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THE CHECK IS IN THE MAIL: HOUSEHOLD CHARACTERISTICS AND MIGRANT REMITTANCE FROM THE U.S. TO MEXICO

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Abstract

We develop a household model of migrant remittance that accounts for the effects of subsistence requirements and transaction costs on remittances. The model supports testable hypotheses about the effect on remittances of migrant income, family composition and distribution, transaction costs, income and residence security, and other household characteristics on remittance levels and frequency. We test these hypotheses using survey data on individual Mexican migrants in the United States. The results are broadly consistent with our hypotheses. For example, our subsistence requirement implies that below a threshold, the income effect on remittance is zero. This is borne out in our results.

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I. Introduction

Remittances by international migrants to developing countries are now as important as foreign direct investment in terms of their impact on the balance of direct payments and poverty alleviation. According to World Bank data, worker remittances sent to developing countries through market channels rose from $31.0 billion in 1990 to $189.5 billion in 2005 (World Bank, 2007), and the International Fund for Agricultural Development (IFAD) estimated the 2006 flows at $301 billion. In contrast, net foreign direct investment in 2005 was $280.8 billion (World Bank, 2007). Remittances on averaged 4 percent of GDP in Africa and were the equivalent of 13 percent of exports in Latin America and the Caribbean (IFAD, 2007) .

The macroeconomic impact of remittances manifests itself largely through the balance of payments. Some estimates suggest that exchange rate appreciation could lessen the positive impact or even negate it, but this is not a widely held view (Adams, 2007). Remittances also augment domestic savings and stimulate small business activity (IFAD, 2007). Poverty alleviation from remittances is such that recipient families spend on consumption relative to investment items like education, housing and other entrepreneurial activities. The relative size and growth rate of remittances has drawn attention to their potential development impact in the recipient countries as well as factors that determine who remits and how much they remit.

This paper develops a household model of remittances and tests several implications of the model using survey data on individual Mexican migrants in the United States. Our theoretical

model allows for variation in the distribution of household assets and liabilities across the home and host countries, explicitly addresses the impact of subsistence effects on remittances, and accounts for various forms of remittances transaction costs. The model provides testable implications regarding the effect of migrant income, transaction costs, and other household characteristics on migrant remittance levels and remittance frequency. We then test these hypotheses using a pair of regression relationships. The results are broadly consistent with our hypotheses regarding of income effects, household distribution of assets and liabilities, expected stay in the U.S., and transaction costs.

Economic models of remittances can be approached as extensions of models for explaining rural to urban migration. In Todaro, (1969) the decision to migrate is a function of the expected urban-rural wage differential, where the urban wage is discounted by the probability of getting urban employment. Migration can also viewed as an informal intra-household contract requiring the migrant remits part of his income to remaining family members for household services rendered at home, or as a form of individual insurance against unemployment, to secure a bequest upon returning home, or even a combination of these reasons (Stark and Levhari, 1982; Stark, 1991; Hoddinott, 1994; Poirine, 1997; Liu and Reilly, 2004).

Another perspective is that remittances are motivated by altruism (Lucas and Stark 1985; Agarwal and Horowitz 2002). Altruism implies that the migrant's utility is a function of the migrant's consumption as well as the utility of other household members (Stark, 1995; Magee and Thomson, 2006; Glytsos, 2002; Bouhga-Hagbe, 2004). Other models link the altruism and contractual perspectives on migration and remittances (Lucas and Stark 1985).

Empirical results have generally supported the altruism hypothesis (Boughba-Hagbe, 2004; Agarwal and Horowitz, 2002) or altruism and self-interest (Lucas and Stark, 1985). There are some contradictions, however. Time series evidence shows a negative elasticity of remittances with regard to per capita GDP, which would support the altruism motive and the constant consumption ratio hypothesis. Results based on pooled data across countries show a positive GDP elasticity (Adams, 2007). This suggests that investment or portfolio diversification, rather than altruism, may drive remittances. Other studies estimate the level of remittances as a function of country or cultural characteristics, such as the desire to inherit the family assets upon return (Hoddinott, 1994), support of a national cause (Magee and Thompson, 2006) or the repayment of informal loan arrangements (Ilahi and Jafarey, 1988).

Remittances are also a function of transactions costs. Intra-country, urban-rural remittances largely use informal channels, and the costs are probably minimal. Remittances to Mexico and Latin America, however, go through a variety of formal channels. Data for 1999-2000 showed that 66 percent of the remittances to Mexico went through non-bank money transfer methods (MTFs), 12 percent through informal channels and 17 percent through commercial banks (Amuendo-Dorantes, Bansak and Pozo, 2004). The share of MTFs is higher for funds remitted to rural areas, and for illegal migrants. The costs vary by type of institution, country of destination and requested speed of delivery. MTFs charges fell from 15 percent in the 1990s to 5 percent by 2005 (CBO, 2005) and they vary by type of service selected. Credit Unions, on the other hand, charge a flat fee of less than one percent and no foreign currency conversion fees. MTFs and banks also levied charges on the recipient when converting the funds into Mexican currency, and these fees are variable (CUNA and Affiliates, 2003).

Migrant workers make their migration decisions based in part on imperfect information about their future income and living costs in the host country. Once employed, they it is not inconceivable for a migrant to live in nothing more than minimum subsistence conditions while remitting as much as possible to provide for family members whom reside in the home country or to support investment in the home country[1]. Having moved to the host country and securing a job, if actualized income is above the migrant's subsistence level, the migrant may be willing to remit. If the subsistence needs and the total costs of sending the remittances equal or exceed the migrant's income the migrant will not to remit, despite possible plans to do so.

Thus, the determinants of remittances are therefore based on motivations to remit and the capacity to remit, which in turn is contingent on a positive net income (above subsistence), and transactions costs. IFAD(2007) and Bernanke (2004) argue for a reduction in remittance fees as a way of increasing total remittance flow, but do not offer any evidence on the expected level of response. Theoretical models recognize the existence of remittance charges but either assume a single remittance mode (Magee and Thompson, 2006) or informal channels where costs are insignificant (Boughba-Hagbe 2004; Lucas and Stark, 1985;).

Our paper contributes to both the theoretical and the empirical literature on remittances by examining the relationship between remittances levels and frequency, remittance costs, and migrant subsistence. The current literature recognizes the importance of transaction costs and the relatively low migrant income (IFAD, 2007; Bernanke, 2004; Magee and Thomson, 2006;

[1] There are no comprehensive income statistics for migrants. In the US, however, Bureau of the Census data on the Hispanic population (of which Mexican migrants are a subset) show that 40 percent of the documented and 32.2 percent of the undocumented migrants are employed in agriculture with an hourly wage below the national average. Hispanics had the lowest distribution by level of education, with 39 percent having less than a high school diploma and 52 percent of the total population had a family income of less than $35,000 in 2004 prices (US Bureau of the Census, 2004).

Boughba-Hagbe, 2004). However, , transaction costs and subsistence consumption have not been incorporated in a formal way into the published theoretical and empirical economic studies. We develop a utility maximization model in which a positive net income constraint is added to a budget constraint that accounts for both marginal and per-transfer remittance costs. If the subsistence constraint is non-binding then the amount remitted is determined by utility maximization subject to the income constraint and exogenous household characteristics.

This theoretical model provides several hypotheses that we test using data from a survey of Mexican migrant workers in the United States. Because of the characteristics of our data, we use a modified Generalized Ordered Probit model to test hypotheses that follow from our theoretical model. Hoddinott (1992) observed that prior empirical work on remittances had not addressed the distinction between the explanatory variables' effects on the likelihood of remitting and the level of remittances. He corrected the omission by using a generalized (Type II) Tobit model (also called a Heckit model) that allows the censoring process to be determined by a different index function than the rest of the distribution. Because we have categorical remittance data, we adapt the generalized ordered Probit model to allow the probability of no remittance to be determined by an index function that differs from the remittance level index (given positive remittances). We also account for endogenous remittance frequency in estimation using an instrumental variable approach. The results are substantially consistent with all six of our hypotheses. Even when the relationships are not statistically significant, there are compelling patterns in the results that are consistent with the theory.

