans. Remittances thus potentially play a meaningful role as a source of insurance for those households with migrants.

The descriptive statistics suggest that 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.

**Table 4 Remittances and insurance of households with sickness events**

| | Households with no migrants[a] | t-Test of difference | Households with migrants |
|---|---|---|---|
| Number of observations | 52 | | 59 |
| Number of workdays lost | 46.27 | | 55.86 |
| Total monetary costs (RD$) | 2,852 | * | 12,281 |
| Means used to pay (percent): | | | |
| Household savings | 40.38 | ** | 57.63 |
| Help from the United States | 7.69 | * | 18.64 |
| Help from the Dominican Republic[b] | 23.07 | | 16.95 |
| Took a loan | 38.46 | ** | 22.03 |
| Sold coffee in advance | 0.00 | | 3.39 |
| Sold cattle | 9.62 | | 8.47 |

Notes: Levels of significance for the t-test: ** at 5 percent, * at 10 percent. RD$ = Dominican Republic peso (RD$12.85 = US$1 in 1994).

[a] Without migrants = with no children or siblings migrant.

[b] Includes other households in the community.

## 4. ECONOMETRIC ANALYSIS

In both models of insurance and investment for inheritance, corner solutions are possible, where migrants decide not to send money to their parents. Half of the migrants actually do not remit. Because of this phenomenon, these models call for a censored regression or a self-selection analysis, as in Funkhouser (1995). In both cases, the reduced-form equation for remittances will be of the form

$$\begin{cases} r_t^* \leq 0 \Rightarrow r_t = 0 \\ r_t^* > 0 \Rightarrow r_t = r_t^* \end{cases},$$

where $r_t$ is the observed remittance sent by migrant $t$ and $r_t^*$ is the corresponding latent variable with

$$r_t^* = \alpha + \beta y_t + \gamma Y_{Pt} + \delta \Delta Y_{Pt} + \epsilon A_t + \eta \phi_t + \mu \begin{pmatrix} z_m \\ z_p \end{pmatrix} + u_t,$$

where

$y_t$ is the migrant's income,

$Y_{Pt}$ is the parent's income,

$\phi_t$ is the parent's probability of death,

$A_t$ are the parents' inheritable land assets,[3]

$\Delta Y_{Pt}$ is the shock on parental income, which we proxy by the total number of working days lost in the year because of illnesses,[4]

[3]We only consider land assets as we do not have information on quality of the house, cattle, or business owned before the year of the survey. Assets are all potentially subject to an endogeneity problem. We used land owned in 1992 to correct for possible purchases in 1993-94 that would be directly correlated to remittances.

[4]lternative variables used were total monetary spending due to illnesses and the number of adults and children that were sick, but none of these were significant.

$z_p$ and $z_m$ are, respectively, parents' and migrant's shifter variables such as composition of the bequest and frequency of visits, and

$u_t$ is an independent identically distributed normal variable with expectation 0.

Since information about migrants' income is not available in the data, we use an earnings function à la Mincer, where

$$y_t = y_t\left(a_t, a_t^2, T, T^2, E, US, C\right),$$

with

$a_t$ = the migrant's age,

$E$ = the schooling level expressed by four dummies corresponding to the levels of education in Table 1, with no schooling as the reference category,

$T$ = the time spent in the migration location,

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

$C$ = a dummy variable for whether the migrants have children of their own in the place of migration, as this is expected to create competition for the income from which remittances can be sent.

As no measures of the parents' and the migrant's levels of risk-aversion are available in the data, we use their respective incomes as proxies, since absolute risk-aversion decreases with income. Parent's probability of death is proxied by the age of

the household head, as older parents are more likely to die. Migrants coming back frequently are more likely to directly bring their remittances home rather than send them. This might cause some measurement error, as the question about remittances asked only for monetary transfers that were sent to the rural family. This frequence of visits is therefore included as a shifter. Finally, the composition of land bequests by the type of land use is included, because 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 that signals longer planning horizons.

A test of endogeneity of the household income[5] is weakly significant in the remittance regressions. We therefore use a prediction of income 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. The regression to predict income is presented in Appendix 2. Total predicted income is then divided by the number of persons living in the house to obtain an income per capita measure.[6]

Based on the comparative statics derived from the models, the expected signs of the coefficients of the included variables are in the table below.

[5]We used a test similar to the test described in Smith and Blundell 1986.

[6]Alternative measures were an adult-equivalent household size and the consumer/worker ratio.

| Coefficients | Insurance Model | Investment Model |
|---|---|---|
| Migrant's income[a] | + | + |
| Parent household income | - | + |
| Number of lost working days | + | 0 |
| Inheritable assets | 0 | + |
| Age of head of household | 0 | +/- |
| Proportion of land in: | | |
| - coffee plantations | 0 | +/- |
| - planted forests | 0 | +/- |
| - pastures | 0 | +/- |
| Frequency of visits home | - | - |

[a] Includes all migrants' income variables, except the dummy for dependents, time squared, and age squared.

## ESTIMATION OF REMITTANCES FOR ALL MIGRANTS

In a first step, we estimate a Tobit remittance function for all migrants (model 0). The results are presented in Table 5. The level of remittance is significantly related to most migrants' income variables, with years of migration, education levels, and migration to the United States strongly influencing it. Parents' household income has a significantly negative coefficient, but the number of days lost is not significant. While this suggests that insurance matters, it provides only a weak test of the insurance model. The level of inheritable assets is positively significant, which is consistent with the inheritance model. As expected, the coefficient for the dummy variable indicating frequent visits is significantly negative, suggesting that these migrants bring more money or goods than was reported in the questionnaire.