The paper is organized as follows. Section II consists of a theoretical model and a set of hypotheses to be tested. Data and the econometric model are described in Section III. A discussion of the results is in Section IV, and section V concludes.

II. Theory

We start with Lucas and Stark's (1985) utility function, but modify it to account for the impact of household composition differences between the U.S. and Mexico. The migrant may bring a subset of the family to the U.S. while others remain in Mexico, and households may have varying portfolios of assets and liabilities in Mexico and the U.S. This will affect the marginal rate of substitution between household consumption in the U.S. versus remittances sent to Mexico. For our purposes, the migrant's utility function will be defined as

$$U(C,R,n;\mathbf{Z})=U\left(\sum_{i=1}^{p^{us}} a_i u(c_i,n),\sum_{i=1}^{p^{mx}} b_i u(r_i,n);\mathbf{Z}\right) \qquad (1)$$

This formulation allows different individuals in the household to hold different weights in the migrant's utility and (e.g. the spouse relative to the children).

Consider the following time frame and decision process. A Mexican worker chooses to migrate if the expected benefits of doing so outweigh the expected opportunity costs. Once in the U.S., the migrant accepts a job offer if real annual income Y^{us} is sufficient relative to the the income Y^{mx} available upon return to Mexico. Given that a job is offered, accepted, and maintained, the migrant decides the amount to remit, and how often to remit per year. At a minimum, income must cover subsistence level consumption plus any remittances, i.e.

$$Y^{us} \geq R^{us} + \underline{C}$$

where R^{us} is the total present value of annual remittances, including transaction costs, sent from the US by the migrant, and $\underline{C}$ is a subsistence requirement. Although not explicit in the notation, the subsistence requirement is dependent on many factors, including the number of family members in the host country.

Remittances from the U.S. are defined as the remittances received in Mexico (measured in U.S. dollars), plus the remittance fees and costs. The frequency of remittance is an important choice variable if there are fixed transaction costs. Let R/n be the per-transaction remittance received in Mexico in real present value terms where n is the number of remittances per year.[2] Then annual remittances plus costs from the migrant's perspective are

$$R^{us} = (1+d)R + nt = (1 + d)R + T,$$

where R is the present value of total annual remittance received in Mexico, d is the percentage transfer fee, t is a lump-sum fee per transaction, so that T is the present value of annual lump-sum transaction costs.[3] The lump sum cost provides an incentive to the migrant to save up and remit less frequently. However, surveys conducted in Mexico reveal that 80 to 90 percent of the remittance receipts are spent on such basic needs as school fees, food and healthcare. Most of the recipients lack financial access and financial literacy. In addition, small accounts incur heavy bank charges and there are limitations on the number of withdrawals from savings accounts. As a result, remittances are usually characterized as "cash-to-cash" instead of account-to-account (IFAD, 2007). This lack of financial services coupled with the day-to-day needs of the recipients, make frequent remittances preferable to recipients. We thus assume a positive but diminishing marginal benefit to the household of more frequent remittance.

Given this setting, the working migrant solves the constrained maximization problem

$$L(C,R) = U(C,R,n;\mathbf{Z}) + \lambda\left(Y^{us} - C - [(1+d)R + nt]\right) + \gamma(\underline{C} - C),$$

[2] We define each remittance to be in present value terms to simplify notation.

[3] The subsistence constraint is equivalent to imposing a discontinuity in the utility function at $\underline{C}$ such that utility drops to zero at and below the subsistence level of consumption.

Where $U(\cdot)$ is given by equation (1). The first constraint is the budget constraint, with Lagrange multiplier λ, and the second is the subsistence constraint with Lagrange multiplier γ. The variable p^i in the utility function is the number of household members in country i; a_i and b_i are utility weights applied by the remitter to each household member in the U.S. and in Mexico, respectively; individual consumption in the U.S. is c such that $C = \sum_{p^{us}} c$; and annual average per person remittances are $r = R/p^{mx}$. Utility in Mexico is dependent on remittance frequency n and the amount remitted each time is R/n.[4] Given this formulation, the marginal price of consumption is 1, the marginal cost of remittance dollars sent is $(1+d)$, and the marginal cost of increasing the number of remittances per year is t. The first-order conditions for the migrant's remittance/consumption problem are

$$
\begin{aligned}
c_i: &\quad U^i(\cdot)\left(\sum_{i=1}^{p^{us}} a_i u_{c_i}\right) - \lambda - \gamma = 0 \\
r_i: &\quad U^i(\cdot)\left(\sum_{i=1}^{p^{mx}} b_i u_{r_i}\right) - \lambda(1+d) = 0 \\
n: &\quad U^i(\cdot)u_n\left(\sum_{i=1}^{p^{us}} a_i + \sum_{i=1}^{p^{mx}} b_i\right) - \lambda t = 0 \\
\lambda: &\quad Y^{us} - C - (R(1+d)+T) = 0 \\
\gamma: &\quad \left(\underline{C} - C\right) \leq 0;\ \text{if } <0 \text{ then } \gamma = 0
\end{aligned}
$$

where subscripts other than the index i denote derivatives. Assuming necessary conditions hold for a maximum, annual remittance demand is $R^*=R(\mathbf{Z}, Y^{us}, t, d, \underline{C})$, and the optimal number of remittances per year is $n^*=n(\mathbf{Z}, Y^{us}, t, d, \underline{C})$.

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[4] To be clear, remittances are split two ways: across remittance events so that per-transaction remittance is R/n, and average per person annual remittance, which is $r = R/p^{mx}$. Thus, per person, per transaction remittance is $r/n = R/np^{mx}$.

We are interested specifically in 1) the effect of income on remittances, 2) the relationship between remittance amounts and the frequency of remittances, and 3) the effect of differences in household marginal rates of substitution between consumption and remittance that follow from differences in the distribution of family and assets between the U.S. and Mexico.

We first consider the comparative statics with respect to income. If the subsistence constraint is not binding, $\gamma^*\left(\mathbf{Z}, Y^{us}, t, d\right) = 0$ and (if strictly nonbinding) $\partial\gamma^*/\partial Y^{us} = 0$. In this case, standard income effects apply. If the benefits accruing through consumption, remittances, and remittance frequency are normal goods, then remittance per period increase with income ($\partial R^*/\partial Y^{us} > 0$), and remittance frequency increases with income ($\partial n^*/\partial Y^{us} > 0$).

If the subsistence constraint is binding ($\gamma^* > 0$), remittances will be zero for a sufficiently low income level and then increase, possibly with a discontinuous jump, depending on the structure of remittance transaction costs. Figure 1 shows the expansion path of remittances and consumption with increases in income. Assume, briefly for graphical simplicity, that optimal remittance frequency is economically separable from everything other than the per-transaction fee t so that $T = n^* t$ is fixed in the graph.[5] Based on the constraints, $\min(C) = \underline{C}$ for subsistence; and if $Y^{us} - \left(\underline{C} + T^*\right) \leq 0$ then remittances are zero. If the inequality strictly holds, remittances will not increase with an increase in income, such that $\partial R/\partial Y^{us} = 0$. For the range $Y^{us} - \left(\underline{C} + T^*\right) \geq 0$, remittance/ consumption expansion path is such that the price ratio equals the marginal rate of substitution between remittances and consumption. Figure 2 shows

[5] In reality, income effects would likely lead to reductions in remittance frequency, thus lowering total transaction costs.

the relationship between income and remittances. For Y^{us} and T^* such that the subsistence constraint is binding, $R^* = \max\{0, (Y^{us} - C^* + T^*)/(1+d)\}$, which is represented by the discontinuous bold line. The minimum remittance is $\underline{R} = \frac{Y^{us} - (\underline{C} + T^*)}{1+d}$. Below this level, remitting is not worth the lump-sum cost T^*. Hypothesis 1 summarizes this result.