The last column in Table 5 presents the marginal effects on the observed remittances given censoring (McDonald and Moffit in Greene 1997). This effect is

**Table 5 Tobit estimation of remittances and decomposition of the coefficients**

| Variable | Coefficient | t-Statistic | Significance Level | Significance Joint-test | Marginal effect given censoring[a] |
|---|---|---|---|---|---|
| Migrant's income | | | | Migrant | |
| Age (years) | 445 | 1.22 | | income | 197 |
| Age squared | −9.01 | −1.51 | | variables | −4.00 |
| Time since first migrated (years) | 573 | 2.65 | *** | | 254 |
| Time squared | −30.17 | −2.72 | *** | F(8,361) = | −13.38 |
| 1 to 4 years of schooling (dummy) | 3,225 | 2.06 | ** | 4.71 | 1,430 |
| 4 to 8 years of schooling (dummy) | 5,387 | 3.46 | *** | Prob > F= | 2,389 |
| Some secondary schooling (dummy) | 3,327 | 1.77 | * | 0.0000 | 1,476 |
| Postsecondary schooling (dummy) | 9,675 | 3.92 | *** | | 4,291 |
| Migrant in the United States (dummy) | 9,394 | 9.97 | *** | | 4,167 |
| Has dependent children (dummy) | −524 | −0.62 | | | −232 |
| Parents' household income | | | | | |
| Predicted income per capita (RD$) | −0.2 | −2.02 | ** | | −0.1 |
| Insurance | | | | | |
| Number of lost working days | 8.2 | 1.17 | | | 3.6 |
| Investment | | | | | |
| Age of head (years) | −45.1 | −0.97 | | | −20.0 |
| Migrant's share of land inheritance (tareas[b]) | 14.0 | 1.76 | * | | 6.2 |
| Proportion of coffee plantation (percent) | 81.4 | 0.04 | | | 36.1 |
| Proportion of managed forest (percent) | −2,600.2 | −0.89 | | | -1,153.3 |
| Proportion of pastures (percent) | 334.9 | 1.55 | | | 148.6 |
| Frequency of visits | | | | | |
| Migrant visits frequently (dummy) | −8,530 | −4.50 | | | −3,783 |
| Other | | | | | |
| Constant | −9,849 | −1.76 | * | | |

Notes: Observations summary:
Number of observations = 379.
181 left-censored observations at remit <= 0, 198 uncensored observations.
Goodness-of-fit:
Log likelihood = -2,099 Pseudo R2 = 0.0335.
* 10 percent, ** 5 percent, *** 1 percent.
RD$ = Dominican Republic peso (RD$12.85 = US$1 in 1994).

[a] McDonald and Moffitt's decomposition of marginal effect of censoring: effect of probability = 66.6 percent, effect of mean = 33.4 percent.

[b] 1 hectare = 16 tareas.

decomposed into the effect of a change in the exogenous variable on the probability of receiving remittances and the effect on the mean of the observed remittance variable. The decomposition shows that a larger share of the effect of the variables comes from increasing the probability of remitting than from the mean level of remittances.

## MOTIVATIONS TO REMIT AMONG DIFFERENT MIGRANT CATEGORIES

If heterogeneity matters in explaining the decision to remit, taking it into account should lead to regressions with higher explanatory power and to greater statistical significance of the variables that capture the roles of insurance and investment. 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 that provide tests for the models. At each step, we compare a "treatment group," for example, males, and a "control group," for example, females.[7] We give the test of the combined effect of the variable as it applies to all categories and to the specific migrant category, in order to identify the net effect of the variable for that migrant category. To assess the role of heterogeneity in explaining remittances, we also give the test of the explanatory power of each successive model against "model 0" that does not discriminate across migrant categories. Table 6 presents the results for three different migrant categories by gender, intention to return, and age. In Table 7, we consider particular combinations of migrant

[7]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 subsamples get smaller, the reliability of the estimates is put in question.

attributes such as men intending to return, young migrants intending to return, and females not intending to return. Finally, in Table 8, we explore migrant composition effects whereby the decision to remit of a particular migrant is affected by the existence of particular types of siblings that may also be remitting.

*Gender Differences and Remittances (Table 6, model 1)*

Analyzing the motive to remit by gender group is important because men and women in traditional Dominican society have very different roles and degrees of control over their households' incomes, and women might be less likely to inherit from their parents because they expect to inherit on the side of their present or future husbands. 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, we see that female migrants are more explicitly motivated by insurance, while male migrants are more explicitly pursuing investment. Female migrants respond differently from the entire group of migrants, in sending higher remittances in response to lost working days due to illness (a significant interaction, lost days × female migrant) and in the total (significantly positive) effect of lost working days on their level of remittances (combined test with a P-value = 0.015). In contrast, among male migrants, we find a significant interaction between inheritance and gender and the combined effect of inheritance on their level of remittances is significantly different from zero. While gender is not important in explaining coffee plantations as a form of bequest (combined

## Table 6 Tobit estimation of remittances by category of migrants: gender, intention to return, and age

| Variable | Model 1 Male versus female migrant Coefficient | t-Statistic | P-value | Model 2 Migrant intending to return versus not returning Coefficient | t-Statistic | P-value | Model 3 Young versus old migrant[a] Coefficient | t-Statistic | P-value |
|---|---|---|---|---|---|---|---|---|---|
| Migrant's income | | | | | | | | | |
| Joint test all income variables | | | 0.0000 | | | 0.0017 | | | 0.0000 |
| Parent's household income | | | | | | | | | |
| Predicted income per capita | −0.06 | −0.52 | | −0.28 | −2.73 | | −0.16 | −1.32 | |
| Migrant category | | Male | | | Returning | | | Old | |
| Income* migrant category | −0.20 | −1.33 | | 0.39 | 1.86 | | 0.06 | 0.40 | |
| Migrant category: combined effect | | | 0.0215 | | | 0.5618 | | | 0.4226 |
| Insurance | | | | | | | | | |
| Number of lost workdays | −8.01 | −0.76 | | 3.09 | 0.11 | | 4.06 | 0.41 | |
| Migrant category | | Female | | | Nonreturning | | | Old | |
| Lost days* migrant category | 30.15 | 2.17 | | 9.98 | 0.34 | | 14.87 | 1.02 | |
| Migrant category: combined effect | | | 0.0147 | | | 0.0612 | | | 0.0735 |
| Investment | | | | | | | | | |
| Age of head | −42.77 | −0.91 | | −29.51 | −0.65 | | −18.96 | −0.38 | |
| Migrant category | | Male | | | Returning | | | Young | |
| Age of head* migrant category | −2.88 | −0.15 | | −23.95 | −0.86 | | −5.67 | −0.23 | |
| Migrant category: combined effect | | | 0.3251 | | | 0.2886 | | | 0.6092 |
| Migrant's share of land inheritance | −12.78 | −0.85 | | −0.11 | −0.01 | | −5.30 | −0.43 | |
| Migrant category | | Male | | | Returning | | | Young | |
| Inheritance * migrant category | 38.4 | 2.20 | | 37.9 | 2.33 | | 31.9 | 2.01 | |
| Migrant category: combined effect | | | 0.0066 | | | 0.0038 | | | 0.0094 |
| Proportion of coffee plantation | −4,327 | −1.51 | | 602 | 0.31 | | −3,885 | −1.45 | |
| Migrant category | | Male | | | Returning | | | Young | |
| Coffee * migrant category | 6,713 | 1.82 | | −1,652 | −0.27 | | 5,908 | 1.58 | |
| Migrant category: combined effect | | | 0.3264 | | | 0.8572 | | | 0.4539 |
| Proportion of pastures | 240 | 0.90 | | 282 | 1.32 | | 384 | 1.55 | |
| Migrant category | | Male | | | Returning | | | Young | |
| Pastures*migrant category | 64 | 0.16 | | 2,200 | 0.60 | | −4,975 | −1.71 | |
| Migrant category: combined effect | | | 0.342 | | | 0.5003 | | | 0.114 |
| Other | | | | | | | | | |
| Migrant visits frequently | −8,652 | −4.58 | | −7,888 | −4.26 | | −8,133 | −4.35 | |
| Constant term | −11,447 | −2.04 | | −7,959 | −1.47 | | −11,613 | −1.86 | |
| Number of observations | | 379 | | | 379 | | | 379 | |
| Log likelihood | | −2,093 | | | −2,087 | | | −2,092 | |
| Pseudo R2 | | 0.0363 | | | 0.0391 | | | 0.0369 | |
| Eq. OLS R2* | | 0.09 | | | 0.10 | | | 0.09 | |
| P-value, model 1 against model 0 | | 0.1076 | | | | | | | |
| P-value, model 2 against model 0 | | | | | 0.0012 | | | | |
| P-value, model 3 against model 0 | | | | | | | | 0.0428 | |

*Source: Veall and Zimmermann 1994.

[a] Young migrant: <28 years old.

test with a P-value = 0.3), male migrants are less averse to coffee as a form of inheritance compared to the entire group of migrants. To assess the role of heterogeneity in explaining remittances, we see that the overall explanatory power of the regression is not significantly higher (test of model 1 against model 0). Nevertheless, the significance of the test variables is higher: the insurance variable that is not significant in model 0 is significant in model 1, and the inheritance variable, which has a P-value of more than 5 percent in model 0, has a P-value of only 0.007 in model 1. We thus conclude that gender differences are indeed important in explaining remittances, with women motivated by insurance and men motivated by investment and inheritance.

*Intention to Return and Motivation to Remit (Table 6, model 2)*

According to statements made by their rural-based family, 15 percent of the migrants intend to return to the Sierra.[8] These migrants should be more interested in the value of their inheritance, as they will be able to directly benefit from it upon returning. Results show that all migrants are motivated by insurance (negative coefficient on parents' income) but that returning migrants have a net effect that is clearly not different from zero (P-value = 0.56). These returning migrants are not motivated to remit for the sake of insurance. In contrast, the inheritance variable, which is not significant for all migrants, is significant for them and the overall effect of inheritance is positive (P-value = 0.004), indicating that returning migrants do remit for the sake of investment and inheritance. The

[8]Men are slightly more likely to wish to return than women.

explanatory power of the model with heterogeneity in terms of intention to return (model 2) has a better explanatory power than model 0, showing the importance of accounting for such differences in explaining remittances.

*Age of Migrants and Motivations to Remit (Table 6, model 3)*

Younger migrants may have longer investment horizons than older ones and might be less settled than older migrants in the place of migration. These younger migrants should thus be more motivated by inheritance in sending their remittances. In our sample, the median age is just under 28 years, so we use this age to divide the sample. Results show that young migrants are definitely not motivated by insurance. In contrast, they are more motivated than older migrants to remit for the sake of inheritance and the total effect of inheritance is positive (P-value = 0.009) on their level of remittances. They are also less interested in pastures, which is consistent with their having a longer planning horizon. The explanatory power of model 3, which takes heterogeneity in age as a determinant of remitting, is higher than that of model 0, confirming again the importance of heterogeneity in explaining remittances.