Hypothesis 1: *The marginal effect of income on remittances will be small and weak at low reported remittance levels, and will be positive at higher remittance categories.*

Now consider the relationship between remittance levels and remittance frequency. Assuming the budget constraint holds exactly for consumption above $\underline{C}$, and for a fixed budget Y^{us}, the following equality holds:

$$(1+d)\,\mathrm{d}R^* + t\,\mathrm{d}n^* + \mathrm{d}C^* = 0$$

Rearranging, we have

$$\frac{(1+d)\mathrm{d}R^*}{\mathrm{d}n^*} + \frac{\mathrm{d}C^*}{\mathrm{d}n^*} = -\frac{t}{(1+d)} < 0.$$

If $\frac{\mathrm{d}R^*}{\mathrm{d}n^*}$ and $\frac{\mathrm{d}C^*}{\mathrm{d}n^*}$ are both the same sign in the relevant range (above subsistence level), then both are negative. This amounts to an income effect of remittance costs on total annual remittances, and expecting a negative sign for both is reasonable given that both *R* and *C* are normal goods.[6] At the subsistence level of consumption, n^* will equal zero because no

[6] Note that this is not a comparative static result with respect to the per-transaction fee *t*. A change in this parameter would lead to both an income and substitution effect in each choice variable. Unfortunately, we do not have transaction cost data to sufficiently characterize the menu of transaction modes for empirical analysis.

remittances will be made. Further, the larger the optimal number of remittances, the larger the gap will be between zero and the minimum nonzero remittance as in figures 1 and 2.

A more intuitively straightforward hypothesis (that we do not formally show) is that the demand for remittance frequency is downward sloping in per-transaction remittance costs. Given positive remittances as the per-transaction cost *t* increases for a chosen (optimal) remittance mode, fewer transactions will be made. This discussion suggests the following two testable hypotheses:

Hypothesis 2: *High remittance frequency implies high total remittance costs, and will be associated with relatively low total remittance.*

Hypothesis 3: *As the marginal cost of a remittance transaction increases, the frequency of remittances decreases.*

Next consider the effect of differences in household marginal rates of substitution between consumption and remittance that follow from differences in the distribution of family and assets between the U.S. and Mexico. The marginal rate of substitution of total consumption in the U.S. for total remittances implied by the model is

$$MRS_{R,C} = \frac{U'(R)}{U'(C)} = \sum_{i=1}^{p^{us}} a_i \Big/ \sum_{i=1}^{p^{mx}} b_i .$$

The willingness to substitute remittances for consumption in the U.S. is weighted by the relative importance the migrant attaches to the utility of the family members in each location. We have no compelling *a priori* notions as to the weights attached to individual family members. However, assume, for the moment, that $a_i = b_i$ and the rate of substitution is based purely on relative numbers in the US and Mexico. As the number of household members in Mexico

decrease relative to those in the U.S. the marginal rate of substitution of *c* for *r* increases, so the migrant is willing to send lower remittances for a given set of relative prices and income. Similarly, if the relative number of family members in the U.S. decreases, the amount remitted will increase. Graphically, if relatively more family members are in Mexico, the household utility function will be flatter in R-C space (as in Figure 1), providing a relatively larger marginal rate of substitution of *c* for *r* in the relevant ranges.

Hypothesis 4: *More (fewer) family members in Mexico and fewer (more) family members in the U.S. will lead to higher (lower) remittances.*

The migrant's job security, U.S visitation security, and his/her plans for returning to Mexico also are likely to be important determinants of remittances. If a migrant has a secure and steady job for any reported income level during their expected stay, the expected value of income will be higher and the variance of income will be lower, so remittances will be higher given stronger job security. Also, if the migrant is planning on being in the U.S. for only a short period of time, or if the migrant's stay in the U.S. is tenuous (perhaps having no legal papers or because of job insecurity itself), the household may in expected value terms benefit from more remittances during their time in the U.S. Finally, if a migrant has strong investment interests in Mexico that must be financially serviced in Mexico, the value of remittances at the margin are likely to be higher. Two more hypotheses follow:

Hypothesis 5: *Less secure employment and residence security in the U.S. will lead to higher current remittances.*

Hypothesis 6: *Larger capital assets and liabilities in Mexico (U.S.) will lead to higher (lower) remittance levels.*

Each of these hypotheses will be tested and discussed using the methods described in the following section.

III. Data and econometric model

The data used in the statistical analysis are described in Table 1, and Table 2 provides their summary statistics. The data come from survey questionnaires administered by the Pew Hispanic Center (PEW).[7] The surveys were conducted from July 2004 through January 2005 at Mexican Consulates in Los Angles, New York, Chicago, Atlanta, Dallas, Raleigh, and Fresno, and the respondents were all applying for a Matricula Consular, which is an identification card.

Matricula consular cards have been around for about 130 years (US Congress, 2003). They are issued by foreign governments to migrants, identifying them as citizens of a particular country in case of an emergency or if stopped by law enforcement agencies. Since 2001 the government of Mexico has issued over one million of the cards, and has urged their acceptance by local authorities in the United States. As of 2003, more than 800 law enforcement agencies and 74 banks accept the matricula consular for identification purposes, and some local authorities accept it as a basis to grant benefits, including subsidized housing (US Congress, 2003). Applicants in the Pew sample could therefore have been remitting funds without the certificate, and were acquiring it for the other benefits. For example, they could use it to open a bank account and thus diversify channels of remitting funds.

Our empirical goal is to estimate the effect of various migrant characteristics on remittance levels and frequency. The response variables of interest are therefore remittance per

[7] The Pew Hispanic Center bears no responsibility for the interpretations offered, or conclusions made based on analysis of the Pew Hispanic Center Survey of Mexican Migrants data.

unit time and the frequency of remittance. In our dataset, the measure of remittances per month is a categorical variable with seven categories ranging from $0 to >$500 in increments of $100 (Table 3). An ordered Probit regression would be a reasonable model to estimate the probability of an individual being in a given remittance category apply, except for two issues. First, we expect a different type of income response for the first category (zero remittance), so the standard Probit model is too restrictive. Therefore, we use the more flexible generalized ordered Probit (GOProbit) regression model. Second, some of our data pertains to chosen remittance mode, and these data are missing for migrants who do not remit anything. We therefore generalize the standard GOProbit slightly to allow the set of variables that affects the choice not to remit or not to differ from the set of variables that affects the level of remittance given positive remittance. As a result, the model we employ is the generalized ordered Probit counterpart to a type-II Tobit model (Heckit), which allows the index function of the censoring process to differ from the index function of the continuous part of the error distribution.[8] Formally, we characterize the decision process in terms of an underlying latent remittance demand and frequency, R^* and $n*$. We want to allow flexibility in the sample range of observed R, while still admitting our imperfect (categorical) observation of it. As such, we begin by characterizing an

[8] This "Type II" approach is similar in spirit to a double hurdle model, but is based on a univariate disturbance process rather than a bivariate disturbance process. In a double hurdle model the choice to remit is determined by a separate regression (with a separate disturbance process) than that which determines remittance level given remittance. In this case, we treat the zero remittances as the lower end of a continuum of remittance categories, but add flexibility to allow the determinants to differ for that first category.

unconstrained spline regression as a piecewise linear approximation to R^* (see Greene (2003), section 7.2.5 for a further description):[9]

$$R_i^* = G(\mathbf{x}_i'\boldsymbol{\beta}, \varepsilon_i) \cong d_i^0(\mu_0 + \mathbf{x}_i'\boldsymbol{\beta}_0) + \sum_{j=1}^{J} d_i^0(\mu_j + \mathbf{x}_i'\boldsymbol{\beta}_j) + \varepsilon_i$$

where $\mathbf{x}_i^0$ are variables affecting R_i^* in the range of no remittances ($R_i=0$), $\mathbf{x}_i$ are explanatory variables (possibly different than $\mathbf{x}_i^0$) that affect $R_i^* > 0$, and

$$d_i^j = \begin{cases} =1 & \text{if } \mu^{j-1} \le R^* < \mu^j \\ =0 & \text{otherwise.} \end{cases}$$