## COMBINED MIGRANT CHARACTERISTICS AND MOTIVATION TO REMIT

The three categories of migrants identified above are not mutually exclusive. Combining these categories may create interactions whereby combined characteristics induce a higher level of remittances than each category alone. For example, a male

migrant intending to return may send more remittances than male migrants and migrants intending to return. Alternatively, one effect may dominate the other, for example, male returning migrants may not be different in their remitting behavior from male migrants or returning migrants. In Table 7, we only report results for interactions that were significant in identifying subgroups of migrants with particular motivations to remit. We also only report variables for which significant effects were obtained.

*Male Migrants Intending to Return (Table 7, model 4)*

In terms of parents' household income, neither the male gender term, nor the interaction term of being male with the prospect of returning, creates differential effects on remittances. Regarding insurance, while all migrants are motivated to remit in response to lost working days, there are no differential effects associated with gender and intention to return. In contrast, returning males are strongly motivated to invest toward inheritance: the joint effects of maleness and intention to return strongly increase remittances for this purpose and the combined effect of being a migrant, male, and intending to return increases remittances (P-value = 0.0001). The intention to return gives rise to an interest in pasture. Men intending to return are thus the main category of migrant in terms of remitting for investment.

## Table 7 Tobit estimation of remittances by composite categories of migrants: Gender, intention to return, and age

| Variable | Model 4 Men migrants intending to return Coefficient | t-Statistic | P-value | Model 5 Young migrants intending to return Coefficient | t-Statistic | P-value | Model 6 Women migrants not intending to return Coefficient | t-Statistic | P-value |
|---|---|---|---|---|---|---|---|---|---|
| Migrant's income | | | | | | | | | |
| Joint test all income variables | | | 0.0015 | | | 0.0022 | | | 0.0002 |
| Parents' household income | | | | | | | | | |
| Predicted income per capita | -0.19 | -1.39 | | -0.31 | -2.20 | | 0.20 | 1.35 | |
| Migrant category | (1) male (2) returning | | | (1) young (2) returning | | | (1) female (2) nonreturning | | |
| Income × attribute (1) of migrant | -0.18 | -0.93 | | 0.12 | 0.61 | | -0.01 | -0.03 | |
| Income × attribute (2) of migrant | 0.51 | 1.67 | | 0.49 | 1.91 | | -0.51 | -3.22 | |
| Income × attribute (1) × attribute (2) | -0.28 | -0.69 | | -0.52 | -1.16 | | 0.00 | -0.01 | |
| Migrant category: combined effect | | | 0.5613 | | | 0.5203 | | | 0.0072 |
| Insurance | | | | | | | | | |
| Number of lost working days | 12.53 | 1.89 | | 19.30 | 2.69 | | 21.28 | 0.70 | |
| Migrant category | | | | | | | (1) female (2) nonreturning | | |
| Days × attribute (1) of migrant | | | | | | | -97.21 | -1.19 | |
| Days × attribute (2) of migrant | | | | | | | -28.03 | -0.87 | |
| Days × attribute (1) × attribute (2) | | | | | | | 128.37 | 1.55 | |
| Migrant category: combined effect | | | | | | | | | 0.0061 |
| Investment | | | | | | | | | |
| Age of head | -24.00 | -0.52 | | -27.59 | -0.56 | | -39.22 | -0.88 | |
| Migrant category | (1) male (2) returning | | | (1) young (2) returning | | | | | |
| Age of head × attribute (1) of migrant | -5.12 | -0.27 | | 14.80 | 0.58 | | | | |
| Age of head × attribute (2) of migrant | 40.38 | 0.98 | | 40.54 | 0.83 | | | | |
| Age of head × attribute (1) × attribute (2) | -117.85 | -2.02 | | -121.21 | -1.94 | | | | |
| Migrant category: combined effect | | | 0.0681 | | | 0.1114 | | | |
| Migrant's share of land inheritance | -4.71 | -0.30 | | 3.52 | 0.27 | | 15.45 | 2.00 | |
| Migrant category | (1) male (2) returning | | | (1) young (2) returning | | | | | |
| Share × attribute (1) of migrant | 10.5 | 0.51 | | -7.80 | -0.40 | | | | |
| Share × attribute (2) of migrant | -28.2 | -0.78 | | -21.35 | -0.60 | | | | |
| Share × attribute (1) × attribute (2) | 82.5 | 2.00 | | 90.82 | 2.12 | | | | |
| Migrant category: combined effect | | | 0.0001 | | | 0.0006 | | | |
| Proportion of pastures | 256.97 | 0.98 | | 387.56 | 1.61 | | 333.41 | 1.59 | |
| Migrant category | (1) male (2) returning | | | (1) young (2) returning | | | | | |
| Pastures × attribute (1) of migrant | 6.65 | 0.02 | | -10,575.34 | -2.94 | | | | |
| Pastures × attribute (2) of migrant | -3,956.13 | -0.73 | | -123.74 | -0.03 | | | | |
| Pastures × attribute (1) × attribute (2) | 12,176.91 | 1.73 | | 16,019.84 | 1.89 | | | | |
| Migrant category: combined effect | | | 0.0647 | | | 0.3767 | | | |
| Other | | | | | | | | | |
| Migrant visits frequently | -7,899.97 | -4.29 | | -7,809.65 | -4.27 | | -8,084.97 | -4.42 | |
| Constant term | -8,394.83 | -1.54 | | -11,110.77 | -1.80 | | -10,399.95 | -1.92 | |
| Number of observations | | 379 | | | 379 | | | 379 | |
| Log likelihood | | -2,082 | | | -2,077 | | | -2,087 | |
| Pseudo R2 | | 0.0414 | | | 0.0438 | | | 0.0392 | |
| Eq. OLS R2 | | 0.10 | | | 0.11 | | | 0.10 | |
| P-value, model vs. Model 0 | | 0.0030 | | | 0.0005 | | | 0.0004 | |
| P-value, model vs. Model 1 | | 0.0040 | | | – | | | 0.0003 | |
| P-value, model vs. Model 2 | | 0.2385 | | | 0.0380 | | | 0.1064 | |
| P-value, model vs. Model 3 | | – | | | 0.0016 | | | – | |

*Young Migrants Intending to Return (Table 7, model 5)*

Here again, the fundamental characteristic is that of intending to return, as opposed to age in remitting for investment in response to parents' income level. Young migrants have no differential behavior toward insurance. They are strongly motivated by inheritance and the features of youth and intention to return interact in enhancing the level of remittances sent. The combined effect of being young and intending to return is highly significant on the level of remittances (P-value = 0.0006).

*Women Migrants Not Intending to Return (Table 7, model 6)*

As opposed to the last two categories of migrants, women not intending to return are strongly motivated by insurance and not by investment. With regard to parents' income, it is the nonreturning feature, as opposed to femaleness, that matters in the motivation to remit to insure the household. Regarding the number of lost working days, it is the combination of being a female and not intending to return that determines the stronger remittance response to shocks. All migrants are motivated by inheritance; there is no differential behavior in this category of women.

## 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 absence of other migrants in the household and the characteristics of these migrants.

One test of household composition effect on interest in bequest is provided in particular by considering women remitters with no brothers who send money to their parents. These women might be in a better position to ascertain their claims towards inheritance and therefore might actually be motivated to send for investment. Such an effect indeed appears in the estimation presented in Table 8 (model 9) where we look only at female migrants' remitting behavior. Women whose remittances do not compete with any from their brothers send more money in a fashion consistent with investment purposes. The bequest size has a small positive effect on remittances and pastures are as attractive to them as any other type of migrant interested in the bequest.

*Migrant Male Remitters with Sisters Only Versus Male Remitters with Brothers (Table 8, model 7)*

With women taking care of insurance, male remitters with sisters only can be relieved of this function. We can see that while all migrants engage in insurance (negative sign on parents' income), the investment motivation of male migrants with sisters is significantly different from that of others. For this group, the net effect of parents' income on remittances is thus nil. For those with brothers who remit, the incentive to increase remittances for inheritance is stronger and the overall effect is positive (P-value = 0.0006). The presence of other male migrants who also remit,

## Table 8 Determinants of remittances with migrant composition effects

| Variable | Model 7 (OLS) Men remitters with sisters only versus men remitters with brothers | | | Model 8 (Tobit) Only one male migrant versus other men migrants | | | Model 9 (OLS) Female remitters without remitting brothers versus with remitting brothers | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coefficient | t-Statistic | P-value | Coefficient | t-Statistic | P-value | Coefficient | t-Statistic | P-value |
| Migrant's income | | | | | | | | | |
| Joint test all income variables | | | 0.5610 | | | 0.0051 | | | 0.0729 |
| Parents' household income | | | | | | | | | |
| Predicted income per capita | -0.35 | -1.91 | | -0.28 | -3.00 | | 0.10 | 0.31 | |
| Migrant category | Male remitter with sisters only | | | Only one male migrant | | | Female remitter without brother remitter | | |
| Income × migrant category | 0.13 | 0.59 | | 1.02 | 1.84 | | -0.04 | -0.12 | |
| Migrant category: combined effect | | | 0.0980 | | | 0.1761 | | | 0.8064 |
| Insurance | | | | | | | | | |
| Number of lost working days | 12.21 | 1.25 | | -11.01 | -1.34 | | 39.26 | 1.91 | |
| Migrant category | | | | Only one male migrant | | | Female remitter without brother remitter | | |
| Lost days × migrant category | | | | 156.71 | 2.75 | | -18.95 | -0.79 | |
| Migrant category: combined effect | | | | | | 0.0106 | | | 0.1373 |
| Investment | | | | | | | | | |
| Age of head | -180.14 | -2.35 | | -97.60 | -1.91 | | 61.90 | 0.69 | |
| Migrant category | Male remitter with brothers | | | Only one male migrant | | | Female remitter without brother remitter | | |
| Age of head × migrant category | 8.06 | 0.26 | | -57.06 | -1.00 | | -30.60 | -0.84 | |
| Migrant category: combined effect | | | 0.0070 | | | 0.4445 | | | 0.7217 |
| Migrant's share of land inheritance | -12.66 | -0.61 | | 22.66 | 3.39 | | 3.9 | 0.15 | |
| Migrant category | Male remitter with brothers | | | Only one male migrant | | | Female remitter without brother remitter | | |
| Inheritance × migrant category | 44.58 | 2.06 | | 20.18 | 0.34 | | 75.86 | 1.76 | |
| Migrant category: combined effect | | | 0.0006 | | | 0.0548 | | | 0.0248 |
| Proportion of managed forest | 2,959 | 0.30 | | -618 | -0.18 | | 4,086 | 0.51 | |
| Migrant category | Male remitter with brothers | | | Only one male migrant | | | Female remitter without brother remitter | | |
| Forest × migrant category | -8,027 | -0.75 | | -70,030 | -2.83 | | -281 | -0.03 | |
| Migrant category: combined effect | | | 0.2013 | | | 0.0043 | | | 0.6063 |
| Proportion of pastures | 177.10 | 0.60 | | 230 | 0.92 | | -447 | -0.87 | |
| Migrant category | Male remitter with brothers | | | Only one male migrant | | | Female remitter without brother remitter | | |
| Pastures × migrant category | 4,737 | 1.54 | | -14,945 | -2.06 | | 8,629 | 2.01 | |
| Migrant category: combined effect | | | 0.1165 | | | 0.0444 | | | 0.0645 |
| Other | | | | | | | | | |
| Migrant visits frequently | -6,836 | -3.09 | | -7,706 | -3.87 | | -12,030 | -2.49 | |
| Constant term | 52 | 0.01 | | -10,255 | -1.66 | | -23,083 | -1.96 | |
| Number of observations | | 107 | | | 182 | | | 91 | |
| Log likelihood | | | | | -1,084.2012 | | | | |
| R2 | (Pseudo R2) | | 0.59 | | | 0.047 | | | 0.61 |
| Eq. OLS R2 | | | | | 0.12 | | | | |
| P-value, OLS men remitters against model 7: | | 0.0314 | | | | | | | |
| P-value, model 8 against model 0: | | | | | 0.0001 | | | | |
| P-value, OLS women remitters against model 9: | | | | | | | | | 0.1290 |