The μ^k are nodes at which the regression line for R may change slope in the sample space of $\mathbf{X}$. Thus, for a given range, $R^* | \mu_{j-1} \le R^* < \mu_j = \mathbf{x}_i'\boldsymbol{\beta}_j + \varepsilon_i$ $R^* \mid \mu^{j-1} \le R^* < \mu^j = \mathbf{x}_i'\ddot{\mathbf{a}}_j + \varepsilon_i$. Thus, the probability of remittance falling within each of the specific categories is

$$\begin{aligned}
\Pr(R_i = 0 \mid \mathbf{x}_i^0) &= \Pr\left(\mathbf{x}_i^0{}'\boldsymbol{\beta}_0 + \varepsilon_i < 0\right) = \Phi(-\mathbf{x}_i^0{}'\boldsymbol{\beta}_0) \\
\Pr(R_i = 1 \mid \mathbf{x}_i, \mathbf{x}_i^0) &= \Phi(\mu_1 - \mathbf{x}_i'\boldsymbol{\beta}_1) - \Phi(-\mathbf{x}_i^0{}'\boldsymbol{\beta}_0) \\
\Pr(R_i = 2 \mid \mathbf{x}_i) &= \Phi(\mu_2 - \mathbf{x}_i'\boldsymbol{\beta}_2) - \Phi(\mu_1 - \mathbf{x}_i'\boldsymbol{\beta}_1) \\
\Pr(R_i = 3 \mid \mathbf{x}_i) &= \Phi(\mu_3 - \mathbf{x}_i'\boldsymbol{\beta}_3) - \Phi(\mu_2 - \mathbf{x}_i'\boldsymbol{\beta}_2) \\
&\vdots \\
\Pr(R_i = 6 \mid \mathbf{x}_i) &= 1 - \Phi(\mu_6 - \mathbf{x}_i'\boldsymbol{\beta}_6).
\end{aligned}$$

where $\Phi(\cdot)$ represents the cumulative standard normal density function.[10] The likelihood function for this type-II ordered Probit is

[9] Note that knots are not imposed on this regression line, so this is not a linear spline. Because knots are not imposed in the generalized regression model described below, this piecewise linear regression rather than a spline is the appropriate analogue.

$$L = \prod_{i=1}^{N} \left(\Phi_{i,0}{}^{d_0} \cdot \prod_{j=1}^{7} \left(\Phi_{i,j} - \Phi_{i,j-1} \right)^{d_j} \right)$$

where $\Phi_{i,0} = \Phi(-\mathbf{x}_i^0{}'\boldsymbol{\beta}_0^0)$, $\Phi_{i,k} = \Phi\left(\mu_k - \mathbf{x}_i{}'\boldsymbol{\beta}_k\right)$ for *k=1…6* and $\Phi_{i,7} = 1$. Indicator variables d^j take the value 1 for $y_i = j$ and zero otherwise. The log likelihood function is then

$$\ln L = \sum_{i=1}^{N} \left(d_0 \ln \Phi_{i,0} + \sum_{j=1}^{7} d_j \ln\left(\Phi_{i,j} - \Phi_{i,j-1}\right) \right)$$

Given the nonlinearity of the effects of an explanatory variable on the probability of the response being in a given category, the parameter estimates are not equivalent to the marginal effects. The change in the probability of being in category *j* with respect to a change in x_i (the marginal effect of an explanatory variable) is

$$\frac{\partial \Phi_{i,0}}{\partial \mathbf{x}_i^0} = -\boldsymbol{\beta}_0 \phi_{i,0} = -\frac{\partial \Phi_{i,1}}{\partial \mathbf{x}_i^0}$$
$$\frac{\partial\left(\Phi_{i,j} - \Phi_{i,j-1}\right)}{\partial \mathbf{x}_i} = -\boldsymbol{\beta}_j \left(\phi_{i,j} - \phi_{i,j-1}\right), \text{ for } j > 1.$$

where $\phi_{i,k}$ is the probability density function value associated with $\Phi_{i,k}$. For all but the first and last category, the sign of the marginal effect may be either the same or different than the sign of the parameter estimates $\boldsymbol{\beta}_j$, because the effect of an increase in explanatory variables with $\boldsymbol{\beta}_j > 0$ is to move some of the density into a category from below, and some of the density to the

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[10] This representation assumes two identification constraints: $\mu_0 = 0$ and the variance of the normal distribution is normalized to one for all *i*. Because parameters are allowed to vary across categories, negative predicted probabilities are possible with the generalized ordered probit for extreme values of independent variables (McCullagh and Nelder, 1989 p. 155).

next larger category. Thus, if a variable $\mathbf{x}_k$ tends to lead uniformly to higher remittances, then the marginal effect of $\mathbf{x}_k$ on the probabilities of low remittance categories will tend to be negative, and the marginal effect of $\mathbf{x}_k$ on the probabilities of high remittances will be positive.

The unconstrained GOProbit allows the parameters associated with a given explanatory variable to differ for each category.[11] For model parsimony, Wald tests are performed to test for differences within of each set of *j* parameters associated with a given explanatory variable. If a test statistic for the null hypothesis of no difference among the *j* parameters is not rejected in a preliminary regression, then the parameters are constrained to be equal for that specific explanatory variable in the final regression.[12]

Some of the variables associated with the first category (zero remittances) are unique. Specifically, one survey question asks what mode of remittance they use (e.g. Western Union, bank card, through a friend, etc.). Data for this question are missing for non-remitters. We therefore omit the indicator variables related to this question from the vector that applies to the non-remitter category. This is easily done in this case by setting the variables to an arbitrary value for the non-remitters, and then restricting the first-category parameters for these variables to be zero. This is equivalent to omitting the variables from the part of the likelihood function that corresponds to category 0 (non-remitters).

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[11] Estimation is performed in Stata IC 10.0 with the GOLOGIT2 routine with the Probit link function, and using the MFX2 routine for calculating marginal effects.

[12] To illustrate, if we failed to reject equality of parameters for each explanatory variable, the standard ordered Probit would result. The literature on generalized ordered probit models refers to the standard ordered probit/logit models as *proportional odds* or *parallel lines* models because they restrict the slope parameters to be the same across all categories. The restricted generalized ordered probit that restricts a subset of parameters to be the same across categories is sometimes called a *partial proportional odds model*.

Because remittance mode and remittance frequency are jointly and endogenously determined along with remittance amount, we treat them as endogenous variables. We therefore estimate first stage regressions to generate predicted values for these variables, which we then use as instruments for the original variables. The original remittance mode variables are binary variables (e.g. *remits via Western Union* or not), and the remittance frequency variable is ordered categorical. We therefore use Probit regressions and a standard Ordered Probit regression to generate expected values for modes and for remittance frequency, respectively.

IV. Results and discussion

Parameter estimates for the remittance regression are reported in Table 4. Because these parameters are harder to interpret than marginal effects for this model, we will not discuss them in detail. However, note that when we fail to reject the null hypothesis that a variable's parameters do not vary across remittance categories, we restrict these parameters to be equal across remittance categories in the final model so that parameter estimates are for the effect of such a variable are identical in that variable's row in Table 4. Based on these tests, this *parallel lines* (or *proportional odds*) restriction is applied for all but six variables, namely *the number of children in Mexico, earnings per week*, *remittance* frequency, and the three remittance mode variables (*remits via Western Union, Remits via Bank,* and *remits via friend/relative*). The parameters for remittance modes are restricted to zero in the *zero remittance column* because no mode is used if no remittance is sent.

Marginal effects of each explanatory variable within each category of remittances are presented in Table 5. Virtually all significant results are consistent with the hypotheses that follow from our model. Although a substantial number of the estimated marginal effects are not

statistically significant at conventional levels, most of the signs are consistent with our theory as well. We will discuss these results in the context of the hypotheses developed earlier in the paper.