presumably equally motivated by investment, is thus an incentive to remit more. This suggests the existence of economies of scale in investment or of incentives to remit more in order to secure one's share of the inheritance when other brothers are competing, as suggested by Hoddinott (1994). In testing this model against the remittances model for male remitters without accounting for the composition effect, we find that the latter has weaker explanatory power (P-value = 0.0314), indicating the importance of heterogeneity in explaining remittances.

*Only One Male Migrant Versus the Case of One Male Migrant among Other Male Migrants (Table 8, model 8)*

In this case, by being the only migrant, this male has to cater to both insurance and investment needs. The insurance concern of this group is shown by a differentially positive effect of the number of lost working days for this migrant category and a positive overall effect (P-value = 0.0106). At the same time, all migrants are motivated by investment and an only male migrant is, overall, also (but not differentially) motivated by investment (P-value = 0.0548). This lone migrant is overall less motivated by investment in managed forest and pastures, suggesting that the base category, food plots and fallow land, is the main land use of interest.

*Female Remitters Without Remitting Brothers Versus Female Remitters with Remitting Brothers (Table 8, model 9)*

When a woman is the sole remitter in the family, she is in a better position to ascertain her claim over inheritance and behaves much like a man in the same situation. While all migrants engage in insurance, compensating through remittances for working days lost by the household, this woman does not engage overall in insurance (P-value = 0.1373). In contrast, much like men, she engages in remittances for investment both differentially relative to other migrants and overall (P-value = 0.0248). Her types of investments are typical of migrants, namely a preference for investment in pastures. Women whose remittances do not compete with remittances from brothers are thus sending money in a fashion consistent with investment.

## 5. CONCLUSIONS

In this paper, we examined two types of motivation for migrant children to send remittances to their parents in rural villages of the Dominican Sierra: insurance in response to shocks to parents' income and investment toward increasing future inheritance. Taking into account the heterogeneous nature of migrants by gender, age, intention to return, and composition effects among migrant sons and daughters of the household, the results show clear contrasts in motivations to remit. Insurance is the main motivation to remit for women migrants, particularly among those with no intention to return to their birthplace.

Only when female remitters have no remitting brothers do they behave like men and remit in pursuit of inheritance. Investment toward inheritance is the main motivation to remit for men, young migrants, and migrants intending to return. These motivations are compounded for returning males and returning young migrants. Composition effects induce higher levels of remittances among male remitters with no brothers remitting. Only when a male remitter is the only remitting member of the household does he remit for the dual purpose of insurance and investment.

Identifying the reasons why migrants remit allows us to better understand why remittances matter in household strategies, beyond constituting an additional source of income for the household. By controlling the decision to remit, migrants send remittances for specific purposes that give them a differential value (positive or negative) for parents. 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 function enhances the welfare value of the money transferred. If male, young, and returning migrants remit for their parents to invest in bequeathable assets, parents will invest remittances in order to increase the flow of transfers from abroad. This could constrain the welfare value of the cash transfers, as remitted money is used for purposes other than consumption. In addition, if migrants have preferences for specific types of assets, such as coffee plantations (males), pastures (males with other remitting brothers), or food plots, this might distort the investment program that parents would have followed with untied money transfers.

The presence of both coffee plantations and pastures are strong determinants of remittance behavior. The interest in cattle ranching in this area has been pointed out by Ravelo and del Rosario (1986) and Peralta (1994), by Lucas and Stark (1985) in Botswana, and de la Cruz (1995) in Mexico. The focus on pastures may be unsustainable in the long run as pastures are a main contributor to erosion in the Sierra. From a social standpoint, in the Dominican Sierra, coffee is desirable for both conservation and employment creation. This leaves room for policies geared towards (1) making coffee more attractive to migrants as an investment, possibly by setting up a special regional investment fund for this purpose, and (2) reducing the role of cattle as an asset to compensate for credit market failures.