The marginal effects for *earnings per week* show that the marginal effect for the zero remittance category is negative but small and not significant at $\alpha=0.10$; negative and significant at the one percent level for categories two and three, and positive and significant at the five percent level or less for the remaining categories. Taken together, these results are exactly consistent with hypothesis 1. The effect of income on the probability of remitting zero is insignificant as expected. Based on our model this is because many of the individuals in this category are constrained by subsistence requirements and are less likely than others to find it worthwhile to incur any lump-sum remittance costs they face unless their income rises.[13] For those remitting less than $200 a month, a larger income has a significant and negative effect on the probability that they remain in those two categories; they will tend to remit more. An increase in income leads to a higher probability of remitting in one of the larger remittance categories. Further, the largest positive impact of an income effect is seen in the top remittance category, suggesting an increase in the marginal rate of substitution toward remittances as migrant incomes increase. Another variable related to income is *the number of workers in the U.S. household.*. The effect of an increase in this number is to increase the probability of being in higher remittance categories. This is both consistent with hypothesis 1 and will be discussed below in terms of income security as well.

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[13] Another interpretation for the insignificant income effect at zero remittances is that income does not play a role in the decision to remit or not, but rather, this decision is based on other factors instead of income. Given our data, our primary interpretation and this one are observationally indistinguishable.

Hypotheses 2 and 3 are related to income and substitution effects of differences in total and marginal remittance costs. Remittance frequency and remittance modes are closely tied to relative transaction costs, and in our model they are jointly and endogenously chosen along with remittance amounts. Therefore, for estimation, predicted values for these variables are included in the remittance regression as instruments for the original variables (more on these instruments later). Money transfer companies such as Western Union and Moneygram have historically been the largest remittance mode. A survey in Los Angeles by the US Comptroller of the Currency found that 37 percent of those remitting to Latin America used wire transfer services such as these (Bernanke, 2004). Due to substantial changes in the market for transfers in the last decade, many of these companies have changed rates structures substantially (IFAD, 2007). Now, transmission fees by Western Union amount to a lump sum fee per transfer on the remitter's end and foreign exchange fee at the recipient's end. The other types of remittance methods ("a bank", an "electronic cashier", "a credit union", "a cash card", "a friend, relative, or other person", or "post office mail") most likely do not generally charge such a per-dollar transfer fee although the speed of transmission is much slower. We include just the three most frequently cited modes of remittance in our regressions (*remits via Western Union [or similar], remits via bank,* and *remits via relative/friend*).

First consider the effects of *remittance frequency* on remittance amounts. According to hypothesis 2, for a given remittance mode, more frequent remittances implies higher total remittance costs, leading to less total remittance. Indeed, we find that as the remittance frequency increases, the probability of remitting small positive amounts increases, and the probability of remitting large positive amounts decreases.

Now briefly consider the first-stage auxiliary Ordered Probit regression used to generate the expected value used as an instrument for remittance frequency (Table 6).[14] These marginal effects are all quite intriguing, but consider the effects of remittance modes specifically. We find that if an individual chooses to *Remit via Western Union* or *remit via a bank*, they are more likely to remit infrequently than the base case modes (other methods). During the time period in which our data were collected (and as is the case presently), Western Union charges a flat per-transaction fee on the front end of the transaction, regardless of the amount remitted (around 11 dollars). We would therefore expect more infrequent remittances to the extent that other methods of transfer have lower per-transaction fees. The signs associated with *remits via friend/relative* follow the same pattern, but all are insignificant, and the magnitudes are substantially smaller. This might be a reflection of both a lower per-transaction cost, as well as an increased risk of theft or loss associated with large individual transactions flowing through informal channels. The statistical insignificance could be a reflection of the varied methods and risks associated with this type of transfer method. It is also noteworthy that the progression of signs for *remits via bank* and *bank account in the U.S.* are in the opposite direction. The implication of this is not clear, but if some respondents are using bank cards to remit but do not consider that to be *remitting by bank* (as in a facilitated bank remittance service), then the *bank account in the U.S.* dummy variable might be picking up the low per-transaction costs of remitting, because it shows that individuals with bank accounts in the U.S. are more likely to remit frequently and less likely to remit infrequently compared to those without U.S. bank accounts. This comparison addresses and is at least not

[14] Probit regression also were used to generate predicted values for the three remittance mode variables *remits via western union, remits via bank.,* and *remits via friends/relatives*. These predicted values were used as instruments in both the remittance and the remittance frequency regressions. These preliminary Probit regression results have been omitted for brevity, but are available from the authors.

apparently inconsistent with hypothesis 3, although we cannot make strong comparisons because we do not have actual estimates of transaction costs for other transaction types.

Now consider again the effects of remittance mode on remittance levels holding remittance frequency constant (revert back to table 5). To the extent that Western Union is more costly per transaction than other methods, we would expect a lower remittance level for individuals remitting by Western Union than by other methods (hypothesis 2). As noted before, the value of this variable is not in the sample if an individual chose not to remit, so the parameter is restricted to zero for the zero remittance category. For the other remittance categories, the results are mixed, but interesting. The results yield positive and significant marginal effect of 1.165 for *remits via Western Union* on category 2 ((remit<$100) and negative effects for categories 4 through 7 (R=$200 and more), though only the effect on the largest remittance category is significant at conventional levels. One interpretation of these results is that Western Union facilitates smaller total remittance levels rather than other modes of remittances (this is not to say smaller per-transaction remittances, as discussed above). This is consistent with the apparent fact that Western Union remittance modes tend to be more expensive than other modes, and may be used primarily by those who do not maintain bank accounts for any of a number of reasons. Familiarity may also play a role. Western Union has pursued the remittances market more aggressively than other market players by conducting campaigns aimed at prospective migrants prior to departure and marketing campaigns in the country of destination (New York Times, 2007). Newly arrived migrants with low incomes are thus more likely to be familiar with Western Union than other financial channels.

The distribution of family members between Mexico and the U.S. has patterns of effects generally consistent with hypothesis 4, although many are statistically weak. If the migrant has a

spouse living with him or her in the U.S., the probability of remitting low amounts is larger, and the probability of remitting high amounts is lower, and these results are statistically significant at the 5 percent level. In contrast, if the spouse lives in Mexico, the effects are just the opposite. The pattern of these effects are compelling, especially in comparison the having a spouse in the U.S., but none of the marginal effects for this variable are not statistically significant. As the number of children in the U.S. household increases, the probability of remitting in each category less than $200 increases while the probability of remitting in each category more than this decreases, so more children in the U.S. leads to less remittance to Mexico. However, all of the marginal effects are insignificant.[15] If the remitter's children live in Mexico, they are statistically less likely to remit less than $100 per month, and statistically more likely to remit between $400 and $500, meaning that the migrant is more likely to remit more given more children in Mexico. The coefficients on all other marginal effects for this variable are not statistically significant at conventional levels.

Marginal effects for the proxies for residence, employment, and financial security in the United States are generally consistent with hypothesis 5. If the remitter plans on remaining in the U.S. for more than 10 years (*Expects to remain in U.S. >10 years*), the probability of remitting in categories less than $200 increase, and the probabilities of remitting more than that decrease. These results are statistically strong. This set of results suggests stronger financial ties to the U.S relative to Mexico. Those who instead indicated that they *will stay in the U.S. as long as*

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[15] As one might expect, there is correlation between spouses living in the U.S. (Mexico) and children living in the U.S. (Mexico). The correlation coefficients are 0.45 between *spouse lives in the U.S.* and # *children in the U.S.*, and 0.56 between *spouse lives in Mexico* and # *children in Mexico*. The correlations between a spouse living separately from children are negative and smaller in absolute value. These correlations can contribute to the statistical weakness of some of these results. For example, when *spouse lives in the U.S.* is omitted from the regression, the parameters on # *children in the U.S.* become significant at the 10% level or lower.

possible are, by their response, indicating some uncertainty about their future in the U.S. Indeed, those who provided this response are less likely to remit small amounts and more likely to remit larger amounts. However, the effects are not statistically significant and are smaller than those associated with *Expects to remain in U.S. >10 years.* The interpretation here is that the uncertainty they face reduces their expected stay, and so they account for this in their remittance levels. The high variance of these estimates associated with *will stay in the U.S. as long as possible* are likely due to the vagaries of this response. Presumably each has some expectation of their likely length of stay, but this expectation is likely to vary significantly among respondents who chose this response.

Remitters who have been unemployed for more than one month in the last year tend to remit more than those who have not. This response is subject to several interpretations, but is consistent with a respondent reporting higher remittance when employed to make up for past and potential future unemployment. Again, however, these effects are both small and weak. A migrant who *has health insurance* is more likely to remit more than those without. Again, none of these parameters are significant at conventional levels, but are qualitatively consistent with a higher propensity to remit under less income/expenditure uncertainty as suggested by hypothesis 5. Remitters who have been in the United States longer (*# years in U.S.*) tend to remit less. This is holding future plans and uncertainty constant, a migrant will have had more time to accumulate savings through remittance, and so has the capacity to remit less for any given goal. Recall also that as the number workers in the respondent's household who work in the U.S. (*# in household who work in U.S.)* tends to increase the probability of remitting more. As noted above, this result can be due to an income effect, but it can also be due to a security effect to the

extent that household members rely on each other to pool income risk in the U.S., thereby allowing larger remittances with less subsistence risk.

Asset ownership in Mexico and the U.S. also affects the amount of remittances. If a remitter owns real estate or land in Mexico, they are significantly less likely to remit in any category less than $200, and more likely for categories greater than $200. Interestingly, the effect of owning a business in Mexico is statistically weak, but it tends to be associated with low levels of remittance rather than high levels. In contrast, if the remitter is an owner or proprietor of a business in the U.S., they are less likely to remit less than $200 and more likely to remit more (each of these marginal effect is significant at the one percent level). These results are consistent with a setting in which land and real estate require loan or maintenance payments (such as mortgage or repair costs), and businesses provide net income at their respective locations.

V. Conclusion

Migrant remittances from the United States to other countries are increasing, public policy with respect to undocumented migrants is under serious debate, and the market for remittance modes is changing rapidly. Remittances now make up 20 percent of per capita income in Latin America, and on average, 90 percent of the proceeds go for subsistence needs (IFAD, 2007), so the impact on poverty alleviation therefore is significant. There is also a secondary balance of payments impact, with remittances averaging 3 percent of exports in 2006 (IMF, 2006). The developmental impact is therefore also dependent on the macroeconomic policies of the recipient country, particularly with respect to exchange rates and financial sector reform.

This paper examines some of the determinants of migrant remittance choices and is unique in its formal application of a net income hypothesis and explicit treatment of remittance transaction costs. The data call for the use of what we term a Type II generalized ordered Probit model. Results are very broadly consistent with the testable hypotheses developed in this paper. Although some of these results are statistically weak, the general patterns of even these statistically weaker parameter point estimates are substantially consistent with our hypotheses. We find that income has no effect on the probability of remitting nothing, but has statistically significant positive effects on the remittance conditional on remitting a positive amount. Further, high transaction costs implied by high transaction frequency appear to have a negative income effect on remittances. We find also that migrants with more family members in Mexico and fewer family members in the U.S. remit more (especially in the case of spouses); migrants with assets (land, other real estate) in Mexico tend to remit more, and migrants who are owners or proprietors of businesses in the U.S. remit more. Measures that capture uncertainty regarding U.S. income, expenditures, or residency status all show that increases in uncertainty lead to larger remittances compared to those who face lower uncertainty in these measures.

Transaction costs are a major determinant of the process by which remittances are made, and a difficult problem for remitters is commonly a lack of transparency about exchange rates at the receiving end of a transaction. Current law restricts payments in Mexico to be made in pesos. The lack of transparency and currency restrictions lower competition by not permitting recipients to "shop around" and in effect establish dual exchange rates that discriminate against remittances. Cross section estimates show that countries with dual exchange rates receive 40 percent less remittances than those with liberalized rates (Lueth and Ruiz-Arranz, 2006). Our estimates show the foreign exchange rate impact indirectly; remitters using money transfer

organizations tend to send smaller amounts, probably because of high per-transaction costs at both ends. Liberalizing conversion rules in the recipient country would probably lower implicit transaction costs for remittances by improving remitters and recipients to more effectively shop for low-cost remittance modes, which might increase the probability of remittances of less than $100 most likely to low-income recipients for whom the poverty alleviating impact is greatest.

Lueth and Ruiz-Arranz (2006) find a link between GDP growth rates in the recipient country and remittance flows. Their results on macro-level data suggest that a one percent change in the growth rate is associated with a 2.8 percent increase in remittances. This is loosely consistent with our results, which show a positive relationship between higher remittances and asset ownership in the country of origin. Remittances from individuals with substantial assets in Mexico are likely to have a greater development impact if they are applied toward the domestic savings and capital markets. These results argue for growth promoting policies, not only for their sake, but because they have a 'multiplier effect' through remittance increases.

Our analysis points to possible impacts of US policy measures regarding immigrants as well. A more active process to interdict illegal migrants will have several offsetting effects on remittances. Illegal migrants are likely to be in the lower wage groups, which according to our results would lead to a less than proportionate decline in remittances relative to the number of repatriations. However, remaining illegal migrants would face a greater degree of uncertainty and a shorter expected stay on average. They are also likely to have a proportionately larger number of dependents in Mexico. Both of these factors would tend to induce more remittance per remaining illegal migrant, so the net effect Is ambiguous. Similarly, a legal guest worker program would likely increase the per-migrant remittance per unit time of the participants during their stay, and will allow them more flexibility in remittance modes.

Our results suggest a possible link between host country policies on security and remittances given that most remittances go for subsistence needs. Assume for the moment that funds for illegal purposes move through informal channels. Developing rules that limit the use of such formal channels as banks and other legal channels by illegal migrants would most likely increase volumes through informal means and make monitoring them for illegal funds more difficult. A combination of financial restrictions in the home country and tighter controls in the host country has the effect also of reducing the flows and exacerbating poverty. The impact might very well be the opposite of what both countries intended. These and other issues that relate to the impact of immigration policy in the U.S. can have profound Impacts on remittance flows.