We do not reject altruism as a motive for sending money. However, altruism seems to be of the "enlightened" type (Lucas and Stark 1985), since even women tend to behave consistently with inheritance motivations when given the opportunity.

## APPENDIX 1

## DERIVATIONS OF THE INSURANCE AND INVESTMENT MODELS

INSURANCE MODEL

The migrant's participation constraint is such that

$$\pi u(y + p) + (1 - \pi)u(y + p - a\Delta) \geq u(y) . \qquad \textbf{(1)}$$

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

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

from which we obtain

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

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

$$\xi p^2 - 2\left[a\xi\Delta(1 - \pi) + 1\right]p + (1 - \pi)a\Delta(\xi\Delta a + 2) \approx 0 . \qquad \textbf{(9)}$$

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

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

The largest root is greater than $a\Delta$ and therefore not acceptable.[9] The only feasible premium level for the child to participate in the contract is therefore

$$p^*(a) = a\Delta(1-\pi) + \frac{1}{\xi} - \frac{\sqrt{1-\pi(1-\pi)\xi^2 a^2\Delta^2}}{\xi}, \qquad \textbf{(10)}$$

as given in the text.

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

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

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

---

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

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

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

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

Using a first-order Taylor expansion around $Y-\frac{1}{\xi}$, the first-order condition reduces to

$$\frac{\xi a\Delta}{\sqrt{A}}v'(y)+\left[-\Delta+\frac{\xi\Delta^2}{\sqrt{A}}(1-\pi)a\right]v''(y)\approx 0\,. \qquad \textbf{(11)}$$

Let us call $\chi=-\frac{v''(y)}{v'(y)}$ the parent's absolute risk aversion and replace $A$ by its expression in equation (11). We then obtain:

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

Taking squares on both sides and solving for $a$ positive yields the optimal $a$. The optimal level of coverage is then

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

INVESTMENT AND INHERITANCE

The migrant maximizes the utility derived from his or her portfolio at time $t+1$:

$$\max_{r_t}(1-\pi)u\left[y_{t+1}+(sy_t-r_t)(1+i)\right]+\pi u\left[y_{t+1}+(sy_t-r_t)(1+i)+A_t+\alpha(A_t,r_t;z^i)(Y_p+r_t)\right].$$

The first-order condition (5) can be written as

$$F(r_t,y_t,Y_p,A_t;\pi,z^i)=0. \tag{5'}$$

We assume that the utility function is a concave function such that the implicit function theorem can be applied. Therefore, we obtain for equation (5'):

$$\frac{dF}{dr_i}=(1-\pi)(1+i)^2u''\left[y_{t+1}+(sy_t-r_t)(1+i)\right]$$
$$+\pi\left\{\begin{array}{c}\left[\alpha''_{r_t}(Y_p+r_t)+2\alpha'_{r_t}\right]u'\left[y_{t+1}+(sy_t-r_t)(1+i)+A_t+\alpha(A_t,r_t;z^i)(Y_p+r_t)\right]\\ +\left[-(1+i)+\alpha'_{r_t}(A_t,r_t;z^i)(Y_p+r_t)+\alpha(A_t,r_t;z^i)\right]^2\\ u''\left[y_{t+1}+(sy_t-r_t)(1+i)+A_t+\alpha(A_t,r_t;z^i)(Y_p+r_t)\right]\end{array}\right\}.$$

This expression is the second-order condition for $r_t^{(}$ to be a maximum, 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 $\frac{dF}{dx}$.

*Remittances and Parental Assets*

$$\frac{dF}{dA_t} = \pi\left\{\begin{array}{c}\left[\alpha_{A_t r_t}(Y_p + r_t) + \alpha'_{A_t}\right]u'\left[y_R\right] \\ +\left[-(1+i) + \alpha'_{r_t}(Y_p + r_t) + \alpha\right]\left[1 + \alpha'_{A_t}(Y_p + r_t)\right]u''\left[y_R\right]\end{array}\right\},$$

so

$$\frac{dF}{dA_t} > 0 \text{ if } \xi_R < \frac{\left[\alpha''_{A_t r_t}(Y_p + r_t) + \alpha'_{A_t}\right]}{\left[-(1+i) + \alpha'_{r_t}(Y_p + r_t) + \alpha\right]\left[1 + \alpha'_{A_t}(Y_p + r_t)\right]}. \qquad \textbf{(12)}$$

*Remittances and Parent's Income*

$$\frac{dF}{dY_p} = \pi\left\{\alpha'_{r_t}u'(y_R) + \left[-(1+i) + \alpha'_{r_t}(Y_p + r_t) + \alpha\right]\alpha u''(y_R)\right\},$$

which implies that

$$\frac{dF}{dY_p} > 0 \text{ if } \xi_R < \frac{\alpha'_{r_t}}{\alpha\left[-(1+i) + \alpha'_{r_t}(Y_p + r_t) + \alpha\right]}. \qquad \textbf{(13)}$$

Let us compare the threshold values for the assets $\xi_A$ from equation (12) and $\xi_Y$ from equation (13). As $\alpha \in [0,1]$, we have $1 + \alpha'_{A_t}(Y_p + r_t) > \alpha$. Thus,

$$1n\left[1 + \alpha'_{A_t}(Y_p + r_t)\right] > 1n\,\alpha,$$

and, taking the derivative with respect to the remittance, by concavity of the logarithm function, we obtain

$$\frac{\alpha''_{A_t r_t}(Y_p + r_t) + \alpha'_{A_t}}{1 + \alpha'_{A_t}(Y_p + r_t)} < \frac{\alpha'_{r_t}}{\alpha},$$

which, in turn, implies $\xi_A < \xi_Y$. So, $\frac{dF}{dY_p} > 0$ for $\xi_R < \xi_A$.