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Table 1: Data descriptions

Variable Name	Description of Variables
Remittance level (Q43)	0 =no remittances sent, 1 = less than $100, 2 = $100 to $199, 3 = $200 to $299, 4 = $300 to $399, 5 = $400 to $499, and 6 = more than $500.
Remittance frequency (Q42)	Categorical responses to "How often do you send money to Mexico?" were translated into the number of weeks per year that an individual remits, so that a high number implies a higher frequency.
Earnings (Q39)	Income per week. 1 = $1-$100, 2 =$101-$199, 3 = $200-$299, 4 = $300-$399, 5 = $400-$499, 6 = more than $500.
Remits via Western Union type (Q44.1)	Equals 1 if the respondents remit via a company like Western Union or a money gram. Alternatives include a bank, electronic cashier, a credit union, a cash card, through a friend or relative, or through a post office.
Remits via bank card (Q44.5)	Equals 1 if the respondents remit via a bank card.
Remits via friend/relative (Q44.6)	Equals 1 if the respondents remit via a friend or relative.
Spouse lives in Mexico (Q8)	1 if spouse living in Mexico and 0 otherwise.
# children in the U.S. (Q10)	The number of respondent's children living in the United States.
# children in Mexico (Q9-Q10)	The difference between the total number of respondent's children and the number of children in the U.S.
Gender [male=1] (Q2)	Categorical variable of gender where 1 indicates male and 0 otherwise.
Age (Q3)	Age in years.
Education level (Q5)	1 =did not attend or complete any schooling, 2 = completion of K-11 but not finishing High School, 3 = completion of a secondary education at a Technical School, 4 = High School or equivalent graduation, 5 indicates college or more.
Speak English (Q6)	1= a lot, 2= some, 3=a little, 4 = none
Marital status (Q7)	Categorical variable of marital status where 1 indicates married and 0 otherwise.
# years in the U.S. (Q22time)	Categorical variable indicating number of years in U.S. where 1 indicates 5 or less years, 2 indicates 6-10 years, 3 indicates 11-15 years, and 4 indicates more than 15 years.
Own land, Own real estate, Own business in Mexico (Q19)	Equals 1 if respondent owns land, real estate, or a business in Mexico and 0 otherwise, respectively.
U.S. Photo I.D. (Q 29)	Equals 1 if respondent has a photo ID issued by a U.S. Agency.
Owner/proprietor of business in U.S. (Q34.3)	Equals 1 if respondent is an owner or proprietor of a business in the U.S.
# in household who work in the U.S.? (Q26)Unemployed > 1 month last year (Q35)	Equals 1 if the respondent had been unemployed for more than one month last year.
Paid by direct deposit (Q40.1)	Categorical variables equaling 1 if paid by direct deposit.
Bank account in the U.S. (Q46)	Equals 1 if respondent has a bank account in the U.S.
Has health insurance (Q48)	Equals 1 if the respondent has health insurance
Expects to remain in U.S. >10 years (Q23)	Response to the question: how long do you think you will remain in the U.S.?
Will stay in U.S. as long as possible (Q23)	Response to the question: how long do you think you will remain in the U.S.?

Table 2. Summary statistics of variables used in regressions. Survey question numbers in parentheses. N=2339

variable	mean	se(mean)	median	max	min
remittance level	2.77	0.03	2	6	0
Earnings per week	3.67	0.03	4	6	0
Remittance frequency	5.16	0.07	4.04	16.85	0
Remits via Western Union	0.73	0	0.74	0.81	0.61
Remits via bank	0.11	0	0.09	0.24	0.04
Remits via relative/friend	0.08	0	0.08	0.18	0.02
Spouse lives with in the U.S.	0.47	0.01	0	1	0
Spouse lives in Mexico	0.13	0.01	0	1	0
# children in the U.S.	1.29	0.03	1	6	0
# children in Mexico	0.5	0.02	0	6	0
Gender [male=1]	0.67	0.01	1	1	0
Age	32.76	0.26	30	97	18
Education level	2.98	0.02	3	5	1
Marital status	0.67	0.01	1	1	0
Speak English	2.64	0.02	3	4	1
Owns land in Mexico	0.16	0.01	0	1	0
Owns real estate in Mexico	0.28	0.01	0	1	0
Owns business in Mexico	0.03	0	0	1	0
U.S. photo I.D.	0.43	0.01	0	1	0
# years in the U.S.	2.08	0.02	2	4	1
# in household who work in U.S.	2.69	0.04	2	20	0
Owner/proprietor of business in U.S.	0.16	0.01	0	3	0
Unemployed > 1 month last year	0.64	0.01	1	1	0
Paid by direct deposit	0.04	0	0	1	0
Has health insurance	0.63	0.01	1	1	0
Expects to remain in U.S. >10 years	0.04	0	0	1	0
Will stay in U.S. as long as possible	0.43	0.01	0	1	0

Table 3. How much do you send per month on average ? (N=2339)

	Freq.	Percent	Cum.
zero	53	2.27	2.27
remit/month<$100	393	16.8	19.07
$100<remit/month<$199	818	34.97	54.04
$200<remit/month<$299	464	19.84	73.88
$300<remit/month<$399	226	9.66	83.54
$400<remit/month<$499	155	6.63	90.17
$500<remit/month	230	9.83	100
Total	2,339	100	

Table 4. Parameter estimates, Generalized Type II Ordered Probit regression

	Dependent variable category					
Variable	zero	remit<100	100<remit<199	200<remit<299	300<remit<399	400<remit<499
Earnings per week	0.012	0.132 ***	0.219 ***	0.230 ***	0.233 ***	0.275 ***
# in household who work in U.S.	0.058 ***	0.058 ***	0.058 ***	0.058 ***	0.058 ***	0.058 ***
Remittance frequency	0.004	-0.071 ***	-0.066 ***	-0.073 ***	-0.078 ***	-0.062 ***
Remits via Western Union	0.000 †	-4.801 *	-5.590 **	-6.046 **	-6.742 **	-6.785 **
Remits via bank	0.000 †	-0.224	-2.136	-1.842	-1.870	-2.183
Remits via relative/friend	0.000 †	-6.148 **	-5.153 *	-6.225 **	-8.137 **	-6.547 *
Spouse lives with in the U.S.	-0.229 ***	-0.229 ***	-0.229 ***	-0.229 ***	-0.229 ***	-0.229 ***
Spouse lives in Mexico	0.098	0.098	0.098	0.098	0.098	0.098
Marital status	0.090	0.090	0.090	0.090	0.090	0.090
# children in the U.S.	-0.030	-0.030	-0.030	-0.030	-0.030	-0.030
# children in Mexico	-0.066	0.199 ***	0.107 ***	0.099 ***	0.082 **	0.038
Gender [male=1]	0.318 ***	0.318 ***	0.318 ***	0.318 ***	0.318 ***	0.318 ***
Expects to remain in U.S. >10 years	-0.415 ***	-0.415 ***	-0.415 ***	-0.415 ***	-0.415 ***	-0.415 ***
Will stay in U.S. as long as possible	-0.059	-0.059	-0.059	-0.059	-0.059	-0.059
Unemployed > 1 month last year	0.028	0.028	0.028	0.028	0.028	0.028
Has health insurance	0.043	0.043	0.043	0.043	0.043	0.043
# years in the U.S.	-0.105 **	-0.105 **	-0.105 **	-0.105 **	-0.105 **	-0.105 **
Owns land in Mexico	0.229 ***	0.229 ***	0.229 ***	0.229 ***	0.229 ***	0.229 ***
Owns real estate in Mexico	0.120 **	0.120 **	0.120 **	0.120 **	0.120 **	0.120 **
Owns business in Mexico	-0.048	-0.048	-0.048	-0.048	-0.048	-0.048
Owner/proprietor of business in U.S.	0.069 **	0.069 **	0.069 **	0.069 **	0.069 **	0.069 **
Age	0.004 **	0.004 **	0.004 **	0.004 **	0.004 **	0.004 **
Education level	0.027	0.027	0.027	0.027	0.027	0.027
Paid by direct deposit	0.032	0.032	0.032	0.032	0.032	0.032
Constant	1.720 ***	4.467 *	3.756	3.524	3.817	3.161

*** p<0.01, ** p<0.05, * p<0.1; † restricted to zero ; N=2339; Wald chi2(50) = 605.99; Pseudo R^2 =0.0764

	zero	remit<100	100<remit<199	200<remit<299	300<remit<399	400<remit<499	_500<remit/month
Earnings per week	-0.001	-0.032 ***	-0.055 ***	0.017 *	0.021 ***	0.014 ***	0.035 ***
# in household who work in U.S.	-0.002 ***	-0.012 ***	-0.009 ***	0.005 ***	0.006 ***	0.005 ***	0.007 ***
Remittance frequency	0.000	0.018 ***	0.009 ***	-0.004	-0.006 ***	-0.008 ***	-0.008 ***
Remits via Western Union	0.000	1.165 *	1.050	-0.385	-0.430	-0.543	-0.857 **
Remits via bank	0.000	0.054	0.792	-0.289	-0.170	-0.113	-0.276
Remits via relative/friend	0.000	1.492 **	0.550	-0.157	-0.195	-0.863 **	-0.827 *
Spouse lives with in the U.S.	0.010 **	0.046 **	0.035 ***	-0.022 **	-0.022 **	-0.019 **	-0.029 **
Spouse lives in Mexico	-0.004	-0.019	-0.016	0.009	0.009	0.008	0.013
Marital status	-0.004	-0.018	-0.013	0.009	0.009	0.007	0.011
# children in the U.S.	0.001	0.006	0.005	-0.003	-0.003	-0.002	-0.004
# children in Mexico	0.003	-0.051 ***	0.006	0.013	0.013	0.012 **	0.005
Expects to remain in U.S. >10 years	0.026 **	0.094 ***	0.038 ***	-0.050	-0.039 ***	-0.029 ***	-0.039 ***
Will stay in U.S. as long as possible	0.002	0.012	0.009	-0.006	-0.006	-0.005	-0.007
Unemployed > 1 month last year	-0.001	-0.006	-0.004	0.003	0.003	0.002	0.004
Has health insurance	-0.002	-0.009	-0.007	0.004	0.004	0.003	0.005
# years in the U.S.	0.004 **	0.021 **	0.016 **	-0.010 **	-0.010 **	-0.009 **	-0.013 **
Owns land in Mexico	-0.008 ***	-0.043 ***	-0.040 ***	0.018 ***	0.021 ***	0.019 ***	0.033 ***
Owns real estate in Mexico	-0.005 **	-0.024 **	-0.019 **	0.011 **	0.011 **	0.010 **	0.016 **
Owns business in Mexico	0.002	0.010	0.007	-0.005	-0.005	-0.004	-0.006
Owner/proprietor of business in U.S.	-0.003 **	-0.014 **	-0.011 **	0.006 **	0.007 **	0.006 **	0.009 **
Gender [male=1]	-0.015 ***	-0.066 ***	-0.043 ***	0.032 ***	0.030 ***	0.025 ***	0.037 ***
Age	0.000 **	-0.001 **	-0.001 **	0.000 **	0.000 **	0.000 **	0.001 **
Education level	-0.001	-0.005	-0.004	0.003	0.003	0.002	0.003

Table 5: Marginal Effects from regression in Table 4, calculated at sample means.

Paid by direct deposit	-0.001	-0.006	-0.005	0.003	0.003	0.003	0.004

Table 6. Dependent variable: Remittance frequency. Ordered Probit marginal effects

	once/year		bimonthly		once/month		twice/month		once/week	
Remits via Western Union	0.7188	***	11.1249	***	4.0465	***	-4.2380	***	-11.6522	***
Remits via bank	0.3581	***	5.5428	***	2.0161	***	-2.1115	***	-5.8055	***
Remits via relative/friend	0.0115		0.1773		0.0645		-0.0676		-0.1857	
Remittance amount per month	0.0030	***	0.0463	***	0.0168	***	-0.0176	***	-0.0485	***
Speak English	0.0078	***	0.1203	***	0.0438	***	-0.0458	***	-0.1260	***
# years in the U.S.	0.0186	***	0.2883	***	0.1049	***	-0.1098	***	-0.3020	***
Expects to remain in U.S. >10 years	-0.0068	***	-0.1822	***	-0.1740	***	-0.0006		0.3637	***
U.S. Photo ID	0.0226	**	0.2614	***	0.0744	***	-0.0977	***	-0.2607	***
Earnings per week	0.0004		0.0058		0.0021		-0.0022		-0.0061	
Bank account in the U.S.	-0.0074	***	-0.0988	***	-0.0276	***	0.0398	***	0.0941	***

N = 2332; LR chi2(10) = 49.37; Prob > chi2 = 0.0000; Pseudo R2 = 0.0076

Note: remittance modes and level (first four variables) have been replaced by predicted values as instruments.

Figures

Figure 1. Budget lines and indifference curves for the consumption/remittance choice, with lump-sum remittance costs and a subsistence constraint. Note that remittances R jump from zero to $\underline{R}$. Below this point, the indifference curve is less steep than the budget line at the subsistence level of consumption.

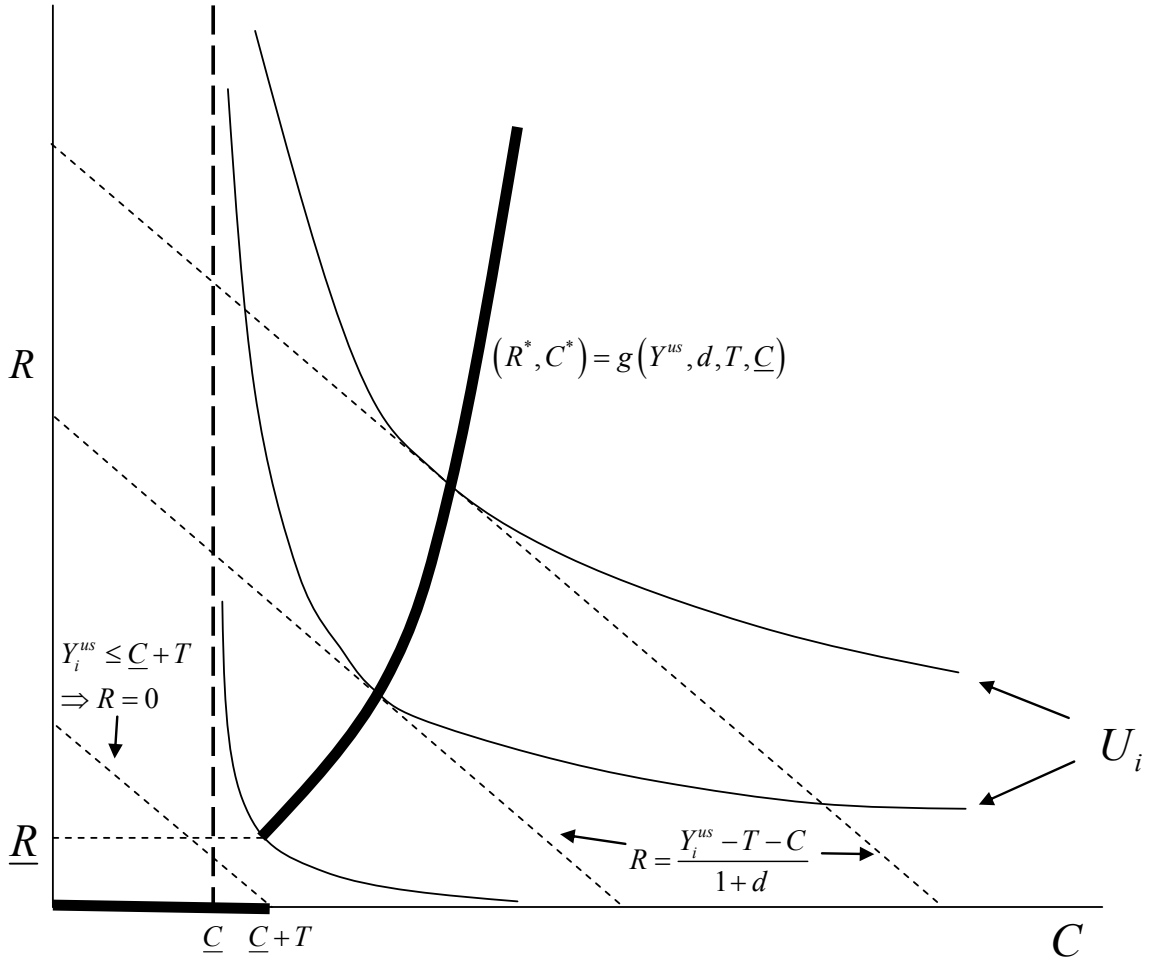

Figure 2: The bold line represents the relationship between income and remittances. An increase in the lump sum cost of remittances T will increase the level of income needed for remittances to be sent, but if the marginal utility of consumption is discontinuous and sufficiently steep at $\underline{C}^{+}$, then remittances will jump from zero to $\underline{R} = \frac{Y_i^{us} - T - \underline{C}}{1+d}$ (see figure 1). For comparison, the other lines represent remittance levels with consumption and/or T held at zero. Holding consumption to zero results in a steeper remittance curve and holding $\underline{C} + T$ at zero forces the remittance curve through the origin.