*Remittances and Probability of Inheritance*

$$\pi: \frac{dF}{d\pi} = (1+i)u'(y_S) + \left[-(1+i) + \alpha'_{r_t}(Y_p + r_t) + \alpha\right]u'(y_R) > 0 \text{ as } \alpha'_{r_t}(Y_p + r_t) + \alpha > 1 + i.$$

*Remittances and Migrant's Income*

$$\frac{dF}{dy_t} = s(1+i)\left\{-(1-\pi)(1+i)u''(y_S) + \pi\left[-(1+i) + \alpha'_{r_t}(Y_p + r_t) + \alpha\right]u''(y_R)\right\}.$$

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 the absolute risk-aversion is decreasing with income, then $\frac{dF}{dy_t} > 0$.

*Remittances and Downwards Shifters $z^i$ or $\alpha_{z^i} < 0$*

$$\frac{dF}{dz^i} = \pi\left\{\left[\alpha''_{r_t z^i}(Y_p + r_t) + \alpha'_{z^i}\right]u'(y_R) + \left[-(1+i) + \alpha'_{r_t}(Y_p + r_t) + \alpha\right]\alpha'_{z^i}(Y_p + r_t)u''(y_R)\right\}.$$

Let us assume, additionally, that $\alpha''_{r_t z^i}(Y_p + r_t) + \alpha'_{z^i} < 0$, so

$$\frac{dF}{dz^{i}} < 0 \text{ if } \xi_R < \frac{\alpha''_{r_t z^i}(Y_p + r_t) + \alpha'_{z^i}}{\left[-(1+i) + \alpha'_{r_t}(Y_p + r_t) + \alpha\right]\alpha'_{z^i}(Y_p + r_t)}.$$

Call this threshold value $\xi_Z$ and compare it to $\xi_A$. This is equivalent to comparing

$$\frac{\alpha''_{r_t z^i}(Y_p + r_t) + \alpha'_{z^i}}{\alpha'_{z^i}(Y_p + r_t)} \text{ and } \frac{\alpha''_{r_t A_t}(Y_p + r_t) + \alpha'_{A_t}}{1 + \alpha'_{A_t}(Y_p + r_t)}.$$

These two terms are similar, except for the denominator, which is larger in absolute value for the second. We can therefore suppose that $\xi_A < \xi_Z$.

# APPENDIX 2

## INSTRUMENTALIZATION OF THE PARENT'S INCOME FOR THE HOUSEHOLDS WITH MIGRANTS

| Variables | Coefficient | t-Statistic | Significance level |
|---|---|---|---|
| Human capital | | | |
| Number of children of the household head | 792 | 0.99 | |
| Number of adults other than the household head and spouse | -904 | -0.60 | |
| Average age of these adults (years) | 295 | 0.72 | |
| Number of adult males apart from household head | 13,280 | 1.32 | |
| Schooling: percent of adults with | | | |
| 1 to 4 years of schooling (dummy) | -5,423 | -0.76 | |
| 4 to 8 years of schooling (dummy) | -9,171 | -1.06 | |
| Some secondary schooling (dummy) | -3,148 | -0.26 | |
| Postsecondary schooling (dummy) | 105,244 | 1.11 | |
| Spouse | | | |
| Age (years) | 74 | 0.54 | |
| Less than 4 years of schooling (dummy) | 4,164 | 0.82 | |
| 4 to 8 years of schooling (dummy) | 3,015 | 0.33 | |
| Secondary schooling (dummy) | -18,401 | -1.08 | |
| Household head | | | |
| Age (years) | -757 | -2.58 | ** |
| Less than 4 years of schooling (dummy) | 3,471 | 0.74 | |
| 4 to 8 years of schooling (dummy) | -5,069 | -0.70 | |
| Migration assets | | | |
| Number of migrant children | -1,428 | -0.99 | |
| Number of children in the United States | 2,891 | 1.09 | |
| Number of siblings in the United States | 819 | 1.14 | |
| Productive assets | | | |
| Business owner (dummy) | 11,745 | 1.87 | * |
| Animals | | | |
| Poultry (head) | 114 | 1.19 | |
| Pigs or goats (head) | 1,287 | 1.77 | * |
| Horses and mules (head) | -3,414 | -1.47 | |
| Calves (head) | -6,683 | -2.62 | *** |
| Cows (head) | 1,163 | 0.64 | |
| Bulls (head) | 24,537 | 3.98 | *** |
| Land (tareas[a]) | | | |
| Fallow land | -57 | -1.36 | |
| Managed forest | 35 | 1.83 | * |
| Pastures | 204 | 2.59 | ** |
| Food plot | 73 | 2.56 | ** |
| Coffee plantation | -108 | -0.45 | |
| Other land | 399 | 4.90 | *** |
| Other | | | |
| Bao watershed (dummy) | -5,148 | -0.94 | |
| Constant term | 46,452 | 2.35 | ** |
| Number of observations = 134 | | | |
| F (32, 101) = 4.55 | | | |
| Prob > F = 0.00 | | | |
| R-squared = 0.59 | | | |

[a] 1 hectare = 16 tareas.

Note: * 10 percent, ** 5 percent, *** 1 percent.

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